Faculty of Science
6th Annual Science Research Conference
Wednesday November 14 - Thursday November 15 2018
Venue: Lecture Hall (LH1) UNAM Main Campus
Book of Abstracts
A VERY BIG THANK YOU

TO

OUR SPONSORS

UNAM
UNIVERSITY OF NAMIBIA

UNESCO
United Nations
Educational, Scientific and
Cultural Organization

NAKARA

Separations
Simply Spectacular

NASHUA
saving you time. saving you money. putting you first

NAMIBIA
Executive Chairperson:
Ndeyapo M. Nickanor (Dean Faculty of Science)

Deputy Executive Chairperson:
Veikko Uahengo (Deputy Dean Faculty of Science)

Chairperson Organizing Committee:
Petrus Shanika (Dept. of Chemistry and Biochemistry)

Deputy Chairperson Organizing Committee:
Elizabeth Lang (Dept. of Biological Sciences)

Organizing Committee Members
Clinton Hay (Dept. of Biological Sciences)
Shipo Panduleni (Dept. of Biological Sciences)
Bernhard Mukuve (Dept. of Biological Sciences)
Renate Hans (Dept. of Chemistry and Biochemistry)
Paulus Kapolo (Dept. of Chemistry and Biochemistry)
Paulina Endjala (Dept. of Chemistry and Biochemistry)
Josia Shilunga (Dept. of Geology)
Paulus Haihambo (Dept. of Mathematics)
Wilhem Nangolo (Dept. of Mathematics)
Atanasia Bonge (Dept. of Statistics and Population Studies)
Maria Ntinda (School of Computing)
Meindf Simbenda (School of Computing)
Charlene Simataa (School of Military Science)
Kanyungule Kefas (School of Military Science)
Edet F. Archibong (School of Pharmacy & Faculty of Science)
IDENTIFICATION OF WILD YEAST CONTAMINATION IN FERMENTATION AND LAAGEERING TANKS AND ITS EFFECT ON THE QUALITY (pH, HAZE) OF UNPASTURIZED BEER

A.T. Nekwaya
Department of Biological Science, Faculty of Science, University of Namibia, Namibia

*Author for correspondence
E-mail: apaopawanekwaya@gmail.com; Tel: +264817761178

Abstract
Wild yeast is known as predominant beer spoiled they cause turbidity, acidity, gas formation and off-flavours in beer formation of side metabolites. Wild yeast contamination which is regarded as a beer spoiler and can occur if the culture yeast come in contact with air and anything added in the fermenter can be a potential source of contamination. Poor hygiene is also the key to cause wild yeast in fermentation and laagering tanks. An effect of wild yeast causes low pH and haze or turbidity in unpasteurized beers which can therefore cause off-flavours in unpasteurized packed beers. As a result of beer spoilage wild yeast have a substantial finance impact in the brewing industry. The main objectives of this study were to identify the present of wild yeast in fermentation tank, laagering tank and unpasteurized beer, to understand the causes of wild yeast in alcohol fermentation and to analyse the effect of wild yeast on the quality of pH and haze of the beer. This study was contacted at Namibia Breweries Limited. Different beer samples namely Draught, Heineken and Tafel were collected from fermentation and laagering tanks in the brew house. In the microbiology laboratory the membrane filtration method was used where the membrane acts as a specific filter that will let the unpasteurized beer flow through, while it traps suspended particles and if the beer is contaminated colonies will grow on the membrane filter. Direct pour plate method was also used, where 1 ml of beer sample from fermentation tank and laagering was poured in the plate then SDA(-) agar was added and swirled to mix evenly(SDA+ was used as a control). The effect of wild yeast on the quality of pH and haze of the beer was analysed by the use of pH meter and haze meter. The contaminated beer was found to yield a low pH which makes a beer to have a bit weird smell and it taste bitterer than its normal bitterness. The beer
haze had slightly increased compared to the normal beer haze. Product quality and contamination risks were minimized by following the aseptic techniques achieved working near the flame and by using the Clean in Place (CIP) method. More research should be done on other beer brands and on other tanks at different stages of brewing process to determine if there is any wild yeast contamination.

**Immunostimulation, antioxidative and prebiotic properties of polysaccharides extracts of the edible mushrooms *Kalaharituber pfeilii* and *Termitomyces schimperi***

A. Amadhila¹, A. Cheikhyoussef²* and Pauline N. Kadhila¹

¹Department of Biological Sciences, Faculty of Science, University of Namibia
²Science and Technology Division, Multidisciplinary Research Centre, University of Namibia

*Author for correspondence*  
Email address: acheikhyoussef@unam.na | Tel: +264 61 2063283

**Abstract**  
Mushrooms are considered as one of the notable functional foods for human consumption that have been cultivated and gathered for hundreds of years. The usage of mushrooms has expanded to a wider extent not only as food but also in the area of pharmaceuticals and nutraceuticals. In particular, mushrooms have been appreciated and consumed for both their nutritional value and medicinal properties. Bioactive molecules, particularly polysaccharides (PS) from mushrooms have been the subject of intense research, taking into view its high potential for application in different sectors. Mushroom polysaccharides are not only important as prebiotics, but possess other biological properties such as antitumor, antimicrobial, antioxidant, immunomodulatory, antiviral and hypoglycemic effects. Despite this interest, no one to the best of our knowledge has studied the immunomodulatory and prebiotic properties of the Namibian wild edible mushrooms: *Kalaharituber pfeilii* and *Termitomyces schimperi*. Hence, this study is a preliminary attempt to elucidate the bioactivities of *K. pfeilii* and *T. schimperi* PS for potential application in functional food and nutraceuticals. Water and alkali PS extracts of *K. pfeilii* and *T. schimperi* were extracted and purified using Freimund’s method. The PS were chemically analysed using FT-IR spectrometry and chromatography techniques (HPTLC). Additionally, the PS were tested for their immunostimulatory activity (ability to induce IL-6, IL-8 and IL-10 cytokines secretion) using ELISA Quantikine kits, their cytotoxicity assay was conducted using CCK-8 assay whereas their antioxidant activity using DPPH assay. *K. pfeilii* hot water extracts had the highest contents of reducing sugars with 261.829 μg/200μL. In terms of monosaccharides composition alkali and water extracts of *T. schimperi* were mostly composed of glucose and fructose minor proportions of sucrose. Both *T. schimperi* and *K. pfeilii*’s alkali and water PS showed good scavenging activities against DPPH radical in a dose dependant manner in all concentration studies. The scavenging ratio at high concentration of KPa and KPw were 48.1% and 41.5% respectively. Whereas, the scavenging ratio of TSa and TSw were 52.1% and 56.3% respectively. This research may be an important first step for the design of PS with immunostimulatory activity that may be used in new health therapeutics and/or incorporation in
functional foods or dietary supplements to infer health benefits and used as complementary or alternative medicine resouce.

**Keywords:** Antioxidant, Cytotoxicity, Immunomodulating activities, Mushrooms, Polysaccharides, Prebiotic activities

**References**

**Identification of different bacteria and analysing their effects on the pH and foam stability of fermentation, unpasteurized and final products of beer**

K.Angula¹ and B.Kaonju²*

1. Department of microbiology, Namibia Breweries Limited
2. Department of Chemistry and Biochemistry, Namibia Breweries Limited

*Author for correspondence

**Correspondence address**
Email address: bkaonju@unam.na| Tel: +264 61 2063811

**Abstract**
Brewing beer involves microbial activity at every stage, from raw material production and malting to stability in the package (Boulton et al., 2001). Most of these activities are desirable, as beer is the result of traditional food fermentation, but others present threats to the quality of the final product and must be controlled actively through careful management, the daily task of malters and brewers globally. This study was therefore meant to identify those microorganisms
and figure out what effects they are capable of causing on the pH and foam stability of fermentation, unpasteurized and final products. The study was carried out at the Namibia Breweries limited. Three different beer samples were used namely, Amstel, Tafel, and Heineken and they were collected from fermentation and laagering tanks. Two processes which are pour plate and membrane filtration were carried out in the microbiology lab and the aim was none other than to observe if there will be any growth caused by microorganisms. The filter is designed to let liquid such as unpasteurized samples pass through it while preventing other suspended molecules. Contamination was observed from colonies growing on the plates. With pour plate method, 1 ml of fermentation, unpasteurized and final products of the above mentioned brands was pipetted into sterilized plates; the plates were incubated and observed after 3 to 5 days for any growth that might have occurred. Different types of bacteria such as lactobacillus, bacillus, streptococcus, pediococcus were observed from the SDA (+), SDA (-), NBBA as well as wort agar on fermentation and unpasteurized products; no bacteria were identified on final products. However bacteria could not be categorized to their specific species due to lack of reagents. Effect on the pH was analysed using a pH meter and the effect on the foam stability was tested using steinfurth foam stability tester. Contaminated beer samples were found to have low pH and high foam stability in comparison to the normal beer that is free from contamination. Simple linear regression was plotted for all the three samples used based on the number of bacterial colonies against pH and foam stability at fermentation and unpasteurized and final stages and it was found that, as the number of colonies increased, the foam increased as well; while as with the case of pH, as colonies increased, the pH was found of have been decreasing. Such contamination can only be avoided by carrying out laboratory work under sterile environments. It follows that, any means by which microbial contamination can be reduced or controlled would be of great economic interest. There has been an increasing effort to develop novel approaches to minimal processing such as the exploitation of inhibitory components natural to raw materials to enhance the microbiological stability of beer. I recommend that further studies be done on different brands and brewing stages.

Key words: beer, bacteria, pH, foam stability

References


Investigating the footprint of climate change on the flowering phenology of Tribulus zeyheri Sond, Tribulus cristatus C. Presl and Tribulus terrestris L. in Namibia

C. Likando*, E.G. Kwembeya and R. I. Shifa
Department of Biological Sciences, University of Namibia, Namibia

*Author for correspondence
email: elikandoh@gmail.com; Tel: +264-81 4015675
Abstract
The effects of climate change on the phenology of plants is complex and only beginning to be understood. Changes in temperature and rainfall are affecting the flowering phenology of plants all over the globe. Herbarium specimens from the National Herbarium of Namibia combined with long term temperature and rainfall data were used to examine the impact of climate change on flowering trends of 201 herbarium specimens from the genus *Tribulus* collected from 1950 to 2016. The main objective of this study was to determine the phenological responsiveness of the genus *Tribulus* to rainfall and temperature changes over the years. A simple linear regression model was used to determine the trends of change in annual mean winter and mean summer temperature of Karas and Otjozondjupa region from 1985 to 2015, as well as to determine the trends of phenological phases of *Tribulus zeyheri*, *Tribulus cristatus* and *Tribulus terrestris* between 1950 and 2015. The study revealed that annual mean summer temperature decreased by 0.079 °C decade\(^{-1}\) (R\(^2\) =0.17; p=0.0236) and mean winter temperature decreased by 0.629°C decade\(^{-1}\) (R\(^2\) =0.1498; p=0.0346) for the last 30 years in the Otjozondjupa region. Mean summer rainfall decreased by 3.092mm year\(^{-1}\) from 1960 to 2016 (R\(^2\) = 0.248; p=0.000) in eight regions. Annual mean winter rainfall also decreased significantly by 5.488mm decade\(^{-1}\) from 1960 to 2016 (R\(^2\) = 0.2484; p= 0.00). Late flowering phenophase of *Tribulus terrestris* advanced by 7.6 days decade\(^{-1}\) for the last 60 years (R\(^2\)=0.125; N=26; p=0.000) whereas the late flowering phenophase of *T. terrestris* and *T. cristatus* advanced by 0.124d/mm and 0.0059d/˚C from 1960 to 2016 respectively. *Tribulus zeyheri* was the only species that showed no phenological responsiveness to either temperature or rainfall.

Keywords: Climate change, Herbarium specimens, Phenology, Rainfall, Temperature, *Tribulus cristatus* *Tribulus zeyheri*, *Tribulus terrestris*.

Detection of the genetically modified organisms (GMOS) in potatoes

C. R. Loemba Malassy*
Department of Biological Sciences, University of Namibia

*email; kybe11.rlm@gmail.com*; Tel: +264856016439

Abstract
Genetically modified organisms (GMOs) have been widely used in the domain of agriculture in many countries in Europe, South Africa and the United states to increase food productivity and help crops survive environmental perils and harsh climatic conditions. However, health risks are presumed to be associated with these crops and consumers are not aware about the genetic modification since most of them are sold without GM labels. In Namibia, most of the vegetables are imported from South Africa. Potatoes is one the highly consumed imported vegetables by urban population in Namibia. This study identified genetic modification in potatoes purchased from local markets in Windhoek, Namibia. DNA was extracted via CTAB method using six
samples of loose potatoes coming from local supermarkets. For Polymerase chain reaction (PCR), the primers which were used are the p35S, cryI1A, cryI2A, cryI3A, cryI4A, p35s-2 and dhfr. The results show no GM events in all the samples analysed. The study suggests that there is no GM in potatoes with the genes analysed.

**Keywords**: Genetic modified organisms, PCR, potatoes, GM labels, the primers (p35S, cryI1A, cryI2A, cryI3A, cryI4A, p35s-2 and dhfr)

---

**Assessing the impact climate change has on the flowering phenology of Namibian Oxalis L. species.**

D. Chibambo*, E.G. Kwembeya and R.I. Shifa

*Department of Biological Sciences, University of Namibia, Namibia*

*Author for correspondence*

e-mail; chibambodavid@gmail.com; Tel: +264-081 6610034

**Abstract**

Climate change has affected the phenology of plants and animals throughout the world. The aim of this study was to investigate whether the flowering dates of the genus *Oxalis* have shifted with time during the period from 1950 to 2014 and to determine whether these shifts are attributable to rainfall and temperature over the same period. Using herbarium specimens combined with mean summer and winter temperatures obtained from the meteorological center a simple linear regression analysis model in excel was used to determine annual changes in trend of winter and summer rainfall and the results revealed that Otjozondjupa had a significant temperature decrease of 6°C decade⁻¹ in winter and 7°C decade⁻¹ in summer (p values <0.05). The results further showed that flowering dates of *Oxalis* did not significantly shift during the period under investigation (P values>0.05). Additionally, mean winter and summer rainfall decreased by 54 mm year⁻¹ and 3.092 mm year⁻¹ respectively (p values <0.05). This study further revealed that the early flowering phenophase of *Oxalis* at was delayed by 15 days due to an increase in temperature (p values <0.05).

**Keywords**: Phenology, climate change, herbarium specimens, *oxalis*, temperature and rainfall.

---

**Assessment of rangeland condition, frequency of occurrence and plant cover of herbaceous plants on Farm Kiamsab West 364, Namibia.**

F. Hamunyela*, M. Morkel and I. Mapaure

*Department of Biological Sciences, University of Namibia*
Abstract
An assessment of rangeland condition, frequency of occurrence and plant cover of herbaceous plants was done on Farm Kiamsab West 364, south-west of Windhoek, Namibia. Overgrazing and exceeding livestock carrying capacity in a rangeland is known to cause degradation which affects the plant functional types, species composition, and generally reduces the biological diversity on the farm. This in turn impacts the productivity of the rangeland negatively particularly for Farm Kiamsab West 364 since it is a commercial farm and this means that there will be less income derived from their cattle sales and game hunted due to poor rangeland condition. Two camps were selected on Farm Kiamsab West 364, based on were the animals are kept, namely Bopos Camp and Middle pos Camp. A total of 12 transects that were 50 m long were demarcated and laid in a east-west direction. Along each line transect at, 10m intervals, six 1m x 1m plots were demarcated on the right hand side of the line. In total 72 plots were sampled on Farm Kiamsab West 364. In each plot every herbaceous plant was identified to species level and recorded on the field sheet. The overall herbaceous cover for each quadrat was visually estimated. The grass species were categorized into different ecological functional groups which includes decreaser, increaser I and increaser II while other grasses which could not fit into such categories in the literature were classified as invader or ‘others’. Forb species were categorized into different ecological functional groups as well which included decreaser and increaser while other forbs which did not subscribe to these categories as found in the literature were classified as invader. To compare the relative proportions of grass and forb species in different functional groups on Farm Kiamsab West 364, a Chi-square test of association was used to test whether the Farm was associated or dominated by any particular functional group. The plant cover was obtained from estimating cover by using cover categories and a Chi-square test of association was used to test whether the Farm was associated or dominated by any particular cover category. The test results revealed that there was a significant difference in the counts of the decreaser, increaser, and invader for both grass and forb species (p=0.000<0.05). Farm Kiamsab West 364 was associated more with increaser grass and forb species compared to the other functional groups. This can be attributed by the low average rainfall since this can influences the type of vegetation in a rangeland. Aristida congesta had the highest frequency of occurrence among all the grasses that could be due to causal factors such herbivory preference as it is mainly perceived as unpalatable for grazing, thus it was less desired by cattle and wildlife game due it its low grazing value. The most frequently encounter forb species on farm Kiamsab was Tribulus terrestris var. terrestris as it possesses spines which serve as physical defenses that deter herbivores. There was a significant difference in the counts of cover categories (p<0.05), thus a greater proportion of plots had a cover of <25%, this could be influenced by herbivory that cause a reduction in vegetation cover and climatic condition such precipitation which also influences plant cover. Rangeland condition is usually influenced by various factors such as herbivory preference, rainfall and grazing. Hence, Farm Kiamsab West 364 can be considered to have a moderately good rangeland condition, due to high presence of increaser species compared to invaders, despite the low average rainfall it receives and low herbaceous cover. Further similar studies should be done in exactly the same area and using the same procedure. Hence, repeat
monitoring for effective and reliable results of the rangeland condition at Farm Kiamsab West 364. Furthermore, research should be expanded to more rangelands in semi-arid savanna in Namibia.

**Keywords:** Farm Kiamsab West 364, frequency of occurrence, herbaceous plants, Namibia, rangeland condition assessment.

**Antibacterial Activity of crude methanolic extracts of Artemesia annua leaves and stems and Kalanchoe pinnata whole plant against Staphylococcus aureus, Bacillus cereus and Escherichia coli.**

F. Izaks*, K. Kaitjizemine, R. Bock  
Department of Biological Sciences, University of Namibia

*Author for correspondence  
Email: romeoizaks@gmail.com

**Abstract**  
The interest in medicinal plant research has grown over the years, as it has been found that there is an increase in drug-resistant pathogens. Medicinal plants contain secondary metabolites that have the ability to inhibit the growth of pathogenic microorganisms. With the increase in resistance to existing drugs, medicinal plants have become a great reservoir for new active compounds against pathogenic bacteria. The main aim of this study was to investigate the antibacterial activity of Kalanchoe pinnata and Artemesia annua against Bacillus cereus, Escherichia coli and Staphylococcus aureus. Crude extracts were prepared by shaking 20g of powdered Artemesia stem (AS) and Artemesia leaves (AL) with methanol for extraction process, each mixed with 200 ml of methanol in an Erlenmeyer for 72 hours. The same was done with 5g Kalanchoe whole plant (KP) in 50 ml methanol. After 72 hours, extracts were filtered using Whatman no.1 filter paper. The anti-bacterial activity of plant extracts were tested against three bacterial species, namely Bacillus cereus, Escherichia coli and Staphylococcus aureus. The antibacterial activity of plant extracts against the respective three bacterial species were determined using the disc diffusion method. Whatman-filter paper discs were impregnated with 25ul of extract and placed on the surface on the agar plates. Plates were incubated at 37 °C overnight. The zones of inhibition (measured in mm) showed that crude extracts from the leave and stems of Artemisia annua was more active than crude extracts of Kalanchoe pinnata. The mean zones of inhibition of Artemisia annua crude leave extract was 12.25±1.54mm, Artemisia annua crude stem extract 12.75±2.60mm and Kalanchoe pinnata crude extract was 10.58±1.56mm, respectively. The data also showed that Escherichia coli was more susceptible to the crude extracts compared to the other two bacterial species. The mean zones of inhibition of E. coli was 12.67±2.96, S. aureus 11.5±1.68 and B. cereus 11.33±1.37mm. These preliminary results validate the antibacterial properties of Artemisia annua and Kalanchoe pinnata. More studies
should be done to establish the significance of these results. It could also be established whether these plants have anti-fungal activity.

Keywords: *Artemisia annua*, *Kalanchoe pinnata*. Crude extracts, Disc diffusion Assay, Antibacterial activity.

**Screening Lactic Acid Bacteria for the Production of Exopolysaccharides and its Characteristics**

F. Shigwedha¹, A. Amadhila¹, and A. Cheikhyoussef²*

¹Department of Biological Sciences, Faculty of Science, University of Namibia
²Science and Technology Division, Multidisciplinary Research Centre, University of Namibia

*Author for correspondence*
Email address: acheikhyoussef@unam.na | Tel: +264 61 2063283

**Abstract**
Lactic Acid Bacteria (LAB) are gram positive, nonspore forming cocci or rod shaped bacteria. LAB exhibit the most effective potential to divert significant amount of fermentable sugars towards the biosynthesis of functional exopolysaccharides (EPSs). EPSs of bacterial cells exert thickening, viscosity, gelling and rheological properties. Such properties may provide valuable applications in the improvement of texture of dairy products such as yoghurt (Sutherland, 2007). This study was performed at the University of Namibia and aimed to screen different LAB species for their ability to produce EPSs and to study their characteristics based on catalase reaction, their antimicrobial activities, acidifying activity and ability to ferment glucose. A total of 34 LAB strains were activated in De Man, Rogosa and Sharpe (MRS) broth and were cultivated on MRS agar. A total of 24 LAB strains were able to form slimy and liquid, mucoid colonies which revealed the presence of EPSs. EPSs were obtained by the method of ethanol precipitation (Surayot et al., 2014). A maximum yield of 3.5 g/L (dry weight) was obtained from the modified culture medium of *P. pentosaceus* 26 strain. Identification of LAB species was conducted on 24 of the LAB strains which produced EPS by conventional methods based on morphological, biochemical while genetic analysis was done on only 10 of the 24 LAB strains that produced EPSs. Antimicrobial activity of the EPSs producing LAB strains was assessed against *Escherichia coli* and *Staphylococcus aureus* by agar spot test (Gaudana, Dhanani and Bagchi, 2010), and the acidifying activities were determined by measuring the pH of the culture supernatants initially at 0 hours before incubation and then after 24, 48 and 72 hours of incubation. Factors affecting cell growth and EPSs production were investigated using one factor at a time method. To optimize the temperature for EPSs production, flask cultures were incubated at 30, 34, 37, 40 and 48 °C, for 24, 48 and 72 hours respectively. Medium composition was optimized when different concentrations of nitrogen source (peptone), and mineral salts (6 and 8% NaCl) were added extra in the basal medium and were grown at different pH (4.2 and 9.6). All strains grew in 6% NaCl but not in 8% concentration, also, they were able to grow at
pH 9.6 but not at pH 4.2. Based on morphological tests, LAB strains were identified as gram positive cocci shaped. Based on the 16S rRNA analysis, all 10 LAB were identified as *Pediococcus pentasaceus* Accession: MF 945627.1. The biochemical tests revealed that all LAB strains were catalase negative, glucose fermenting bacteria and acidifying agents. LAB demonstrated inhibitory effects against both *E. coli* and *S. aureus*. *P. pentosaceus* 26 showed the most effective inhibition of *E. coli* with a zone diameter of 8 mm while *P. pentosaceus* 11 and 17 showed the smallest inhibition zone (3 mm). The most effective inhibition zone of *S. aureus* was by *P. pentosaceus* 17, 26 and 24 with an inhibition zone of 15 mm. Culture parameters such as pH and NaCl content have shown to have an influence on LAB growth. The study revealed that LAB sp. belonging to *Pediococcus* are able to produce EPSs. These EPSs producing LAB could be used as unique starter cultures to improve some of the organoleptic properties of food products. However there is still low yield of production which is not yet resolved. Therefore it is recommended to undertake microbial EPS production studies and their potential applications.

References


Isolation and characterization of antibiotics producing Actinomycetes from desert soil of Rehoboth

S.N. Haimbodi

*Department of Biological Sciences, University of Namibia*

E-mail: suamahaimbodi@gmail.com Tel: +264 81 656 5623/ +264 81 651 3362

Abstract

The accumulation of antibiotics has directed to the growth of drug –resistant microorganism. A transpire of resistant strains has meet halfway the cure and regulator of infectious diseases. As an outcome, the pursuit and development of different class of antibiotics drugs is very essential. Actinomycetes have been known as a wealthy foundation of minor metabolites as well as antibiotics. The purpose of this reading was to isolate and characterize the variety of antibiotic-producing soil Actinomycetes from desert soil in Rehoboth, Namibia. The soil from this region has been identified for its poor in nutrients, very hot and dry. In such severe settings, soil-inhabiting Actinomycetes promote their defensive mechanisms by encouraging the production of antibiotics and other resistance compound. For that reason, dry, hot areas might assist as possible sources for isolating of novel antimicrobial drugs. Methods: one soil sample was
collected, serial dilution and spread on Water Yeast Extract agar and ½ Zhang Starch Soil Extract supplemented with Rifampicin and Nalidixic acid for inhibition of fungi and bacteria, respectively. The screening of actinomycetes for antitubercular antibiotics which determine morphological characteristics which are spore-mass colour, colour of the substrate mycelium, spore-chain morphology, spore-surface ornamentation plus the production of diffusible pigments was carried out. And also physiological characteristics which include production of melanin on peptone- yeast extracts –iron agar and degradation of urea of actinomycetes isolates was carried using the International Streptomyces Project (ISP) media protocol. Pure cultures were inoculated in a broth and incubated at 37°C shaking to produce cell. Genomic DNA extracted was done with a DNA isolating molecular kit. After amplification by 16S rDNA PCR, PCR products were sequenced and undertaken phylogenetic analysis in order to determine the ownership of isolates. 6 antibiotic- producing isolates from soil in Rehoboth produce antimicrobial agent and considered to be active. Established on 16S rRNA gene analysis, this strains are near associated with the genus Streptomyces (3 isolates) and uncultured (3 isolates). Utmost soil isolates show narrow spectrum activity against Gram-positive bacteria. Three isolates S1, S3 and S6, display broad spectrum activity against Gram-positive bacteria and Gram-negative bacteria. Phylogenetic tree study of 16S rDNA tells that isolates S1 to S6 strains are not groups with others strain of Streptomyces. They characterize a different phyletic line which might be put forward the new strains. This study was not the first attempt to isolate antibiotic-producing Actinomycetes from desert soil in South-Namibia. These isolates may possibly be used for the improvement of new treatments to fight antibiotic resistances.

Evaluation of sows and piglets management in communal areas of Okaku constituency in Oshana region

E N Haukongo, N P Petrus*, T Uushona, V Charamba
Faculty of Agriculture and Natural Resources; Department of Animal Science, University of Namibia

*Author for correspondence
ppetrus@unam.na | Tel: 061-206 4035

Abstract
Pig farming is one of the livestock sub-sectors with great potential to support economic growth and ensure sustainable food security in Africa [1]. Sows are prolific producing large number of offspring with a short gestation period [2]. In addition, pigs consume almost any feed as compared to ruminants. However, due to shortage of documented information, a survey was conducted to evaluate how farmers manage their sows and piglets at household level. Data collection concerning housing, feeding, health, farrowing, weaning and constraints facing smallholder pig producers were obtained through the use of semi structural questionnaire. Additional information such as demographics, breeding were also addressed. Farmers interviewed in Okaku constituency were selected using the networking sampling technique to identify the pig owners and non-pigs owners within the three different villages (Ondukutu,
Epilangapi and Omuzilembungu). Results indicated that smallholder pig farming is predominated by female farmers (76.3%), aged between 40-49 years (27.5%) and generating income through self-employment (37.5%). The majority (90.0%) of the smallholder farmers did not receive any training in pig farming, but most of them (51.4%) reached secondary education. The total number of pigs kept is 4.8 on average and most of the farmers have farming experience of 10.8 years on average. The mortality of piglets experienced is 4.7 and the most piglets affected were aged on average of 3.1 weeks old. The feeds used mostly by the communal farmers to feed their pigs are; mahangu products, Kalahari melons and commercial pig feed. The main challenges faced by the farmers were; insufficient feeds due to unaffordable expenses (66.3%), diseases outbreaks (9.3%), lack of knowledge on pig farming (9.3%), lack of time (6.5%), destruction of crops (3.7%) and losing of pigs once they allowed to roam on the outside (3.7%). Cluster analysis was done to classify households according to socio-demographic characteristics. It was noted that houses with low income, less years of farming experiences, no agricultural training, completion of secondary education and mostly owned by females experienced most of the challenges highlighted in pig production. The study served to assist in establishing reasons to why there is minimal pig production in communal areas so that it can be useful in coming up with services that will enhance pig farming.

**Keywords:** pig farming, feeding, housing, furrowing, pig farming constraints

**References**


---

**Isolation of Actinomycetes from Namibian Desert soil samples**

**Hausiku WN**

*Department of Biological Sciences, University of Namibia*

email.: heiman@unam.na, Cell: +26484091017

**Abstract**

Actinomycetes are a group of prokaryotic organisms phylogenetically grouped as aerobic gram-positive bacteria with high guanine + cytosine over 55% in their DNA. They have been recognized as sources of several secondary metabolites, antibiotics, and bioactive compounds that affect microbial growth. The main objective of the present study was isolation, purification, and characterization of actinomycetes from Namibian Desert soil samples, having antimicrobial activity and to discover new antimicrobial metabolites. The collected samples were transferred to research laboratory of microbiology, Department of biological science, UNAM, Windhoek,
Namibia where the entire research work was carried out. Isolation of Actinomycetes strain were obtained by serial dilution method and grown on actinomycetes isolation agar. Colonies of pure cultures were then morphologically and physiological characterized and gram staining was done to fully characterise the isolates. Isolates were transferred to Erlenmeyer flask containing ½ Zhang’s Starch Soil Extract and Water –Yeast Extract broth. CTAB and the ZYMO research kit were used to extract DNA. DNA was then amplified using PCR and the samples were sequenced and bacterial phylogenetic trees of maximum likelihood were constructed. Isolation plates developed different types of bacterial actinomycete colonies. Colonies having characteristic features such as powdery appearance with convex, concave or flat surface and colour ranging from white, red, gray to pinkish and yellowish were selected. The study indicated that Namibian Desert soil had diverse group of actinomycetes. From the results, it was suggested that the low yield of antibiotic producing actinomycetes isolates obtained in this study, could be improved by employing a combination of several molecular analysis methods and techniques.

Keywords: Actinomycetes, Isolation, Soil sample, secondary metabolites, Antibiotics, bioactive compounds, purification.

ANTIBACTERIAL AND ANTIBIOFILM ACTIVITY OF CRUDE METHANOLIC EXTRACTS OF MUNDULEA SERICEA AND ASPARAGUS EXUVIALIS (BURCH) AGAINST WOUND INFECTING AND MULTI DRUG RESISTANT PATHOGENS

HM. Bock¹*, AMN. Iikasha², D. Mumbengegwi ³

¹ Department of Biology Sciences, Faculty of Science, University of Namibia.
² Department of Anatomy, University of Namibia School of Medicine.
³ Science and Technology Division, Multidisciplinary Research Centre, University of Namibia.

*Author for correspondence
Email: hmbock23@gmail.com cell:0813202853

Abstract

The rise of multi drug resistance is threatening all the progress made in treatment of infectious diseases over the last century, Multi drug resistance can have a devastating impact on developing countries such as Namibia where the increasing expenditure on health care can put more strain on already stretched resources. Some bacterial species have the ability to form biofilms, which allow them to resist the action of antibacterial agents. Plants have been used traditionally for their medicinal properties as an easily assessable and effective alternative to costly medicines. This study aims to investigate the antibacterial and antibiofilm properties of Mundulea sericea leaf and Asparagus exuvialis (Burch) root methanolic extracts against wound infecting bacteria namely Pseudomonas aeruginosa, Staphylococcus aureus and a methicillin resistant strain of Staphylococcus aureus (MRSA). Thin Layer Chromatography (TLC) was used to screen the crude methanolic extracts of Mundulea sericea leaves and Asparagus exuvialis (Burch) roots for the presence of coumarins, tannins, alkaloids and saponins since these secondary metabolites are known for their wound healing properties. Antibacterial activities of the methanolic plant extracts were determined by the disc diffusion method at four different concentrations (125, 250,
500 and 1000 μg/ml). Biofilm formation was determined by growing the test organisms overnight in a flat bottom 96-well microtiter plate; then stained with crystal violet and the optical density (OD) were measured at 595nm. Biofilm inhibition and eradication was determined as above, but in the presence of the methanolic plant extracts.

A high presence of coumarins were observed in the *M.sericea* leaf extract with a moderate presence of tannins and saponins but no presence of alkaloids. *A.exuvialis* (*burch*) roots had a high presence of coumarins and a moderate presence alkaloids, tannins and saponins. The average inhibition zones were measured in mm and determined on Mueller- Hinton agar plates. Minimum inhibitory concentrations were also determined to obtain the lowest inhibitory concentration of the various plant extracts against the test organisms. *M.sericea* had moderate inhibition zones against *P.aeruginosa* and *S.aureus* with average inhibition zones of 12.33 ± 0.471 and 13 ± 0.816 respectively at a 1000 μg/ml with an MIC at 125 μg/ml for *P.aeruginosa* and *S.aureus* species. *A.exuvialis*(*Burch*) methanolic root extracts had average inhibition zones of 14 ± 0.816 and 12.67 ± 0.471 at a 1000 μg/ml respectively with an MIC at 62.5 μg/ml against *P.aeruginosa*, determined by a broth dilution, its MIC were at 125 μg/ml against *S.aureus*. Low antibacterial activity were observed against the MRSA strain with average inhibition zones of 8.33 ± 0.471 and 7.67 ± 0.942 for *A.exuviali* (*Burch*) and *M.sericea* respectively at a 1000 μg/ml. All three bacterial species showed a strong biofilm formation ability after a 24hour incubation period. with the highest biofilm formation observed for MRSA. Only *A.exuvialis* (*Burch*) root extracts showed a moderate ability of 41% to inhibit biofilm formation in *P.aeruginosa* . None of the plant extracts showed an ability to eradicate preformed biofilms. A notable difference between the two plants were that *A.exuvialis* (*Burch*) has antibacterial activity at lower concentrations than *M.sericea*. The preliminary results of this study validate the use of the selected plants as alternative treatments for treating wounds and show their potential for discovery and development of antibiotics. However, in-vitro and in-vivo toxicology effects of the extracts have to be evaluated.

This is a comparison of biological efficiency for oyster mushrooms grown on liquid and solid spawned substrates

**Iipinge, R**¹* and Kadhila, N. P²*

¹Department of Biological Sciences, University of Namibia  
²MRC: Zero Emissions Research Initiative, University of Namibia

*Author for correspondence*  
Email: iipingern@gmail.com  
Tel: +264 818563529

**Abstract**
Oyster mushrooms are edible fungi that are grown commercially worldwide. There are different kinds of species of oyster mushroom such as, *Pleurotus ostreatus*, *Pleurotus florida*, *Pleurotus sajor-caju* and lastly *Pleurotus HK35*. The most important *Pleurotus* species cultivated in large scale are *Pleurotus ostreatus* and *Pleurotus pulmonarius*. Mushrooms are considered as sources of important nutrients including dietary fibre, minerals, and vitamins, in particular, vitamin D.
The oyster mushroom *Pleurotus eryngii* is rich in polysaccharides (e.g. hemicellulose, α- and β-glucan), proteins, vitamins, and 18 kinds of amino acids, especially aspartic acid, glutamic acid, and arginine that are needed for the biosynthesis of proteins. It is reported that inter-species comparative between most widely cultivated and appreciated mushrooms, the oyster mushroom species such as *P. ostreatus* and *P. eryngii* had higher levels of monounsaturated fatty acids compared *Agaricus bisporus, Lentinula edodes* and *Flammulina velutipes* (Curtis) Singer. In medicine, mushrooms are reported to lower blood pressure preventing hypertension, and blood lipid concentrations this helps in the prevention of cholesterol diseases. Some mushroom farmers in Namibia believe that liquid spawn is faster in colonizing substrate bags than solid spawn. This study was carried out to compare the two spawning methods (solid and liquid) to determine which had more biological efficiency. The results of this study will be used to inform mushroom farmers which spawn to use for mushroom cultivation. The study compared only two species of oyster mushrooms namely *Pleurotus eryngii* and *Pleurotus HK35*. The MRC-ZERI Division provided the laboratory for the experiment and the culture materials of *Pleurotus eryngii* and *Pleurotus HK35*. To make the experiment fair the tissue cultures of both solid and liquid spawn of *Pleurotus eryngii* and *Pleurotus HK35* were both inoculated on wheat straw substrate. Upon successful growth of the two species of oyster mushrooms the harvested mushrooms were weighed and the total yield of oyster mushrooms was recorded in kg for each inoculated spawn solid and liquid. The recorded yields were used to determine the biological efficiency for each spawn by using the formula Biological efficiency = (Mass of fresh mushrooms) / (Weight of dry substrate)) x 100. The biological efficiency of the two spawn showed to be different, solid spawn had a higher biological efficiency of 30.0102 %, (4.50154kg) compared to liquid spawn which had 0.194 % (0.0291kg). During the study it was noticed that contamination by *Trichoderma* was more during incubation time and it lead to loss of substrate bags. Lower temperatures during the incubation period was observed to slow down mycelia growth in the inoculated bags, while high temperatures dried the substrate inoculated bags. Lastly after carrying out this experiment, it is recommended that mushroom farmers must use solid spawn over liquid spawn due to its high biological efficiency and lower rate of contamination. It has been reported that water-soluble sulfonated poly-saccharides of *Pleurotus eryngii* inhibit the growth of pathogenic *Escherichia coli, Staphylococcus aureus* and *Listeria monocytogenes* (Li and Shah, 2014). Various studies revealed that powdered fruiting bodies of *P.eryngii* were used as effective cancer, lumbago, numbed limbs and tendon and blood vessel discomfort treatment (Wiel, 1987; Wasser and Weis, 1999).

**Keywords:** Biological efficiency, liquid, solid, spawns, oyster mushrooms

**References**


EVALUATION OF ANTIBACTERIAL AND ANTIOXIDANT PROPERTIES OF ENDOPHYTIC ACTINOMYCETES ISOLATED FROM HARPAGOPHYTUM PROCUMBENS (DEVIL’S CLAW)

J. Kanyanda*, M.E. Lang and J.D.Uzabakiriho
Department of Biological Sciences, University of Namibia

* Author for correspondence
Email: Jnkanyanda96@gmail.com

Abstract

*H. procumbens* is a weedy, perennial tuberous ethnomedicinal desert plant. Cultivable endophytic actinomycetes isolates obtained from this plant occurring in Rehoboth (Hardap region) and Prosperita (Khomas region) were assessed and characterized for their antimicrobial and antioxidant activities. Screening of primary and secondary metabolites was done using the disc diffusion method. Extraction of secondary metabolites was done using ethyl acetate. Total phenolic content of antioxidant activity and reducing power were assessed by Folin-Ciocalteau assay and ferric chloride respectively. Seven isolates were identified based on 16S rRNA Gene analysis, 40% from Rehoboth and 60% from Prosperita. During primary and secondary screening, all isolates were active against the gram + and gram -bacteria. *S. hypolithicus* had the highest antibacterial activity of 6.8 mm against *M. avium* while *S. longisporoflavus* had the lowest antibacterial activity of 4.6 mm against *M. avium* during primary screening. *S. longisporoflavus* had the highest antagonistic activity of 17 mm against *L. monocytogens*. *S. hypolithicus* showed the highest ability of reducing power at 0.025mg/ml dilution of 0.08 mm while *S. longisporoflavus* had the lowest reducing power of 0.005 at 1mg/ml. *A. nasicola* had the highest total phenolic content of 0.050mg/ml. All 8 isolates were negative for the indole test and positive for catalase and urea test. *A. nasicola, A. haliotis and A. longisporoflavus* showed negative results for the starch degradation while positive results were observed in the rest. The study showed us indeed that actinomycetes from the Devil’s claw have a promising source of bioactive compounds with antibacterial and antioxidant properties and there’s a need for further characterization these isolates for pharmaceutical purposes.

Keywords: antioxidant activity, antimicrobial activity, biochemical tests, endophytic actinomycetes
The effect of clipping on biomass partitioning in *Senegalia mellifera* seedlings grown under greenhouse conditions.

J. Thomas*, I. Mapaure and M. Morkel

*Department of Biological Sciences, University of Namibia*

*Author for correspondence*

Email address: jacquelinemildredt@gmail.com; Cell: +264 816515237

**Abstract**

Namibia has had problems with bush encroaching species for several years. *Senegalia mellifera* has been identified as being the main bush encroaching species in Namibia. The overall objective of this study was to determine biomass partitioning in seedlings of *Senegalia mellifera* subjected to simulated herbivory (clipping) grown under greenhouse conditions. *Senegalia mellifera* seeds were sown at 0.5 cm depth in plastic pipes filled with potting soil. Seedlings were watered once every day at 13:00 for the duration of the study. After 10 weeks and 3 days from when the seeds were sown, 40 seedlings were clipped above the cotyledons, 40 seedlings were clipped below the cotyledons and 20 remained unclipped as controls and watering continued once each day. After 13 weeks and 2 days from when seedlings were sown, the seedlings were removed from the pipes and measured using a measuring tape. A pair of secateurs was used to separate the seedlings into the shoots and roots, this was done for both clipped and none clipped seedlings. Seeds were then placed in an oven for 24 hours at a temperature of 50°C. Then for each seedling, root and shoot were weighed to get the biomass using an analytical balance. A Mann Whitney U test showed that there was no significant difference in root to shoot biomass ratio between lightly and non-clipped *Senegalia mellifera* seedlings (U=336, df=59, P=0.319>0.05). For the comparison of root length to shoot height ratio, a T-test showed that there was no significant difference in root length to shoot height ratio between lightly and non-clipped *Senegalia mellifera* seedlings (df=58, P=0.151>0.05). Mean root to shoot biomass in non-clipped seedlings showed that 55.5% was allocated to shoots and 44.5% to roots while 52.7% was allocated to shoots and 47.3% to roots in lightly clipped seedlings. The mean root length to shoot height ratio indicated that 88.2% was allocated to root length and 11.8% to shoot height in non-clipped while 87.7% was allocated to the root length and 12.3% to shoot height in lightly clipped seedlings. A Pearson Correlation test showed that there was a weak, insignificant positive relationship between root length and shoot height in lightly clipped Senegalia mellifera seedlings (r=0.412, p=0.08>0.05) and there was a weak, insignificant positive relationship between root length and shoot height in non-clipped Senegalia mellifera seedlings (r=0.456, p=0.050>0.05). Spearman rank correlation test showed that there was a strong, significant positive relationship between root and shoot biomass in non-clipped and lightly clipped *Senegalia mellifera* seedlings (r_s=0.811, P=0.00<0.05). In this study, *Senegalia mellifera* seedlings allocated available resources to compensate for lost shoot biomass instead of root biomass.

**Keywords:** Biomass partitioning, Bush encroachment, clipping, Namibia, root biomass, seedlings, *Senegalia mellifera*, shoot biomass
The effect of Yeast Viability on Turbidity of Beer

K. Kamukwema*, B. Kaonjua and R. Eugene
Department of Biological Science, University of Namibia

*Author for correspondence
Email: pkpkornelius15@gmail.com; Tel: +264 81 3410475

Abstract
Turbidity provides the primary observable impact of Heineken beer quality to the consumers. Hence after filtration, the end product should be clear, bright and non-hazy. This makes Heineken more worthwhile and is repeatedly regarded as sufficient and conceivably inoffensive (Togo et al., 2002). Thus, haze formation is an important problem in beer production, as it affects the quality of the end product. For this reason, the aim of this study was to determine the effect of yeast viability on beer turbidity of the final product, to determine the physiological condition of the yeast quality by measuring its viability. The experiment was done at the Namibian Breweries Limited Laboratory, and only two parameters, Viability and Turbidity were analysed. Yeast strains of Saccharomyces pastorianus was used throughout the experiment. Samples of yeast were collect and viability was determined using a NucleoCounter instrument. Ten samples of Heineken were collected and Turbidity of each sample was measured using a Hazemeter following instructions as described on the one-point lesson of the VOS ROTA. SPSS was performed for data analysis followed by Normality test using the Shapiro-Wilk test than Correlation using Simple Linear Regression test. Results showed that there is no relationship between yeast viability and turbidity of beer, therefore yeast viability possesses no influence on the turbidity of Heineken. Conclusions were drawn that yeast strain were health and were not affected by pH, Oxygen Demand and Temperature.

Herbaceous species composition, richness, diversity and abundance on farm Kiamsab West 364, Namibia.

K. Shilongo*, M. Morkel and I. Mapaure
Department of Biological Sciences, University of Namibia

*Author for correspondence
e-mail: shilongokristophine@gmail.com; cell: +264 81 8177 565

Abstract
This study was conducted on Farm Kiamsab West 364, Khomas Region, Namibia. The overall aim of the study was to determine herbaceous species composition, richness, diversity and abundance on Farm Kiamsab West. A systematic sampling method was done in two Camps,
mainly Bopos and Middle pos focusing on the herbaceous plant species. A total of 12 transects were laid out measuring 50m in an east-west direction. Along the transect six plots of 1 x1m was demarcated systematical at 10m intervals at the right-hand side of the line transect. A total of 72 plots were sampled. In each plot every herbaceous plant was identified to species level and their abundance recorded. The herbaceous plants that were not identified in the field, were collected and pressed and later identified using field guides and with assistance of experts. Data for comparison were obtained from a study done at Neudamm farm. To determine variations in herbaceous species composition on Farm Kiamsab West, a HCA was carried out. Species richness data were tested for normality using Shapiro-Wilk test, and were found to be not normally distributed. The difference in species richness as well as herbaceous species diversity between the two Farms was tested using a Mann-Whitney U test. The abundance data were tested for normality using Shapiro-Wilk test, and were found to be not normally distributed. Differences in the abundance between forbs and grasses on farm Kiamsab were compared using a Mann–Whitney U test. Heterogeneity of herbaceous species composition is relatively high on Farm Kiamsab (28 % similarity), variations in vegetation were not due to grazing only. A large proportion of the variation in vegetation composition has not been explained by the measured variables, indicating that other unmeasured factors such as soil depth, slope, terrain structure, etc. may also be important. The farm was dominated by herbaceous species composition i.e. *Aristida congesta*, *Tribulus terrestris* var. *terrestris*, *Hibiscus elliottiae*. There was no significant difference in species richness (p=0.192>0.05) and diversity(p=0.214>0.05), because both the farms experience disturbance in the form of grazing, as both of these farms have animals that graze on the vegetation that are found in the farms. There was a significant difference in forb and grass abundance on Farm Kiamsab West, p=0.000<0.05, whereby the grasses had the higher median of 41.5 species than the forbs (14.0 species). The grass species abundance is higher than the forbs because, most grasses are pioneer’s species that are the first species to colonize a new area after a disturbance, as there is grazing disturbance on Farm Kiamsab. The reason why the number of forbs is low on farm Kiamsab is that forbs are more shade tolerant than grasses and on the farm there are only scattered trees making it unsuitable for the forbd to grow as they requires shade for their growth. It is recommended that a biodiversity assessment should be carried on the whole Farm of Kiamsab West 364, so that it gives clear results for the whole farm just not few camps from the whole farm.

**Keywords:** Farm Kiamsab West 364, Herbaceous plants, Namibia, species composition, species diversity, species richness.

---

**Comparative Analysis of Antibacterial Activities of *Kigelia Africana* and *Ziziphus Mucronata***

**Kaali L. E.**

*Department of Biological Sciences, University of Namibia*

email: kchinsembu@unam.na
Abstract
Kigelia africana commonly known as sausage or cucumber tree, belongs to the Biognoniaceae family and Ziziphus mucronata which is commonly known as buffalo thorn, belongs to Rhamnaceae family. These are medicinal plants that have been documented for their antimicrobial activities for years in Africa. Their different plant parts such as barks (stem and root), leaves, fruits and roots are used in treatment of different microbial diseases. This study was undertaken to compare antibacterial activities of K. africana and Z. mucronata leaves and stem barks, and to determine which solvent is more effective in extraction of the antibacterial plant extracts. This study will aid in application of the two species in drug development and provide insight to traditional healers on Kigelia africana and Ziziphus mucronata treatment against bacterial infections. Leaves and stem bark of K. africana were collected at Augustinum Secondary school and Z. mucronata from University of Namibia, Windhoek. The plant materials were extracted and tested for antibacterial activity using disc diffusion method. The plant extracts were evaluated for antibacterial properties against gram negative bacteria (Escherichia coli and Shigella sonnei), as well as against gram positive bacteria (Staphylococcus aureus and Bacillus subtilis). Solvents used for extraction are ethanol, methanol, acetone and water. The results of this study showed that there are no significant differences in the antibacterial activities of the two plants. Stem barks and leaves had the same antibacterial activities. However, there was a significant difference in the antibacterial activities of organic versus water extracts. Ethanol extracts had greater antibacterial activity than water extracts.

Keywords: Kigelia africana, Ziziphus mucronata, plant extracts, solvents, antibacterial activities.

Estimating the density of two independent leopard (Panthera pardus) populations using hierarchical spatial capture recapture in Namibia

Kakove, M. N.1, A. Andreas2, Fabiano, E. C.1*
1Faculty of Agriculture and Natural Resource, Department of Wildlife Management and Ecotourism, University of Namibia
2Ministry of Environment and Tourism

*Author for correspondence
fabianoezekiel@gmail.com; 0817547327

Abstract
The African leopard (Panthera pardus) is a solitary, solitary and adaptable species in the Felidae family (Ntefeleng, 2015). The species is classified as near threatened by the IUCN Red Data Book (Stein et al., 2018). This species has the widest geographic distribution of all felid species (Turnbull-Kemp, 1967). However, estimating and assessing trends in the population size of leopard and other carnivores, is a challenge for conservationists and wildlife managers. This has
resulted in the lack of information about local population demographic status, inability to ascertain whether conservation measures are being effective and of identifying areas of conservation concern where intervention may be needed. Such information is critical given the multitude of threats that carnivores face across their range including in Namibia. Remote camera trapping and spatial capture recapture (SCR) methods have become the survey and analytical methods of choice when determining various ecological parameters of a carnivore population(s). However, to date, the application of SCR in Namibia has been limited to density point estimates. In this study, the Multi-Session Sex-Structured Spatial Capture-Recapture model was applied, to demonstrate the potential of such models to estimate leopard density and space use patterns, by combining data from two independent leopard populations and analyzing it as a single dataset. Remote camera trapping was conducted in 2011 from April to May in central Namibia and from October to December in southern Namibia for 60 days each. A total of 23 and 26 Reconyx Hyperfire (HC500 model) cameras were deployed along trails in central and southern sampling sites, respectively. A total of 16 candidate models including covariates on encounter probability (sex, sampling site and constant), density (site and constant) and movement parameter (sex and constant) were fitted. Cameras in central Namibia accumulated a total of 1560 camera trap nights, which yielded 53 leopard photographs which were identified as belonging to 12 individuals, 6 males and 6 females. In turn, cameras southern Namibia accumulated a total of 230 trap nights, 56 leopard photographs which were identified as belonging to 7 individuals, 2 males, 3 females and 2 cubs. The best model which accounted for study area and sex specific estimated a density of 1.37 ± 0.58 male and 3 ± 1.67 female leopard per 100 km² for the central Namibia study site, and of 0.28 ± 0.17 male and 0.6 ± 0.32 female leopard per 100 km² for southern Namibia study site. Leopards were significantly less detectable in the study area in the south than the one in central Namibia (-1.58 ± 0.62, p = 0.01) while male leopards had a significant higher detection probability than the female leopards (1.55 ± 0.73, p = 0.034). On average leopards irrespective of study area or sex moved 3.84 ± 0.61 km. The study demonstrated that it is important to account for various sources of variation when estimating ecological parameters and that combining datasets has the potential of improving parameter estimation. Despite the low precision associated with density estimates, higher female density may indicate healthy populations. This study provides the first empirical SCR based density estimates for leopards and demonstrates a framework for combining data from individual populations in different habitats to derive national density estimates.

References
Functional characterisation of the hypertrehalosaemic hormone II from the Indian stick insect *Carausius morosus*: carbohydrate-mobilisation and cardio-stimulatory activities

OKH. Katali*, HG. Marco, and G. Gäde
Department of Biological Sciences, University of Cape Town, South Africa

*Author for correspondence
Email address: ottiliekatali@gmail.com Tel: +264 81 345 1589

Abstract
The populations of insects that negatively impact the society need to be regulated using environmental friendly insecticides that are selective and affect only the target species instead of all insects in the ecosystem. One proposal to tackle this issue is through developing non-toxic and species-specific insecticides by designing specific peptidomimetics, which requires having knowledge of the range of neuropeptides and their regulatory functions in target species.

Therefore, this study characterised the receptor-binding interaction of the neuropeptides (i.e., hypertrehalosaemic hormones family) that are involved in critical physiological processes (i.e., metabolism and circulatory system) in stick insects (i.e., *Carausius morosus*) using biological assays. The biological assays were used to assess the potencies of various analogues, in comparison to that of the native hypertrehalosaemic hormones: (1) the carbohydrate-mobilizing assay assessed the increase in levels of carbohydrates; and (2) the semi-exposed heart assay assessed the increase in heart rates. The study reveals that the receptor(s) for the hypertrehalosaemic hormones of these stick insect are very specific, do not tolerate the replacement of most single amino acids as well as modification to the sequence terminals. Knowing the peptide sequence in a particular species and its performance in different biological assays allows for predictions of the conformation of the receptors and binding sites. Hence, the knowledge generated by such a study, together with similar studies performed previously on other insects, such as cockroaches, flies, locusts and moths, will assist in the development of hormone-like compounds that can be used in specific drug design to act as pesticides.

References
Isolation and molecular characterization of fungi associated with sorghum grain.

K Klemens1,2*, S Nafuka1

1Department of Biological Sciences, University of Namibia, Namibia
2Department of Anatomy, Hage-Geingob campus, University of Namibia, Namibia

*Author of Correspondence:
Email: Kklemens15@gmail.com, cell number: 0813498589

Abstract
Sorghum is an important cereal produced as staple diet in the northern part of Namibia and is prone to fungal infection during pre- and postharvest period. The goal of this study was isolation and identification of fungi associate with sorghum grain from Oshana region Namibia.

1 kg of sorghum grains was bought from the market and 1 kg of sorghum grain were collected from the farmer’s field, in Oshana region and a 100 g of each sample were analysed for present fungi by inoculating serial diluted sample on potato dextrose agar medium. Single Fungal colonies were sub-cultured, isolated and identified using a microscope on the basis of morphological appearance.

Pure fungal isolates of each sample were prepared for genomic DNA isolation by growing on PDB and final identification using microscopic. Genomic DNA was isolated using fungal DNA isolation kit (Quick-DNA Fungal/Bacterial Kit) and according to manufacturer’s instructions. Molecular identification was performed by amplifying the Internal Transcribed Spacer region (ITS) using ITS 1(50TCC GTA GGT GAA CCT GCG G30) as forward and ITS4 (50TCC TCC GCT TAT TGA TAT GC30) as reverse primer (White et al., 1990). PCR products were detected
on 2% agarose ethidium bromide gels in TAE 1× buffer. DNA ladder was used as the molecular size marker. Further, sequencing of amplicon was carried, Confirmed identification of these isolates was made by comparing these sequences with the sequences available in GeneBank database using online BLAST tool. The overall result reveals that the genera *Fusarium*, *Aspergillus*, *Alternaria* and *Penicillium* are associated with sorghum grain sample brought from the market and from the the farmer’s field collected from Oshana region, Namibia. In conclusion, *Aspergillus*, *Fusarium*, *Alternaria* and *Penicillium* species of fungi do occur in sorghum grain both in the field and in the store. *Aspergillus* species was predominant in sorghum from farmers’ stores, while *Fusarium* species was predominant in freshly harvested grains.

**Keywords:** fungi, pre and postharvest, sorghum grain, *Aspergillus*, *Fusarium*, *Alternaria* and *Penicillium*

---

**Bacteriocin screening and partial characterization of lactic acid bacteria isolated from beef biltong in Namibia**

L. W. Boois¹, A. Cheikhyoussef²*

¹Department of Biological Sciences, Faculty of Science, University of Namibia
²Science and Technology Division, Multi-disciplinary Research Centre, University of Namibia

*Author for correspondence:*
E-mail: acheikhyoussef@unam.na; Tel: +264 61 206 3283

**Abstract**

Bacteriocins are small, bacterially produced, ribosomally synthesized peptides that are active against other bacteria and against which the producer has a specific immunity mechanism [1]. Bacteriocins that produced by lactic acid bacteria (LAB) attract considerable interest as natural and nontoxic food preservatives and as therapeutics, whereas the bacteriocin-producing LAB are considered potential probiotics for food, human and veterinary applications [2]. There is a limitation in literature with regards to the analysis of bacteriocins or bacteriocin like inhibitory substances (BLIS) of LAB from beef biltong in Namibia with potential applications as biopreservatives. The aims of this study were to screen for BLIS from LAB, partially purify and characterise BLIS and, finally, to identify BLIS producing LAB. Eighteen (18) LAB isolates were cultured in de Man Rogosa and Sharpe (MRS) broth at 37°C with a pH that ranged from 4.27±0.36 to 5.80±0.36. Aerobically, the total plate count ranged from 3.64± 0.51 to 8.22±0.67 CFU/mL and anaerobically, ranged from 3.89±0.19 to 6.45±0.34 CFU/mL on MRS agar. Cell free supernatants (CFS) of LAB isolates were tested for anti-microbial activity against *Bacillus subtilis*, *Staphylococcus aureus*, *Shigella sonnei*, *Escherichia coli*, *Listeria innocua*, *Clostridia perfringens*, *Bacillus cereus*, *Saccharomyces cerevisiae*, *Klebsiella pneumonia* using the well diffusion assay [3]. Four LAB strains retained at least 50 % of inhibitory activity after neutralization against *E.coli*, *S. aureus*, *L. innocua* and *C. perfringens* and were identified using...
API 50CHL as *Lactococcus lactis* ssp. *lactis*. The neutralised cell free supernatants (NCFS) of these strains were partially purified using 80% Ammonium sulphate precipitation, whereby protein concentration of partially purified NCFS was determined using the Bradford assay [4]. Furthermore, the NCFS of strains were partially characterised with treatments of varying p.H, heat and proteinase K. The strains retained stability after treatment with pH ranging from 2-10 and heat ranging from (30-100) °C. However, inhibitory activity was not retained after treatment with Proteinase K, suggesting proteinaceous nature of BLIS. BLIS can be presented and used as a potential biopreservatives but further studies are needed with regards to genetic composition and mode of inhibitory action.

**References**


ANTIOXIDANTS, ANTIBACTERIAL AND ENZYMATIC ACTIVITY PRODUCING ENDOPHYTIC ACTINOMYCETES ASSOCIATED WITH 
HARPAGOPHYTUM PROCUMBENS

L.T.T Makoti*, E.M. Lang, J.D. Uzabakiriho
Department of Biological Sciences, University of Namibia

*Author for correspondence
Email: liinamakoti@gmail.com; Cell: +264-81-4668902

Abstract
Harpagophytum procumbens (devil’s claw) is a plant with high medicinal value since time immemorial. The present study investigated endophytic Actinomycetes associated with the desert adapted H. procumbens from Rehoboth (Hardap region) and Prosperita (Khomas region) for their antioxidants, antimicrobial and enzymatic activities. A total of six isolates were identified by 16S rRNA gene sequencing where 50% were from Rehoboth and the other 50% were from Prosperita. Primary and secondary screening of antimicrobial activity was performed using disc diffusion method. Pure culture’s secondary metabolites were extracted using Ethyl Acetate. Antioxidant activity was evaluated based on determination of total phenolic content and reducing power using Follin-Ciocalteu reagent and ferric chloride respectively. Isolates were screened for Amylase, Protease and Lipase enzymatic activities. In this study all isolates exhibited broad spectrum antibacterial activity. During primary screening ethyl acetate extract exhibited the highest antibacterial activity with S.eurythermus (5.83mm) against S.aureus and the lowest antibacterial activity with S.vitaminophilus (3.50mm) against E.coli. During secondary screening A.radicidentis had the highest antibacterial activity against L.monocytogenes (8.17mm) and S.eurythermus had the lowest antibacterial activity against B.cereus (5.00mm). During total phenolic content results, S.avermitilis strain showed higher production of phenols at 0.025mg/ml Gallic acid concentration. Isolates showed potent reducing power results at 0.075mg/ml dilution and A.radicidentis strain had the highest of 0.100 mg/ml Gallic acid concentration. All isolates showed positive results for amylase activity except A.radicidentis strain that showed negative results for both lipase and protease activity. This study demonstrated that Actinomycetes associated with H.procumbens have higher therapeutic potential against harmful free radicals and bacterial pathogens.

Keywords: Actinomycetes, Antibacterial activity, Antioxidant activity, Enzyme Activity

Population structure and abundance of Mytilus galloprovincialis and Perna perna along the central coast of Namibia.

M. Dumeni*, C. Deelie and C. Hay
Department Biological Sciences, University of Namibia
Abstract
Mussels are ecologically important components of nearshore marine communities around the globe and they are one of several organisms that have given significant insights in the rocky shore community dynamic worldwide. This study assessed the abundance and population structure of the indigenous mussel *Perna perna* (brown mussel) and the alien mussel *Mytilus galloprovincialis* (blue mussel) at two sites along the central coast on Namibia. The sampling took place in March 2018 at Long Beach and Dolphin Beach located between Walvis Bay and Swakopmund. At each site one 50m transect was laid down from low water mark to high water mark with a measuring tape and 50cm × 50cm quadrat was demarcated at a regular interval of 5m that were alternating. Each quadrat was further divided into four 25cm × 25cm small quadrat and this were treated as replicates. In each small quadrat the mussels were removed and kept in a cooler box that were transported to UNAM and kept refrigerated. Samples were removed from the freezer, and were sorted with several sieves with different mesh sizes. The mussels were identified base on their morphological features with the aid of several identification guides. Individuals of each species were counted and they were grouped as either recruit, juvenile or adult based on the size. In each quadrat the shell length of thirty random selected mussels were measured with a bio-digital caliper to the nearest mm.  The measured lengths were assigned to length classes.  Kruskal–Wallis test was used to test if there was a significant difference in the abundance of recruits, juveniles and adults of each species among the intertidal zone of each site. A Chi-square for Independence was used to test if there was a significant difference in length frequency distribution of each species between the sites. There was a significant difference in the abundance of recruits, juveniles and adults of both species at each site. The abundance of recruits, juveniles and adults of *P. perna* was significantly high on the low zone at all sites, and low on the high zone, whereas for *M. galloprovincialis* was significantly high on the higher zone and low on the low zone at all sites. This can be explained by a strong attachment strength of *P. perna* to the substrate that enables it to withstand strong wave action at the low zone and its low tolerance to desiccation that reduces its abundance at the high zone. *Mytilus galloprovincialis* has a high tolerance to desiccation and extreme temperature that enables it to cope well at the high intertidal zone and its weak attachment strength that reduces its abundance at low the zone. There was a significant difference in length frequency distribution of both *P. perna* and *M. galloprovincialis* between Long Beach and Dolphin Beach. Long Beach had the higher number of *P. perna* individuals under the biggest length classes compared to Dolphin Beach. Dolphin Beach had the higher number of *M. galloprovincialis* individuals for all length classes compared to Long Beach. This is may be due to the fact that, *P. perna* was found to be abundant at the low intertidal zones, and since Long Beach lack several rock pools to reduce the wave energy, compared to Dolphin Beach, the suspended nutrients are delivered by strong waves in large quantities and are continuously available because this zone is always covered with water. This may favor *P. perna* to attain the longer shell length as enough nutrients are available for growth. The presence of several rock pools at Dolphin Beach provide shelter and reduce the energy of the waves by breaking them down as they hit in the rock pools and since this species cannot
tolerance strong wave action, it could be the reason why all length classes of *M. galloprovincialis* had a higher number of individuals at Dolphin Beach.

**Spatial distribution of macroinvertebrate on rocky intertidal shores, along central coast of Namibia**

M. Kahungu*, C. Deelie and C. Hay  
*Department of Biological Sciences, University of Namibia*

*Author for correspondence*  
Mariakahingu70@gmail.com; 0818619593

**Abstract**

Sampling was done at two sheltered rocky shores namely Long Beach and Dolphin Beach in March 2018 during spring tide. The aim of this study was to determine macroinvertebrate species richness, abundance, diversity and composition among the intertidal zones at each site. A 50m line transect was laid out perpendicular to the shore at both Long and Dolphin Beach. Along the line transect, a 0.25m² quadrat was demarcated at a regular interval of 5m. The 0.25m² quadrat was further divided into four (4) equal quadrats with an area of 0.0625 m² using a string. At each transect, forty-four (44) quadrats were sampled. Organisms belonging to each species were counted and their abundance recorded. Kruskal – Wallis test indicated a significant difference in species richness, abundance, and diversity among the intertidal zone at both study sites (P = 0.000). In addition, the Pairwise comparisons revealed that species richness, abundance and diversity were all high at the low and mid intertidal zones compared to the high intertidal zone at both sites (P = 0.000), this is because organisms at low and mid intertidal zones have enough oxygen since they are submerged under water most of the time. This increases their feeding time compared to those at high intertidal zones. The Hierarchical cluster analysis showed that at Long Beach, the low and mid intertidal zone where more similar in species composition (average similarity = 60%) whereas high intertidal zone was less similar in species composition (average similarity = 10%) from both low and mid intertidal zones, because different conditions and interactions prevail at different intertidal zones hence they support a different species composition. However the mid and high intertidal zones at Dolphin Beach were more significantly similar in species composition (average similarity = 60%), whereas low intertidal zone was less similar in species composition (average similarity = 20%) from both mid and high intertidal zones. The SIMPER Version 7 showed that *Semimytilus algosus*, *Mytilus galloprovincialis* and *Choromytilus meridionalis* species were mostly responsible for the dissimilarities among intertidal zones at each site.
Cytotoxicity and antimicrobial activity of *Ochna pulchra* berries from Zambezi region

M. Muyongo¹²*, A. Cheikhyoussef ², A. Iikasha ³

¹ Department of Biological Sciences, Faculty of Science, University of Namibia, Windhoek, Namibia.
² Science and Technology division, Multidisciplinary Research Centre, University of Namibia, Windhoek, Namibia.
³ School of Medicine, University of Namibia, Windhoek, Namibia

*Author for correspondence*
Email: mmuyongo79@gmail.com ; Cell: +264 81 127 3104

Abstract
Traditional medicine has been practiced in Africa and many other parts of the world for many generations to treat many diseases (Cheikhyoussef et al., 2011). Many plants are being used in Namibia have been used to treat different diseases in different regions have not been validated. However recently, more studies are done to validate these traditional medicinal plants in the traditional settings. The Khwe community in the Zambezi region use *Ochna pulchra* as medicine to treat skin rashes and smallpox. While kyara oil is produced from the berries of *O. pulchra*, by boiling them in water and is used as source of food. Traditionally, it is believed that the berries are poisonous and are not advised to be eaten. This study is carried out to screen for phytochemical compound, yield percentage obtained from aqueous and ethanoic extract as well to evaluate the potential antimicrobial activity of *O. pulchra* berries against laboratory strains of *Escherichia coli*, *Staphylococcus aureus*, *Candida albicans*, *Lactobacillus plantarum* and *Listeria monocytogenes* and its cytotoxicity. The *O. pulchra* berries were collected in Bwabwata National Park. Photochemistry and antimicrobial activity were examined on dried and fresh berries using ethanol and distilled water as solvents. Thin-layer chromatography (TLC) was used to quantify the amount of phytochemical compounds were confirmed using different chromogenic spray reagents (Iikasha, 2016). Antimicrobial activity was determined using disc diffusion method using crude extract at different concentrations for both ethanoic and aqueous by measuring the minimum inhibition zones on Mueller-Hinton agar. It was observed that there was inhibition of bacterial growth except for *S. aureus* which showed resistance. Ethanol extracts for both fresh berries and dried berries produced high yield of 19% and 16% respectively while water extracts for both fresh berries and dried berried produced a low yield of 11% and 12% respectively.
Fig. 1 Yield percentages for ethanolic and aqueous extracts of plant form of O. pulchra. Phytochemical screening of O. pulchra berries indicated the presence of alkaloids, saponins, tannins, coumarins and tripenoids. Cytotoxicity will be determined to assess the fruit toxicity level and advice on their edibility.

**Keywords:** Antimicrobial activity, disc diffusion method, Ochna pulchra, phytochemical compounds, thin-layer chromatography.

**References**

A spatial comparison of abundance and body length variation of *Scutellastra natalensis* and *Scutellastra miliaris* among rocky intertidal zones at Long Beach and Dolphin Beach along the central coast of Namibia

M. Ndishimonima*, C. Deelie and C. Hay
Department of Biological Sciences, University of Namibia

*Author for correspondence
monikandishimonima14@gmail.com; 0814185300

**Abstract**
Two sheltered rocky intertidal beaches (Long Beach and Dolphin Beach) were sampled during two consecutive days (16&17) on March 2018 during the spring tide. The Long Beach and Dolphin Beach are 2km apart, situated in Swakopmund which is one of the coastal towns in Namibia. It is 280km, west from Windhoek. This paper documents the abundances and body length variation of intertidal limpets (Scutellastra natalensis and Scutellastra miliaris) among the intertidal zones at Long Beach and Dolphin Beach along the central coast of Namibia. Limpets are intertidal keystone grazers and their overexploitation could have significant consequences for intertidal communities, influencing patterns of invertebrate and macro-algal dominance and their biodiversity. A 50m line transect was laid down from the low intertidal zone to high intertidal zone at each site. Eleven quadrants of 0.25m² were systematically placed after every 5m interval from 0m to 50m at each site. Each quadrant was further divided into smaller four (0.0625 m²) equal replicates with a string. In total forty four (44) quadrants were sampled. In contrast, Kruskal Wallis test revealed that there was a significant difference in abundance and body length of S. natalensis and S. miliaris (P<0.05) among intertidal zones at Long Beach and Dolphin Beach. The pairwise comparison showed that the difference was between the low intertidal zones and high intertidal zones but not between the low and mid intertidal zones or mid and high intertidal zones because of abiotic (temperature, wave action etc.) and biotic factors (competition and predation) that are differently experienced among each intertidal zones. This data are very essential, as abundance information of the rocky intertidal communities allows conservationists to develop or improve current management strategies as it can provide science based advice to the management and conservation of marine protected areas.

Determination of the phenological response of the genus Barleria L. to climate change in Namibia

M.P. Mwilima*, E.G. Kwembeya, and R.I. Shifa
Department of Biological Sciences, University of Namibia, Namibia

*Author for correspondence
Email: mariapricella@gmail.com; Tel: +264-818218248

Abstract
Climate change can be referred to as the long term change in the earth’s typical weather especially a change due to an increase in the average atmospheric temperature. And it is known to lead to variations in the phenology of plants and animals. As a result the proper functioning of the ecosystem is disrupted. The main objective of this study was to determine whether there is change in days of flowering of the genus Barleria over time, and also determine whether flowering times of Barleria have changed in response to changes in temperature and rainfall over the period from the year 1985 to 2015. Simple linear regression was used to explore trends in temperature, rainfall and phenological responsiveness of the genus Barleria. Results of the study revealed that the mean summer and winter temperature changed significantly from 1985-2015 in the Kavango region (P<0.05). However, in Khomas region mean summer and winter temperatures did not change significantly (P>0.05). The flowering time of Barleria from 1907-
2016 indicated a change in peak flowering where $P<0.05$, whereas, the early flowering phenophase did not significantly change $P>0.05$. The study also revealed that mean rainfall (summer and winter) of Namibia changed significantly from the year 1960-2016. This study has demonstrated that changes in flowering phenology of *Barleria* are attributable in part to the changes in rainfall and temperature.

**Keywords:** climate change, phenology, *Barleria*, temperature

---

**Seasonal variation in diurnal activity patterns of the cape ground squirrel**

*(Xerus inauris)* in a selected habitat around

University of Namibia Main Campus.

N. Iipinge and J.K.E. Mfune*

*Department of Biological Sciences, University of Namibia, Namibia*

*Author for correspondence*

email: jmfunenamun; Tel: +264-61-2063743

**Abstract**

The Cape ground squirrel (*Xerus inauris*) is a conspicuous, strictly diurnal, common rodent found in many arid parts of southern Africa. Their small surface area-to-volume ratio makes them more vulnerable to heat load. Like many small mammals, they engage in many different survival and reproductive activities. The purpose of the study was to investigate diurnal and seasonal variation in activity patterns of the Cape ground squirrel at a selected habitat at the UNAM Main Campus. The specific objectives of the study was to 1) determine the different behaviors displayed by the cape ground squirrel, 2) determine and compare the frequency and duration of behaviors exhibited by the squirrel during different times of the day and how these varied in summer and winter. This study was carried at University of Namibia main campus soccer pitch. In each season, video footage of behavioral activities were recorded from which different behavioral activities, frequencies and duration of each behavior were extracted from individual Cape ground squirrel during three times of the day for a 2 hours duration (i.e. Morning, mid-day and late afternoon). This was done for 5 consecutive days in each season. Statistical testes where then used to test data for normality and for significant differences between activities, time of the day, and between two seasons. The result showed that there were significant differences in frequencies and duration of different behaviors that were displayed by Cape ground squirrels. Feeding was significantly the most frequent activity which also lasted the longest, on a daily and seasonal comparison. Walking, running, resting, playing /fighting, posing and scratching were the other commonly observed behaviors, in order of magnitude of frequency. In summer, there was no significant difference in frequency and duration of behaviors displayed by Cape ground squirrel during different times of the day except for vigilance behavior which was significantly higher during midday than during late afternoon. During winter, Cape ground squirrels remained in their burrows during the morning. They only came above ground
during midday and late afternoon. These results of the present study suggest that Cape ground squirrels prioritize activities that are important for their survival and reproduction. This may include but not be limited to maximizing their energy intake while balancing that with responding to weather conditions (ambient temperature) during different times of the day and different seasons and avoidance of predation. The study also showed that both heat load and coldness affect the activities of the squirrels. The size of group and availability of threats affect vigilance. In general, the squirrels were more active during summer than winter. It is recommended that further studies should be conducted to investigate the spatial variation in activity patterns of Cape ground squirrels and on their mating behaviors.

**Keywords:** Cape ground squirrel, behavioral activities, frequency, duration, seasons, time of the day.

---

**Snakebite injury in Namibia**

KH Piechazek, PM Nyarang’o, T Rennie, L. Shipingana, O. Katali, and CJ Hunter*

*Faculty of Health Sciences, University of Namibia*

*Author for correspondence*

Email address: chunter@unam.na | Tel: +264 81 867 9668

**Abstract**

Despite frequent interactions between snakes and humans in Southern Africa there are very few data describing the burden of injury caused by snakebite1,2. Namibia is a vast and arid country that is sparsely populated. The majority of the population lives in rural areas (villages and farms). These factors lead to a situation of widely distributed clinical services and centralisation of speciality medical services. There are over 85 species of snakes in Namibia with 11 of them considered extremely dangerous3.

After receiving permission from the Ministry of Health and Social Services (Windhoek, Namibia) We completed a prospective study of snakebites at Namibia’s only general referral hospital — Katutura State Hospital, located in the capital city in central Namibia (Windhoek). We recorded all cases who presented to the casualty department or were referred to the surgical services from outside health facilities. De-identified data were recorded at the initial presentation to Katutura State Hospital. From August 2015 to August 2016 there were 721 snakebites recorded with a peak in December (Figure). Of these, 376 resulted in serious injury. 569 of the bites happened in regions outside the city and were transferred to Katutura State Hospital after stabilisation. Children under the age of six years-old made up a third of the total snakebites and were impacted more by injury than older children and adults. Of the 33 fatalities recorded, 21 were children under the age of six.

Most certainly there were other snakebites treated at local clinics and health centres that either did not require transfer or who died at the location. Deaths outside of the hospital or before transfer were not recorded.
The distinct seasonality of the snakebites may be related to temperature and rain changes. 116 patients were treated with anti-venin. Of these, 30 patients died. The low incidence of anti-venin therapy may be a result of supply line deficiency, knowledge of clinical providers, or other factors.

In summary, we conducted a year-long prospective survey of all patients presenting to a large referral hospital in central Namibia. There was a large number of injuries with a seasonal pattern. Polyvalent and monovalent antivenin were only provided in about 18% of cases. Young children made up a large proportion of the victims and were more likely to die or have serious injury than adults and older children.

References
[1] Longbottom, J, Shearer, FM, Devine, M et al. Vulnerability to snakebite envenoming: a global mapping of hotspots. (published online July 12.) Lancet. 2018; http://dx.doi.org/S0140-6736(18)31224-8
Isolation and characterization of psychrotrophic bacteria isolated from frozen fish “Horse mackerel in domestic settings

Piniku A. N.
Department of Biological Sciences, University of Namibia

*Author for Correspondence
Email: sylvianfk760@gmail.com

Abstract
Food spoilage is a common process greatly known all over the world and it has been a major concern in the world’s food industry. Many food products are discarded due to microbial spoilage despite of the modern techniques discovered to preserve and keep the food safe. In this study, food spoilage bacteria associated with Horse mackerel fish purchased from local supermarkets in Windhoek and stored in domestic settings are considered. The bacteria that form on fish during storage as well as those responsible for fish spoilage can be found based on where the fish comes from. The problem investigated in this research was that frozen fish refrigerated in domestic settings becomes contaminated with bacteria even though it is meant for consumption and leads to food spoilage and food borne illnesses.

Food borne illnesses are caused by consumption of these contaminated food infested with bacteria such as E.coli, Staphylococcus species, Pseudomonas, Shigella, Salmonella, Lysteria, Campylobacter, Enterobacter etc. The study was conducted at the

The prime objective of this study was to isolate and characterize psychrotrophic bacteria associated with frozen fish (Horse Mackerel) in domestic settings. Isolation and characterization of bacterial communities in the fish was performed using selective and differential culture media (MacConkey and Mannitol salt agar), biochemical tests (lactose and non-lactose fermenting) including 16S ribosomal RNA gene sequencing. The bacteria found in the fish was revealed to be Klebsiella, Enterobacter, Janthinobacterium lividum, Bacillus cereus, Staphylococcus equorum and Staphylococcus epidermidis. It was concluded that storage has an effect on the bacteria present in fish sample upon purchase, contamination may occur during improperly packaged food, constant opening of the refrigerator or through poor sanitation. Frozen fish can give a storage life of more than a year if it is properly carried out. At temperatures below -10C bacterial growth is limited and altered by the high temperature as freezing.

KEYWORDS: Psychrotrophic, food borne illness, food poisoning, E.coli, Staphylococcus species, Pseudomonas, Shigella, Salmonella, Lysteria, Campylobacter, Enterobacter, Janthinobacterium lividum, Bacillus cereus.
Isolation of Actinomycetes from Namibian marine samples

PSA Autoni
Department of Biological Sciences, University of Namibia

peterwellorganised@gmail.com, Cell: +264813793800

Abstract

Background: Actinomycetes are the most economically and biotechnologically valuable prokaryotes since they have the ability to synthesize metabolites which inhibit the growth of disease causing bacteria. The significance of testing presence of actinomycetes in Namibian marine samples is that: isolation of new actinomycetes from marine has a great chances to discover new antimicrobial metabolites.

Methodology: Starch casein agar enriched with 10% and ½ ZSSE agar were used to grow pure cultures. Colonies of pure cultures were then transferred to Erlenmeyer flask contain SCA broth and ½ ZSSE broth respectively. The flask were incubated for 14 days on shaker incubator. CTAB was used to extract DNA. DNA was then amplified with PCR under the following condition: Denaturing temperature 95°C for 5 minutes, annealing temperature 56 °C for 1 minute and final elongation was done at 72°C for 5 minutes. The concentration of forward (27F) and reverse (1492 R) primers used was 10µM. The samples were sequenced for indentification of strains.

Results: Morphology of pure culture was observed. White colonies were observed forming mycelium over ½ ZE agar. Grey colonies were observed to for blue colour of ½ ZE agar. After PCR, all the DNA bands were observed to be of the same size. Isolated strains include Arthrobacter sp. strain and Glutamicibacter creatinolyticus strains.

Conclusion: Based on the morphological results, colonies form mycelium similar to fungi.. The research hypothesis was accepted that Namibian marine samples contained actinomycetes.

References

Assessment of cattle forage selectivity in relation to grazing value of herbaceous plants on Farm Kiamsab West 364, Namibia.

S. Kadhikwa*, I. Mapaure and M. Morkel
Department of Biological Sciences, University of Namibia

*Author for correspondence
e-mail: kadhikwass@gmail.com; cell: + 264 81 7384313
Cattle forage selection and diet preferences was assessed on Farm Kiamsab West 364 based on herbaceous plants grazing value. Twelve 50 meter line transects were laid out perpendicular to the road in Bopost and Middle Post cattle camps. Herbaceous plants were identified to species level and recorded as grazed or not grazed in a total of 72 plots. There was a significant difference in the grazing values among herbaceous plants ($\chi^2=261.170$, df= 3, $p=0.000$). Farm Kiamsab West 364 was dominated by moderately grazing value herbaceous plants. A rangeland is considered healthy when it is dominated by widespread, high grazing value, perennial species such as *Anthephora pubscens*, *Schmidtia pappophoroides*, *Urochloa oligotricha*. There was no significant difference between forage selectivity and grass grazing value ($\chi^2 =5.611$, df = 3, $p=0.060$). Intra species selection of grass was reduced because of low basal cover and sparse grassland characterizing Farm Kiamsab West 364. There was a significant difference between forage selectivity and forb grazing value ($\chi^2 =442.698$, d.f= 3, $p=0.000$). Grazing ruminants select plant species and plant parts with higher nutritive value first in order to meet their nutritional needs. Cattle exhibited dietary preference towards a particular grass species ($\chi^2 =91.855$, d.f= 12, $p=0.000$). *Eragrotis echinocloidea* was the most preferred while *melinis repens* was the least preferred grass species. Cattle showed preference towards a particular forb species ($\chi^2 =526.144$, d.f= 22, $p=0.000$). *Tribulus terrestris var. terrestris* was the most preferred forb on Farm Kiamsab West 364 while *Senecio consanguines* was the least preferred forb. Dietary preference increases when forage species are rich in nutrients however it decreases with presence of secondary metabolites and plant morphological defences. The knowledge of cattle forage selection and dietary preference is of paramount importance to the farmer as it can aid the farmer in sustainably managing his/ her rangeland.

**Keywords**
Cattle, Diet preference, Forage selection, Grazing value, Herbaceous Plants, Kiamsab West 364, Namibia.

**Antibacterial and Antioxidant Activities of *Amaranthus thunbergii***

*S. Simasiku*, K. Kaitjizemine, R. Bock and S. Nafuka  
Department of Biological Sciences, University of Namibia

*Author for correspondence*  
Email: sylvianfk760@gmail.com ; Cell: +26481 454 6212

**Abstract**
The current study was carried out to evaluate the antibacterial and antioxidant activities of *Amaranthus thunbergii*, mainly on their stems and leaves. Phytochemical analysis was also performed. The solvents used for extraction procedure were; methanol, water and 1:1 methanol-hexane. The disc diffusion method was used to test for antibacterial activities of *Amaranthus*
thunbergii extracts against Escherichia coli, Staphylococcus aureus and Bacillus cereus. The phytochemical analysis was done specifically to evaluate the presence of terpenoids, phenols and flavonoid compounds in the extracts. The antioxidant activity of Amaranthus thunbergii extracts was done using 2, 2-diphenyl-1-picrylhydrazyl (DPPH) radical scavenging assay. In antibacterial activity, methanol and 1:1 methanol-hexane extracts showed inhibitory activity. Methanol extracts inhibited the growth of all bacterial species while 1:1 methanol-hexane extracts was only effective against B. cereus. Of all extracts, aqueous extracts did not inhibit any of the test microorganisms. Methanol leaf extracts showed the highest inhibition size (15.75 mm) which was observed against B. cereus. Methanol extracts were the most effective, followed by 1:1 methanol-hexane extracts and lastly aqueous extracts that showed no effect. Methanol extracts of both leaves and stems showed the presence of terpenoids. Aqueous extracts of leaves also produced positive results for terpenoids while stems produced negative results. In 1:1 methanol-hexane extracts, stems showed the presence of terpenoids while leaves yielded negative results. Stems also produced positive results for the presence of flavonoids, leaves produced negative findings for the same test. None of the extracts showed the presence of phenol compounds. Both stem and leaf extracts of Amaranthus thunbergii exhibited antioxidant activities. Off all solvents, methanol extracts of stems exhibited the highest antioxidant activity (56.12%). In both stems and leaves, the strength of solvents in radical scavenging activity was observed in the following manner: Methanol > 1:1 methanol-hexane > water. As the concentration of extracts increased, the radical scavenging capacity also increased. In conclusion, methanol extracts possess the most antibacterial and antioxidant ability among all extracts. In comparison to stems, leaves have higher antibacterial activity than stems while stems possess higher antioxidant activity than leaves, therefore the plant possesses both antibacterial and antioxidant activities.

**Keywords:** Amaranthus thunbergii, Phytochemicals, Antibacterial, Antioxidant activities.

**DETECTION OF GENETIC MODIFICATION IN LOCALLY VENTED MAIZE PRODUCTS**

Shikalepo G.N. N
Department of Biological Sciences, University of Namibia

**Author for correspondence**
Email: giselindendeshi@gmail.com; cell: +264817455654

**Abstract**
A wide range of genetic modifications (GM) in humans and animal consumptions have become a provoking issue in the modern world and have brought concerns to scientists to find reliable methods of detecting and evaluating the existence of these transgenic materials. Most of the GM foods are not labelled and thus grabbing away the consumers right to know what is contained in the food they choose to eat and make the right and informed purchasing decisions. The aim of this study was to detect and quantify GM events in locally vented labelled and unlabeled maize
and related products in Namibia. Different GM labelled and unlabeled maize products were selected and bought from local supermarkets in Windhoek, Namibia. The maize products are 2 corn flakes brands (no GM label), Top Score maize flour (no GM label), instant maize porridge flour (presence of GM label) and popcorn grains (non-GM label). Each of these 5 items, 2 samples were analyzed making it a total of 10 samples for this study. DNA was extracted using CTAB method and identification by polymerase chain reaction of the cauliflower mosaic virus promoter (CAMV 35S) and 4 Cry1, cry2 cry3 and cry4 genes. The 6 samples of the 3 maize products with no labeling all tested negative. Furthermore, the 4 samples of 2 maize products with GM labeling all tested negative too. To conclude, labelled and unlabeled maize food and related products found in local shops in Namibia are not genetically modified.

Keywords: GMO, Maize, PCR, Detection, DNA extraction

Phytochemicals and antibacterial activity of selected Namibian lichens

Shikongo, M. N.1*, Kadhila, N. P.2, and Iikasha, A. M.3

Department of Biological Sciences, University of Namibia, Namibia
MRC: Zero Emissions Research Initiative, University of Namibia
Department of Anatomy, Hage Geingob campus, University of Namibia

*Author for correspondence
Email: amnelagoshikongo@gmail.com Tel: +264 818030606

Abstract
Pathogens such as Escherichia coli, Staphylococcus aureus, and Streptococcus aureus lead to mortality and morbidity worldwide. Bachir & Abouini (2015) described these pathogens as major contributors of respiratory infectious diseases especially in humans. The use of microbial agents such as antibiotics against these pathogens results in super pathogens through resistance mechanism. Limited researches have been carried out on lichen species in Namibia, therefore this study aims to investigate the presence of mycochemicals in lichens, concentrating on the flavonoids, Saponins, terpenoids, anthraquinones, coumarins, and alkaloids. Those phytochemicals are described as natural secondary compounds, which plays an important role in both biological and pharmaceutical sectors. The study aims to investigate the ability or inability of lichens extract to inhibit the growth of the three target bacteria namely; Escherichia coli, Staphylococcus aureus, and Streptococcus pneumonia. A random sampling method was employed to collect lichens from Dorob Lichen Field situated between Hentiesbay and Swakopmund in Namibia during the year 2018. Five (5) grams of each lichen species was dissolved in 50ml of each four solvents namely; hexane, ethyl acetate, methanol, and dichloromethane. Phytochemical screening was performed using Thin Layer Chromatography. Positive control for each phytochemical to be screened was used in order to compare the results. The TLC plates were sprayed with reagents and viewed under UV of length 255-360nm. Antibacterial activity was carried out using the disk diffusion assay method with volumes of 10µl of target bacteria E. coli, S. aureus, and St. pneumonia, and disk papers soaked in 50µl of lichen extract for 10 minutes. The positive control used was gentamycin and negative control as the same solvents were lichen powder. The inhibition zones were observed at a concentration of 100mg/ml. Hexane lichen extract both samples showed the presence of Saponins, Terpenoids,
Anthraquinones, coumarins. Alkaloids were present in sample 1 to sample 5. All methanolic lichen samples showed the presence of Saponins, Terpenoids, Anthraquinones. Coumarins were present in sample 1, 2 and absent in sample 3 and 5. For ethyl acetate lichen extracts all samples showed the presence of Saponins, Terpenoids, Anthraquinones, Coumarins. For dichloromethane lichen extracts Saponins and terpenoids were present in sample 1,2,3,5. Anthraquinones and Coumarins were present only in two samples namely 1, 2. Methanolic lichen extract showed the best inhibition zones in comparison to the hexane, dichloromethane and ethyl acetate solvents.

**Figure 1.** The inhibition zone of *E. coli*

**Figure 2.** TLC plate for detecting Saponins

**Keywords**: Phytochemical, Lichen, extracts, antibacterial activity, concentration

**References**

**Identification and characterisation of venom proteins from *Naja Mozambique* and *Naja nigricincta nigricincta***

L. Shipingana, O. Katali, E. Haindongo, P Nyarang’o, CJ Hunter*

*Faculty of Health Sciences, University of Namibia*

*Author for correspondence*
Email address: chunter@unam.na | Tel: +264 81 867 9668

**Abstract**
Snakes bites are a major cause of morbidity and mortality in Africa, Asia and Latin America¹. The cobra snakes (including: *Naja mossambica* and *N. nigricincta nigricincta*) are one of the major snakes responsible for snake bites in Southern Africa such that they have been recognised as a medically important snakes in 2006². However, the antivenoms currently available to treat snakebites caused about 32,000 deaths in sub-Saharan Africa and leaves about 100,000 survivors with permanent disabilities³. This is a clear indication that a large percentage of antivenoms marketed in Africa are ineffective as they are developed from snake species that are not relevant to Africa⁴. Although the *N. mossambica* has been characterised, the venom composition of *N. n.
*nigricincta* is not known. This study identified and characterised the protein constituents of the Namibian *N. mossambica* and *N. n. nigricincta* venom. The separation and identification of venom proteins was achieved using Sodium dodecyl sulphate (SDS)-polyacrylamide gel electrophoresis (PAGE) followed by high performance liquid chromatography-mass spectrometry (HPLC-MS) analysis. All data was run against a protein database (UNIPROT) to identify specific proteins. Most of the peptides are less than 17 kDa in both *N. mossambica* and *N.n. nigricincta*. *Naja mossambica* was found to have 90 peptides in total (from 18 protein families) whereas *N.n. nigricincta* have 111 (from 22 protein family). Of these identified peptides, 69 peptides are common in both snakes and belong to 17 different protein families. This study will facilitate in understanding the role of these proteins in envenomations and lay the foundation for alternative therapeutic agents from snake species that are relevant to Africa.

References

[1] Longbottom, J, Shearer, FM, Devine, M et al. Vulnerability to snakebite envenoming: a global mapping of hotspots. (published online July 12.) Lancet. 2018; http://dx.doi.org/S0140-6736(18)31224-8


Conserving and preserving the cheetah through effective conservation, research and education strategies

Siyaya, A
*Cheetah Conservation Fund, Otjiwarongo, Namibia*

anntjie@cheetah.org Tel: +264 67 306225
Abstract

About 80% of cheetahs (*Acinonyx jubatus*) in Namibia live outside protected areas due to intraspecific competition from more aggressive predators, which decreases their survival rate in protected areas. Cheetahs therefore have to share their habitat with farmers, which results in human-wildlife conflict (HWC). Whether perceived or real, livestock loss to cheetahs is an economic and emotional issue as farmers’ livelihoods depend on the economic success of their livestock and wild game industries. While many Namibian farmers are very respectful of nature and tolerate a certain level of loss, some resort to lethal predator control rather than alleviating their problems in a non-lethal manner through appropriate livestock and predator management.

By addressing livestock-predator conflict through a conservation management strategy that benefits both humans and cheetahs, Cheetah Conservation Fund (CCF) is ensuring the long-term species’ survival on Namibian farms and has raised greater awareness of better farm practices, through workshops with farmers and other education programmes. The CCF addresses some of these challenges through innovative research and conservation strategies.

The LGD programme began in 1994, using the Anatolian shepherd dog, and later the Kangal, two Turkish breeds with a long history of protecting wildlife in arid terrain. CCF breeds these dogs and places them on suitable farms that experience HWC with cheetahs. To date, CCF has placed 596 (304M, 292F) dogs throughout Namibia and other parts of Africa, and farmers with an LGD have reported a 70 - 80% decrease in predation to their livestock, and 92% farmers have reported the LGD to have an economic benefit (Figure 1).

![Figure 1: Reported livestock loss (left) and response to economic benefit of dog (right) by farmers.](image-url)

The Bushblok, another conservation strategy is a habitat improvement program that is ecologically and economically viable and serves as a demonstration for alternative energy sources through the manufacture of briquette logs, and charcoal. Central Namibia suffers from bush encroachment by invasive species of native thorn bushes. For CCF and its mission to save the wild cheetah, bush encroachment is a critical problem which causes; loss of biodiversity, reduction in prey species, and physical obstacles (dense bush) that reduce the hunting success of cheetah. These consequences of bush encroachment combine to suppress the population of cheetahs. Bushblok as part of CCF’s conservation strategies harvests these species and manufactures briquette logs and charcoal, while providing economic opportunities for local communities. The Bushblok project employs 30 workers, and as of June 2018 has produced 164 tonnes of logs and sold 223 tonnes (Table 1).
The E-Shepherd and Fox Light projects are new strategies that CCF is piloting to mitigate HWC. The E-Shepherd collar is an electronic collar that goes around the neck of a goat/sheep or calf. These collars emit high-pitched sounds when they are under distress from being chased by a predator. The sound then deters the predator. The Fox Light project, involves lights that emit different colour lights and are placed at the corners of the kraal. Predators are deterred by the lights thinking a human being is present. In addition, the Go-Green Project investigates wildlife species present on communal and commercial farmlands. This will provide an understanding of which predators (and their prey base) are present versus perceived. With this understanding, CCF can then work with farmers on appropriate mitigation measures.

The potential of *Cleome gynandra* endophytic seeds bacteria from Omusati Region, Northern Namibia for the production of antineoplastic enzymes: L-asparaginase and amylase.

T.L. Helao* and P.M. Shipoh¹
*Department of Biological Sciences, University of Namibia*

*Author of correspondence*
Email: leonard.tuhafeni@outlook.com

**Abstract**
Endophytes are novel sources of natural bioactive compounds. This study seeks enzymes from endophytes that produce the anticancer enzyme L-asparaginase and amylase, from *Cleome gynandra* a selected host plant. In recent years, microbial asparaginase and amylase have drawn interest because of their potential antineoplastic properties. L-asparaginase and amylase are enzymes which are widely used in various industries. Amylase is an amylolysis enzyme used in many food industries and L-asparaginase is a well-recognized as amino acid degrading enzyme and is recommended as therapeutic agent due to an antineoplastic activity. L-asparaginase can be effectively used for the treatment of patients who suffer from acute lymphoblastic leukemia (ALL) in children and tumor cells. Microbial sources are the best source for these enzymes because of the bulk production. Pure cultures of isolated bacterial endophytes were examined.

### Table 1: Monthly log production from January - June 2018.

<table>
<thead>
<tr>
<th>Month</th>
<th>Amount (tonnes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>10</td>
</tr>
<tr>
<td>February</td>
<td>15</td>
</tr>
<tr>
<td>March</td>
<td>24</td>
</tr>
<tr>
<td>April</td>
<td>22</td>
</tr>
<tr>
<td>May</td>
<td>30</td>
</tr>
<tr>
<td>June</td>
<td>63</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>164</strong></td>
</tr>
</tbody>
</table>
and screened for L-asparaginase production. The anticancer enzyme L-asparaginase activity was determined using spectroscopy. Among nine isolates of the test, three isolates produced L-asparaginase which are, Enterobacter cloacae (F10), Enterobacter hormaechei (XJUHX-4) and Enterobacter hormaechei (AER 304-6). One isolate showed the ability to produce both L-asparaginase and amylase, Enterobacter hormaechei subsp. xiangfangensis (GW321). Five isolates showed a negative test in both enzymes, Staphylococcus epidermidis (MKO24298.1), Staphylococcus sp. (IOM 2617228), Delftia acidovorans (ANG1) and Delftia acdovorans (JMC 2784). This study has revealed that endophytes are good alternative sources for L-asparaginase and amylase production and they can be sourced for anticancer treatments and industrial applications.

Molecular Identification of selected Basidiomycetes using Internal Transcribed Spacer (ITS) region

Tjaveondja1*, R. and Kadhila, N. P.2
1Department of Biological Sciences, University of Namibia
2MRC: Zero Emissions Research Initiative, University of Namibia

*Author for correspondence
Email: riatjaveondja@gmail.com Tel: +264 81 8563529

Abstract
The Fungi kingdom is estimated to include 1.5 million or more species, playing key roles as decomposers, mutualists, and parasites in every biome on the earth. Different kinds of fungal species are utilized by humans with applications in agriculture (bio-pesticides), pharmacology (antibiotics), the food industry (edible mushrooms), and environmental technologies (decomposers). Thus, exploration of fungal diversity is crucial not only for the ecosystem and community ecology, but also to provide invaluable resources for various fields of Applied Microbiology. Mushrooms have recently gained attention in the market, for their nutritional and medical uses, as well as their role in economical and food sustainability. Therefore accurate identification of wild and potentially edible mushrooms is key in order to effectively utilize them for the benefit of humankind. However, morphological identification of mushrooms is a time consuming, tedious process that is mostly prone to error, especially in closely related species. Hence the use of DNA barcoding method targeting the internal transcribed spacer (ITS) region of the nuclear ribosomal (r-DNA) repeat as a tool in mushroom taxonomy. This study employed the use of the ITS region and sequencing technique as a method of identification of the selected basidiomycetes at a molecular level. The genomic DNA material was extracted and the ITS region was amplified using ITS primers ITS1 and ITS4. PCR products from amplification were visualized in a 1% agarose gel, stained with Ethidium bromide and viewed under UV light. Identification of mushroom species involved BLAST sequencing and phylogenetic analysis. Six mushroom samples were identified as Leucoagaricus leucothites (RT1 & RT2), Kalaharituber pfeilii (RT3), Agaricus hondensis (RT4), Psathyrella candolleana (RT5) and lastly Agaricus
Out of the six identified species of mushrooms, *Agaricus subrufescens* and *Kalaharituber pfeilii*, are known to have economical and medicinal uses, while *Agaricus hondensis* is classified as a poisonous mushroom. *A. hondensis*, which is characterized by white to gray-brown caps that darkens (to brown) with age, is known to cause severe gastrointestinal upset when consumed (Kuo, 2005). *A. subrufescens* is characterized by high content level of beta glucans, compounds known for stimulating the immune system, thus it’s currently used in oncological therapy (Chen & Wu, 1984). Another mushroom specie with economical value is the *Kalaharituber pfeilii*, a truffle commonly found in Kalahari Desert as well as in arid regions of South Africa, Angola, Botswana and Namibia (Taylor, et al., 1995). *K. pfeilli* is utilized as a stable food by the Khoisan clan of the Kalahari, thus has the potential to be cultivated and harvested by Namibian communities, providing them with a source of income and food. Phylogenetic analysis revealed that *P. candolleana* is closely related to *A. hondensis*, while *A. subrufescens* is closely related to *L. leucothites* species. All of the above-mentioned species were observed to be a monophyletic group, as they had a common ancestor.

**Keywords:** ITS, Basidiomycetes, DNA, PCR, Sequence, Identification

**References**

---

**Phytochemical screening, antioxidant activity and antibacterial activity of select medicinal plants found in Southern Africa**

**K. Tjirare**, Iikasha. A, and Prfo Davis
*Department of Biological Sciences, University of Namibia*

*Author for correspondence*  
email: tjirareka@gmail.com; Tel: +264812320360

**Abstract**
The objective of this study was to perform phytochemical screening, to determine the secondary metabolite content, to evaluate antibacterial and antioxidant activities of methanol and water extracts of *Acacia eriolba*, *Acrotome inflata*, and *Diospyros lycoideas*. Antioxidant activity was determined by 2,2-dimethyl-1-picrylhydrazyl (DPPH), phytochemical screening was performed using Thin layer Chromatography (TLC). Antibacterial tests were performed on common gastroenteritis causing bacteria which included *Staphylococcus aureus*, *Lesteria monocytogenes*, *Shagella sonnei*, and *Escherichia coli*. Results showed that *A. erioloba* was rich in triterpenoids, saponins, Tannins, Alkaloids, Steroids, and flavonoids. *A. inflata* showede to have an abundance
of Alkaloids, Steroids, and Flavanoids, While *D.lycoides*, showed larger amounts of Coumerin, Triterpenoids, Saponins, Tannins, Alkaloids, Steroids, and Flavonoids. Antibacterial test using the disc diffusion assay method showed *S. aureus* to be the most susceptible to the plants tested. The ability of the plant extract to scavenge DPPH radical (RSA). The plants was recorded *D.lycoides* (twigs) showed percentages of 75.8%, 81.4%, 81.2%, and 77.2% for concentrations of 1000, 500, 250, and 125 micrograms per mL respectively. *D.lycoides* (leaves) showed values of 62.5%, 59.6%, 77.3%, and 65.4% respectively for similar concentrations. *A. inflata* had values of 82.7%, 80.1%, 52.7%, 51.2% respectively for similar concentrations ranging for 1000 -125 micro grams per mL, The roots of *A. erioloba* showed figures of 88.6%, 87.2%, 67.2%, and 37.2% respectively for said concentrations. These findings demonstrated that *Acacia erioloba*, *Acrotome inflata* and *Diospyros lycoides* potential activity against selected gastrointestinal pathogens. However further toxicology tests should be done before they can be considered as alternative in treating gastrointestinal pathogens. Antioxidant activity index (AAI) will have to be calculated using calibration curves in linear range.

Isolation and characterization of plant growth promoting seed bacterial endophytes associated with *Cleome gynandra* in Omusati region of northern Namibia

U. Tjijenda*, J. D. Uzabakiriho and P. M. Shipoh
Department of Biological Sciences, University of Namibia

*Author for correspondence
Email: utjijena@gmail.com

Abstract
Although it is recognized that plant harbour dense and diverse endophytes endowed with plant growth promoting or bio controlling traits, only specialized strain would be able to colonize and survive in the plant seeds. However, this vertically transmitted endophytic microbiota has remained largely unexplored. In this study, the seed bacterial endophytes were in vitro screened for plant growth promoting activities (siderophore, Indole Acetic Acid (IAA) and phosphate solubilization). According to their 16S rRNA sequencing, 10 distinct bacterial strains were isolated and identified as *Bacillus pumilus*, *Bacillus subtilis*, *Methylobacterium aminovoras*, *Haematobacter massiliensis*, *Delftia acidovorans*, and one isolate actinomycete *Arthrobacter creatinolyticus* from 10 isolates. These isolates were assigned to 5 families (*Methylobacteriaceae*, *Bacillaceae*, *Rhodobacteraceae*, *Comamonadaceae* and *Micrococccaceae*) and 5 genera (*Methylobacterim*, *Bacillus*, *Haematobacter*, *Delftia* and *Arthrobacter*). From the 10 isolated bacterial endophytes 8 tested positive to siderophore production, which are *Bacillus subtilis*, *Methylobacterium aminovoras*, *Haematobacter massiliensis*, *Delftia acidovorans*, and *Arthrobacter creatinolyticus*. Isolates were screened for IAA production. *Bacillus pumilus*, *Bacillus subtilis*, *Methylobacterium aminovoras*, *Haematobacter massiliensis*, *Delftia acidovorans*, and *Arthrobacter creatinolyticus* produced IAA, with *B. pumilus* producing the
most IAA. *B. subtilis* tested positive in the production of all PGP traits. The results indicated that the *C. gynandra* seed harbor a number of bacterial endophytes with significant potential for plant growth promoting growth that can be used in the agriculture as biocontrol and bio-enhancers.

GEOMETRIC MORPHOMETRIC VARIATION OF *PROCAVIA CAPENSIS* (*HYRACOIDEA, PROCAVIIDAE*) OCCURING IN NAMIBIA

Y.L.N Abiatar* and S.J Eiseb
Department of Biological Sciences, University of Namibia

*Author for correspondence*
Email: iabiatar20@gmail.com, Cell: 0816024132

Abstract
Morphological variations can occur within the same population or different populations of the same species found in different geographic areas. Organisms adapt to their environments through natural selection. The environment changes every time, influenced by physical and biological factors, including anthropogenic influences. All the changes taking place within and on an organism allows for growth, survival and reproduction, thus increasing the fitness of organisms in a particular environment. The aim of this study was to investigate geometric morphometric variation in *Procavia capensis* (*Hyracoidea, Procaviidae*) from Namibia. Skull specimens of *Procavia* skull specimens were divided into sex (males or females) and age categories (based on the degree of tooth wear). A total number of 270 skull images (dorsal and ventral) were taken using a Sony Cyber-Shot (DSC-H5) digital camera. For non-geographic variation, 41 females, 44 males and 34 juveniles (skulls) were selected from the area of Keetmanshoop, in the //Karas region. Twenty anatomical landmarks (dorsal-8; ventral-12) were selected to compare the variation in skull shape between the sexes and age classes in Namibia. A Thin-plate spline relative warps analysis (equivalent to a Principal Component Analysis) of landmark data of OTUs for each of the two views (dorsal & ventral) was computed. Partial weight matrix data (W) for dorsal and ventral views were further subjected to a Discriminant Analysis to test for significant differences in the shape of the skulls within the population. The results of this study indicate presence of sexual dimorphism between adult males and adult females within a single population (males larger than females). It was recorded in previous studies that *Procavia* males are territorial and competes for females. This implies that sexual selection may act via male–male combats or/and female choice and thus favour bigger male body size. Juveniles differ from adults in size and shape because of differences in growth patterns between these groups. No analysis was done for geographic variation due to sample size limitations. Therefore more sampling is needed from rest of Namibia to compare for variation due to various environmental conditions.
Keywords: Hyracoidea, Procaviidae, Procavia capensis, Non-geographic variation, Geometric Morphometrics.
Synthesis of Calcined Co Fe Hydrotalcites and Characterization with SEM and TEM on the Efficient Removal of Colour and Organic Matter from Contaminated Water

T. Amiila*, A. Rahman, and P. Kapolo
Department of Chemistry and Biochemistry, University of Namibia

*Corresponding Author:
Email: toinimulipo@gmail.com; Tel: +264818509773

Abstract
Most diseases in the world are related to water and sanitation. To break the cycle of disease, improvements should be made in water treatment industries in order to provide more quality water to the community. The purpose of this project is to produce calcined Co Fe hydrotalcite to remove colour and organic matter from contaminated water. Hydrotalcites have a brucite-like structure (Mg (OH)2) with the general formula of [M2+1−xM3+x(OH)2]x+(An−)x/n.mH2O, where M2+ and M3+ are divalent and trivalent cations and An− is an anion. The heat treatment of LDH to a high temperature lead to the formation of a calcined LDH. LDHs are important due to their potential applications as adsorbents, catalyst supports, catalysts, medicine, ceramic industry and polymer additives. Co Fe hydrotalcite was prepared via co-precipitation method at pH 10 and aging step at 40 °C for 4 hours. It was prepared into 3 different ratios of 2:1, 2.5:1 and 3:1. Various applications were done with the uncalcined and calcined hydrotalcite. Fe contaminated water, Gammams raw water and Ocean water (Swakop) were filtered to remove the dirt and then treated with equal amounts of three samples. The results were characterized with different analytical tools. Methylene orange and methylene blue were also treated with the hydrotalcites to remove the colour. Large nano-particles and others with hexagonal-shaped particles were observed. As the pH increased, the cations react with OH− and (CO3)2− generating hydrotalcite. Some nanosheets became irregular as the Co concentration decreased. Sample B and C exhibited bright, highly dispersed hexagonal nanoparticles, along with some petal-like layers on the surface. The samples also presented darker areas indicating the stacking of the LDH nanotubes crystallites perpendicular to the sample stage. It presented the formation of thin nanotubes. The
dispersion study that showed high transparency in the initial sample and of the lower phase once the sample had settled into two phases was methanol, thus it gave better results than others. In conclusion the hydrotalcites can be prepared from cobalt (ii) nitrate hexahydrate and iron (iii) nitrate nonahydrate and can be used for wastewater treatment.

References

Antioxidant potential of selected hydrazone ligands

S.H. Kanalelo, V. Uahengo, P. Kapewangolo*
Department of Chemistry and Biochemistry, University of Namibia

*Author for correspondence
Email: pkapewangolo@unam.na; Tel: +264 61 2063384

Abstract
Hydrazone based ligands are known to possess a wide range of biological activities, including antioxidant property. Antioxidant compounds possess the ability to prevent oxidative damage in biological systems. The present study investigated the in vitro antioxidant potential of 3 hydrazone ligands 7, 8 and 12 using 2,2-diphenyl-1-picryl hydrazyl (DPPH), Ferric reducing power and Hydrogen peroxide (H₂O₂) scavenging assays. Ligand 12 demonstrated good antioxidant activity with an IC₅₀ value of 9.88 ± 0.53 µg/ml for DPPH. The other two ligands, 7 and 8 showed low DPPH scavenging activity. The H₂O₂ assay showed that all 3 ligands demonstrated high antioxidant potential with IC₅₀ values of 0.56 ± 0.13, 0.04 ± 0.009 and 0.05 ± 0.025 µg/ml for ligand 7, 8 and 12, respectively. The reducing power for the Hydrazone ligands increased with the increase in concentration. The results of this study suggest that compounds 7, 8 and 12 have the potential to be developed as synthetic antioxidants.

Keywords: Hydrazone ligands, Antioxidant activity, antioxidant, DPPH, Reducing Power, IC₅₀
Isolation and biochemical characterization of microorganisms present in used engine oil contaminated soil from Katutura, Namibia

V. T. I. Mupupa1*, P. Kapolo1, R. Ateeq1 and W. Embashu2
1Department of Chemistry and Biochemistry, University of Namibia
2Multidisciplinary Research Centre (MRC), University of Namibia

*Author of Correspondence:
Email: vistomupupa@gmail.com; Cell: +2648 12120311

Abstract
Used engine oil is the major source of pollution and it may have harmful effects on the environment and most importantly to human. Replacing car parts and engine at some garages result in the oil spill which cause environmental pollution. In order to reduce this problem bioremediation have emerged as the cheaper, efficient and environmental friendly method of cleaning. The present study aim at isolation and biochemical characterization of microorganisms present in engine oil contaminated soil from Katutura, Namibia. Six soil samples were collected from three garages through random sampling method and enrichment was done by serial dilution method. Sixteen bacterial colonies were isolated and through gram staining and biochemical testing, they were identified up to genius level. Microorganisms were identified using the Berge’s manual of determinative bacteriology for the characterization. The identified microorganism were five Enterobacter species, three Pseudomonas, two Shingella, two Klebsiella, one Escherichia Coli, one Micrococcus species, one Enterococcus species and one Cytobacteira diversus. Results from the study indicated that Enterobacter species and Pseudomonas were spread in the soil at different garages.

Keywords: Bioremediation, engine oil, oil degrading bacteria, pseudomonas sp, Enterobacter sp

References
Removal of organic compound contaminants in water with activated carbon derived from Acacia seed pods

M. Hamushembe*, A. Rahman, and P. Kapolo

Department of Chemistry and Biochemistry, University of Namibia

*Author of correspondence
Email: arahman@unam.na/mhamushembe@gmail.com Cell: +264813376063

Abstract
Activated carbon (AC) was prepared from *A. erioloba* seed pods using H3PO4 activation. It was sieved into 3 different particle sizes of 50 (AC-1), 100 (AC-2) and 200 μm (AC-3). AC was characterized by different analytical tools [1]. The surface of AC was found to contain elements namely, Na, K, Al, Si, Ca and Cu. These were observed with SEM. The studies on characterization of adsorbent from acacia seed pods has been performed. The characterization of the adsorbents includes estimation of various parameters such as proximate analysis (moisture content, ash content, volatile matter content and fixed carbon content), bulk density, SEM, pH, iodine number and methylene blue number [2]. Batch Adsorption dynamics and equilibrium studies for the removal of organic compounds from aqueous solution using indigenously prepared Acacia Erioloba carbon (AEC), has been carried out under various experimental conditions at room temperature (25°C±1°C) [3]. Refinement of contaminated water is necessary for the safety of living beings. The main objective of this research is to produce activated carbon for the removal of contaminants from water containing organic contaminants from Gammamsrer and Fe from iron contaminated water collected from NAM water. The results show that the prepared activated carbon removed Fe and the organic contaminants as well. Adsorption of methylene blue followed Freundlich adsorption model, showing higher R^2^ values for AC-1, 2 and 3 than Langmuir model. Surface area was estimated to be 617 ± 4.1, 62 ± 3.6 and 164 ± 2.9 m^2^/g for AC-1, 2 and 3, respectively. Iodine number was found to be 520 and 576 sample A and B for AC 1,670 and 672 for AC 2 and 662 and 632 for AC 3 mg/g for the 50, 100 and 200 μm activated carbon particles, respectively. AC-2 was found to have the highest iodine number (670±2.9 and 672±3.1 mg/g) compared to AC-1 and 3. The results revealed that prepared *A. erioloba* can be used for iron removal and can also be used for the treatment of contaminated water, which were characterized by UV. Hence, in conclusion, an activated carbon can be prepared from *A. erioloba* seed pods and is an economic and environmental green process for wastewater treatment in Namibia.

References
Identification of drought tolerance genes in *Ximenia Americana* by genetic analysis

H. Shambwila¹, A. Ekandjo¹*, P. Kapolo¹ and L. Mhuulu²

¹Department of Chemistry and Biochemistry, University of Namibia
²Department of Biochemistry and Microbiology, School of Medicine, University of Namibia

*Author of correspondence
Email address: aekandjo@unam.na Tel: +264 81300 3350

Abstract
*Ximenia Americana* is a tree or shrub which is found growing reaching up to 4.5-6 meters on average. This Species is commonly known as Sour plum, Sea lemon, tallow wood and false wood [1]. Although native to the African tropics *Ximenia Americana* Linn is now found growing all over the world, and being used for several reasons such as, leaves and twigs for treating colds and flus, the oil for cosmetic reasons, fruits for the laxative properties, and the list is endless [1]. In many parts of the world, drought is a major problem especially for crop farmers. Identifying the genes responsible for drought tolerance capability in drought tolerant plants, will be a step further into solving this issue. The specific objective of this study was to identify the genes that are responsible for drought resistance in *Ximenia Americana* Linn. The samples were collected from Waterberg Otjiwarongo in the Otjozondjupa region and kept at -80°C until analysis. DNA was extracted from leaves using the protocol adopted by Sunil Kumar Sahu et al (2012) with a few modifications. DNA quantification was then carried out using both the Nano-drop spectrophotometer and agarose gel. The PCR amplification was done using 10 primers namely, DEG, ABA, Am421515, SSAP1, SSAP2, SSAP3, SSAP4, SSAP5, UBQ and ACT. Four of the genes, namely UBQ (Ubiquitin), ABA (Abscisic acid) and Am421515 showed bands when viewed under the UV transilluminator, indicating the presence in the genome. Two of the genes namely, Actin (ACT) and Ubiquitin (UBQ) are housekeeping genes, confirming that the DNA isolated is indeed that of a plant. The other two genes, one being abscisic acid (ABA) and Am421515 belong to the LEA-D11 and GmLEA-D11 respectively. The two genes produce dehydrin protein which is responsible in stabilization of membrane structure and protection of macromolecules in the presence of drought [2, 3]. Further studies will be required to help demonstrate that these factors are indeed the key basis for the *Ximenia Americana*’s adaptation to hot climate.

References
Antimicrobial properties of selected hydrazone based ligands and complexes

H.N.M. Namwandi, P. Kapewangolo, and C. Mukakalisa*
Department of Chemistry and Biochemistry, University of Namibia

*Author for correspondence
Email; cmukakalisa@unam.na; Tel: +264-61-2063484

Abstract
With science dealing with the prevention and treatment of diseases, the development of compounds that possess antimicrobial activity has led to scientists synthesizing hydrazones and their derivatives. Infectious diseases caused by multi-resistant microbial strains are on the increase. Hydrazones are developed to replace antibiotics that have become bacteria resistance over the past few years. This study aims at (1) screening for antimicrobial activity of 5 hydrazone based ligands and complexes, (2) evaluating the mode of action of the compounds, (3) evaluating the compounds antibiofilm abilities, and (4) determining the Minimum Inhibition Concentration. The antimicrobial activity of 5 hydrazone based ligands and complexes were evaluated against five microbial strains; Escherichia coli, Klebsiella pneumoniae, Staphylococcus aureus and Caninda albicans. Antimicrobial activity was found by using nutrient agar disc diffusion method with Gentamycin and Vancomycin serving as positive controls and DMSO as negative control and the zone of inhibition was measured in mm. The MIC was determined in the hydrazone compounds that showed some efficacy against the tested microorganisms. Antibiofilm activity for biofilm reduction and for biofilm inhibition the compounds were tested only against Staphylococcus aureus, while for the mode of action determination of the 3 compounds were tested against Candida albicans, Staphylococcus aureus and Escherichia coli. The compounds showed good activity against the tested strain with inhibition zones ranging from 10mm to 16mm. However, compounds 1 and 4 were inactive. Good MIC of $\leq 1.25\text{mg/mL}$ was recorded for compound 2 against the strains (except K. pneumoniae). The compounds showed both bacteriostatic and bactericidal abilities against the different strains. Good biofilm inhibition was recorded ranging from 79% to 81%. Low eradication is recorded ranging from 18% to 23%.

The study showed good activity for only three compounds which are compound namely; 2, 3 and 5. Further analysis, such as toxicity, should be carried out to determine their suitability for human usage.

REFERENCES
Phytochemical analysis and antioxidant potential of *Gunnera perpensa*

F.N.P Amadhila, P. Kapewangolo*

*Department of Chemistry and Biochemistry, University of Namibia*

*Author for correspondence*
Email: pkapewangolo@unam.na; Tel: +264 61 2063384

**Abstract**

*Gunnera perpensa* also known as river-pumpkin is a medicinal plant that belongs to the family Gunneraceae. It is traditionally used in South Africa to treat stomach ailments and it is also used to remove excess fluid or blood from the human body and facilitates the removal of the placenta from humans and animals after birth. The present study was designed to conduct the qualitative and quantitative phytochemical analysis of *G. perpensa* as well as to evaluate its antioxidant activity. The antioxidant activity was determined by 2,2-diphenyl-1-picrylhydrazyl (DPPH) and Ferric reducing power assays. Phytochemical screening of ethanol and ethyl acetate extracts of *G. perpensa* revealed the presence of flavonoids, phenols, tannins, saponins and glycosides. However steroids and sterols were absent in both extracts. The total phenolic content values for ethanol and ethyl acetate extracts were 16.56 ± 0.05 and 16.09 ± 0.02 mg GAE/g respectively, while for total flavonoid content the values were 0.25 ± 0.01 and 0.20 ± 0.01 mg QEE/g respectively. Ethanol and ethyl acetate extracts of *G. perpensa* exhibited good scavenging of DPPH and Ferric reducing power. For DPPH, the IC₅₀ values for ethanol and ethyl acetate extracts were 2.74 ± 0.26 and 4.51 ± 0.55 µg/ml respectively. The reducing power of *G. perpensa* extracts was found to be concentration dependent, increasing with an increase in the concentration. The results from the present study demonstrated that ethanol and ethyl acetate extracts of *G. perpensa* contain compounds with antioxidant properties.

**Keywords:** *Gunnera perpensa*, antioxidants, DPPH, reducing power.
Antimicrobial Properties of a Patent Medicinal Plant Product, TIB
(Tian Immune Booster)

R.K. Katjinaani and C. Mukakalisa*
Department of Chemistry and Biochemistry, University of Namibia

* Author for correspondence
Email: cmukakalisa@unam.na; Tel: +264-61-2063484

Abstract
Due to increased resistance of many microorganisms towards established antibiotics, investigation of the chemical compounds within traditional plants has become desirable. The use of plant products for treatment of diseases is no new idea as it has been used before the start of modern medicine. A possible solution discovered is the Tian Immune Booster (TIB), invented by Tian Shengxun, a medical practitioner based in Nairobi, Kenya. TIB (Tian Immune Booster) is a Chinese herbal extract which has proved to be useful in tackling opportunistic infections such as tuberculosis and multi-drug resistant tuberculosis which is a global threat (Simengwa et.al., 2016). Having showed activity against HIV, TIB presents itself as a potential antimicrobial agent. The study aimed at (1) screening for antimicrobial activity of TIB extracts, (2) evaluate the mode of action of these extracts and (3) evaluate the extracts anti-biofilm abilities.

Antimicrobial activity was carried out using disc diffusion method. 100 µL of four actively growing strains (*Staphylococcus aureus, Escherichia coli, Candida albicans and Klesiella pneumonia*) in nutrient broth were spread on plates containing solidified nutrient agar. The plates were allowed to stand for an hour. 10µL of each extract were used to impregnate disks. The plates were then incubated for 24 hours at 37°C. After incubation, plates were observed to see if there were any zones of inhibition present. DMSO was used as a negative control with vancomycin and gentamycin as positive controls. Minimal inhibitory concentration was determined using the same method as antimicrobial screening, with different concentrations of extracts used on the disks. About 100µL of nutrient broth was added to each well of a 96-well plate with 50µL of fresh bacterial strain adjusted to 10³ CFU/mL except for the negative control (extract in broth). 50µL of each extract was added to each well except for the positive control (bacterial suspension in broth). After incubation of the plates for 24 hours at 37°C the wells were washed with 200µL of sterile distilled water to remove planktonic bacterial cells. The developed biofilm was stained with 0.1% Crystal violet. The optical density of stained bacteria was obtained at a wavelength of 630 nm using the UV spectrophotometer. % inhibition was calculated using the following equation:

\[
\% \text{ Inhibition} = \left[ \frac{C - T}{C} \right] \times 100 \ \text{where:} \ C \text{ is the control OD and} \ T \text{ is the test OD.}
\]

For biofilm reduction or removal by extract 200µL of each strain was transferred to a pre-sterilized, 96-well polystyrene microtiter plate and incubated for 24 hours at 37°C with some wells containing only broth as the blank. The plate was then washed with distilled water to remove planktonic bacterial cells. 200µL of extract was added to each well (except for the positive control and blank) and incubated for 15 minutes at room temperature. The plates were washed to remove planktonic cells. 125 µL of 0.1% crystal violet was added to each well for staining. The plate was washed and the stain was stabilized with 200µL of 95% ethanol ant incubated for 15 minutes at room
temperature. The optical density was obtained and the percentage reduction was calculated using the following equation:

\[
\% \text{ Reduction/removal} = \left( \frac{(C-B) - (T-B)}{(C-B)} \right) \times 100,
\]

where: \( C \) is the positive control OD, \( B \) is the blank OD and \( T \) is the test OD.

For the extracts mode of action, the strains were activated overnight. 200µL of the strains were transferred in each well with 50µL of extract and the OD was measured at 620 nm. The plates were incubated at 37°C for 24 hours and the OD was read again at 620 nm. If the OD remained the same then the extract was bacteriostatic and if the OD decreased, then the extract is bactericidal. The MICs of the five extracts were organism specific and ranged from 1.0 mg/mL for extract 0 and 2 and 2.5-5.0 mg/mL for extract 1, 1.0-5.0mg/mL for extract 3 and 5.0-10.0mg/mL for extract 5. The MIC obtained were only for the extracts that showed antimicrobial and antifungal activity. The five extracts showed anti-biofilm activity against Staphylococcus aureus. The percentage inhibition for extract 0,1,2,3 and 5 were 71.3%, 62%, 64%, 65% and 65.3% respectively. Percentage reduction was higher compared to percentage inhibition with minimum percentage reduction of 81% by extract 5 and the others ranging from 91.6% to 96%. This study indicates that all five extracts have both antimicrobial and anti-biofilm properties. Considering that all the extracts have an MIC of 10mg/mL and below against all the four strains of bacteria validates that the extracts have good antimicrobial properties. The antimicrobial activity of this extracts may be due to the presence of different chemical constituents known as secondary metabolites produced by the herbs from which the extracts are obtained from. Therefore, the five extracts could be a source of potential candidates in drug development of broad antimicrobial spectrum and antifungal agent.

References
biotechnologyjournal.usamv.ro/pdf/2015/Art18.pdf

Antioxidant potential of selected hydrazone based ligands

S.N. Hâitembu, V. Uahengo, and P. Kapewangolo*
Department of Chemistry and Biochemistry, University of Namibia
Abstract
The main aim of the study was to investigate free radical scavenging properties of three hydrazone ligands. Hydrazone ligands and their derivatives are well known to exhibit a wide range of interesting biological activities, including antioxidant properties. The antioxidant activities of the three ligands were determined using 1,1-diphenyl-2-picryl hydroxyl (DPPH), hydrogen peroxide (H$_2$O$_2$) radical scavenging and the reducing power assays. Ligand 1 and 5 tested against DPPH, demonstrated good antioxidant properties, with IC$_{50}$ values of 13.41 ± 1.044 ug/mL to 29.9 ± 5.045 ug/mL, respectively. All 3 ligands also demonstrated high radical scavenging activity against H$_2$O$_2$ method with very low IC$_{50}$ values of 1.782 ± 0.2016 ug/mL, 0.0303 ± 0.0442 ug/mL and 0.502 ± 0.6652 ug/mL for ligand 1, 4 and 5 respectively. The reducing power ability of the ligands was found to be concentration dependent. This study suggests that the 3 hydrazone ligands could be potential antioxidant agents.

Key words: Hydrazone ligands, Antioxidant activity, DPPH, Reducing power, Hydrogen peroxide.

References:
Abstract
Hydrazones are Schiff base compounds or azomethines considered important in the syntheses of ligands, metal complexes and heterocyclic compounds. These compounds contain a \( R_1R_2C=NNH \) heterocyclic structure which makes them important for new drug development. Hydrazones also possess diverse pharmacological and biological activities which include, antimalarial, anti-microbial and anti-cancer activities amongst others. Five hydrazone based ligands were assayed for \textit{in vitro} inhibition against HIV-1 protease (PR) and reverse transcriptase (RT). Only two of the assayed ligands demonstrated good inhibition of more than 50\% at tested concentrations against HIV RT with IC\textsubscript{50} values of 53.69 \pm 3.80 and 59.01 \pm 6.98\,\mu g/mL for compounds 4 and 12 respectively. The assayed ligands demonstrated less than 50\% inhibition against HIV PR. This data suggests that the two hydrazone based ligands 4 and 12 have good \textit{in vitro} inhibition against HIV-1 RT enzyme, suggesting merit for further studies.

Keywords: Hydrazones; ligands; anti-HIV; HIV Protease; HIV reverse transcriptase

Nutritional evaluation of \textit{Nymphaea nouchali var. petersiana} tubers from Zambezi region

S. Simpande*, M.M. Nyambe, C. Mukakalisa
Department of Chemistry and Biochemistry, University of Namibia

*Author for correspondence
Email: malumkoolkit@gmail.com; Cell: +264813325753

Abstract
\textit{Nymphaea nouchali var. petersiana} are flowering plants commonly known as water lilies [1]. In Namibia this species is mostly found in rivers and seasonally in lakes. They produce tubers which are commonly known as Inkuma (Subia), Manhwa (Okavango) and Omavo (Oshiwambo). These tubers are considered to be a delicacy by people in Zambezi region. However, the nutritional and chemical constituents of the Namibian species tubers has not been determined. This study thus evaluated the nutritional composition of \textit{Nymphaea nouchali var. petersiana} tubers. Proximate analyses included moisture, ash, fats, crude protein, crude fiber, and carbohydrate. Minerals measured were Na, K, Ca and Mg. The results show that inkuma is a rich source of nutrients with total crude protein concentration of 0.0127mg/ml fresh tubers and 0.0828mg/g dried tubers; total carbohydrates 0.107 mg/g fresh tubers and 0.141mg/g dried tubers. Fresh tubers contained elements (mg/g) Na (10.26), K (48.97), Ca (45.09), Mg (10.63) and dried tubers (mg/g) Na (8.09), K (44.2), Ca (40.01), and Mg (9.44). This study revealed that
processing the tubers by drying enhances the protein and carbohydrate content of the tubers. The tubers are also shown to be rich sources of nutrients and minerals.

References

Extraction of some primary and secondary metabolites and Thin Layer Chromatography (TLC) from different parts of marama beans
( Tylosema esculentum)

O.N. Natanael, A. Ekandjo*, H. Hakwenye
Department of Chemistry and Biochemistry, University of Namibia

*Author for correspondence: Miss A. Ekandjo
email: aekandjo@unam.na Tel: +264813003350

Abstract
Tylosema esculentum is a drought tolerant plant and is known as Marama beans, Gemsbock beans or Tamani berry. The plant is derived from a plant family of leguminosae-caesalpinioideae[1]. It is drought resistant and an excellent source of quality proteins, oil and a source of water for humans and animals. This study focused on the metabolic profiling of drought-exposed and controlled plants of T. esculentum. The aim of the study was to grow marama beans, expose some of them to drought, water some after four days, some after eight days and others every day, to detect metabolites of different parts of T. esculentum using thin layer chromatography (TLC)[2].

Metabolites were extracted from the leaves, roots and bark of drought-exposed and control plants of T. esculentum and where screened to determine the presents of metabolites. Different metabolites such as alkaloids, saponins, flavonoids, tannins, phenolics, terpanoids, amino acids and carbohydrates were detected using TLC following the procedures adopted by M. G. Ajuru, L. F. Williams[2]. Retention factors of standards and compounds were measured and recorded. From the screening, the ethanolic extract indicated the presence of phenols, amino acids and tannins in the leaves and bark of all plants, flavonoid in both roots, leaves, bark of well-watered plants and bark and roots of the rest of the plants, saponnins in leaves and roots carbohydrates in all parts of well-watered plants and in leaves and roots of the rest of the plants. catechin for flavonoid was present in leaves, glucose and fructose were found in plant parts of well-watered ,chlorogenic and caffeic showed positive in some plant parts on TLC. Some other compounds were determined by TLC.

Further studies should be done on how to increase the TLC’s stationary phase of the plates in order to increase the length of separation, separation length is limited, which could affect the expected results.
Abstract

Plants have been used traditionally as a source of medicine for decades. Many such traditional medicines are prepared in the form of an infusion and decoction which are taken orally and commonly referred to as “tea” [1]. Of interest to this study is the use of three plants as herbal tea in the Zambezi region. Communities in Zambezi region believe that these herbal tea have health benefits. However, their phytochemical profiles have not been analysed in order to back up the traditional beliefs with scientific evidence. This study is therefore aimed to determine the phytochemical profile of the three traditional tea and compare these profiles to that of commercially available tea from *Aspalathus linearis* and *Camellia sinensis* plants that are known to have health benefits [2]. Qualitative phytochemical screening was done to test for alkaloids, anthraquinones, anthranoids, saponins, terpenes, polyphenols and flavonoids. Quantitative tests were also done for phytochemical that were present. The results show that all 5 tea contain good amounts of polyphenols which prevent damage of the body and its cells caused by free radicals. *Abrus precatorius*, *Tea R* and *Tea L* contains 40, 23 and 15μg/ml respectively. A significant amount of flavonoids were also detected in the 3 traditional tea *A. precatorius*, *Tea R* and *Tea L* with 0.0304, 0 and 0.0238g respectively. The results obtained correlated well with the literature values. For All five tea samples indicated the presences of alkaloids with commercial tea have very low quantity. Alkaloids have therapeutic effects like muscle relaxants and painkillers when consumed in small amounts, however when consumed in large quantities tend to have negative effects and can lead to toxaemia. *Tea L* contains 0.0116g/g alkaloids which are comparable to rooibos tea amount of 0.0117g/g. indicating that *Tea L* has the consumable amount of alkaloids. Saponins were also tested positive in the commercial and in the traditional tea in amounts of *Abrus precatorius* 0.0164g, *Tea R* 0.0194g, *Tea L* 0.0088g, *Rooibos* 0.0073g and *Green tea*...
0.0153g saponins are known to boost the immune system and promote normal cholesterol levels. The results reveal that the 3 traditional tea have a similar phytochemical profile to the tested commercial tea therefore they possess health benefits as believed by the local consumers in the Zambezi region.

References

Optimization of DNA extraction protocol from a local medicinal plant (Devil’s Claw)

A Thitunda*, A. Ekandjo, P. Kapolo
Department of Chemistry and Biochemistry, University of Namibia

*Author for correspondence
email; althitudaaa@gmail.com; Tel: +264812314589

Abstract
Herbal and aromatic plants are drawing attention among current plant investigators for the reason that some human diseases resulting from bacterial antibiotic oppositions have become a wide-reaching alarm [1]. Devil’s Claw also known as Harpagophytum procumbens is a Medicinal and Aromatic Plant (MAP) containing exceptionally high amounts of polysaccharides, polyphenols, tannin, hydrocolloids and other secondary metabolites such as alkaloids, flavonoids, phenols, Terpenes and quinines known to interfere with the DNA isolation procedures and the extraction of pure genomic DNA. Although there are many plant DNA isolation protocols exist, extracting DNA from Devil’s Claw is a challenging task. This study describes a rapid and reliable cetyl trimethylammonium bromide (CTAB) protocol described by Saghai-Maroof et al suited specifically for extracting DNA from plants which are rich in polysaccharides and secondary metabolites. This protocol also excludes the use of expensive liquid nitrogen and toxic phenols and can be performed in an open laboratory environment.

Degradation of DNA due to endonucleases is one of a major problem encountered in the isolation and purification of good quantity and quality of DNA from plants, the endonucleases directly or indirectly interfere with the enzymatic reactions [2]. Polysaccharides are particularly problematic when present in DNA samples, since their presence as well inhibits enzymatic activity. Presence of polysaccharides has been shown to inhibit activities of an enzyme Taq polymerase which is responsible for attaching nucleotides to a DNA template [3] and restriction enzyme activity [4]. Purity of extracted DNA was excellent as evident by A260/A280 ratio ranging from 1.79 - 2.08 which is in the range 1.8 to 2.0. DNA concentration ranged from 15.0 - 211.3 ng/μL.
Keywords: *Harpagophytum procumbens*, DNA, polyphenols, secondary metabolites, polysaccharides, medicinal plants.

References list


Phytochemical and antioxidant activity analysis of *Amaranthus thunbergii* and *Cleome gynandra*

W. N. Hatutale ¹, W. Embashu ², K. M. Kalili ¹ and K. K. Nantanga³*

¹Department of Chemistry and Biochemistry, University of Namibia
²Multi-disciplinary Research Centre, University of Namibia
³Department of Food and Technology, University of Namibia

*Author for correspondence:
Email; knantanga@gmail.com; Tel: +26461-2063241

Abstract

Phenolic compounds are known to have antioxidant, anti-microbial, anti-carcinogenic, anti-inflammatory, prevention of cardiovascular diseases, diabetes and diseases associated with oxidative stress [1]. *Cleome gynandra* and *Amaranthus thunbergii* is known amongst the Oshiwambo speaking people of the northern Namibia as *Omboga* and *Ekwakwa* respectively. They are seasonal leafy vegetables that are consumed mostly as relish either fresh or dry. There is scanty information on the condensed tannins content on the two vegetables, as well as the use of sequential extraction solvents of acetone and methanol on fresh leaves. The objective s of the study was to determine the total phenol, total flavonoid, condensed tannins content as well as the antioxidant activity and characterize the phenolic compounds of the leafy vegetables using HPLC in combination with ultraviolet (UV) spectroscopy. Fresh samples of the leafy vegetables were collected from Omusati region and transported at -4 °C. Extracts were obtained by sonication-assisted solid-liquid extraction using aqueous acetone (70%, v/v) and methanol (60%, v/v) sequentially. The total phenol content of the extracts was determined using the Folin-Ciocalteu method [2] while the total flavonoid content was determined using the aluminium chloride method [3]. The condensed tannin content was determined using the vanillin-HCl method [4] and antioxidant activity was determined using the 2, 2-diphenyl-1-picrylhydrazyl
(DPPH) assay [5, 6]. The results from this study showed that, the total phenol content differed significantly (p<0.05) between *A. thunbergii* and *C. gynandra* but there was no significant difference (p<0.05) in the total flavonoid content between the two samples. A significant difference (p<0.05) was also observed in the total condensed tannin content between the two samples. For the DPPH assay, it was found to be 0.203 ± 0.037 mg AA/g equivalent, a 43.3% inhibition for *A. thunbergii* and 0.105 ± 0.014 mg AA/g, equivalent and 52.6% inhibition for *C. gynandra*, indicating a significant difference (p<0.05) between the two species. The total phenol, total flavonoid and condensed tannin contents were found to be higher in *A. thunbergii* than in *C. gynandra*. The capacity of *A. thunbergii* to scavenge 2, 2-diphenyl-1-picrylhydrazyl (DPPH) radical is lower compared to *C. gynandra*. As expected, the radical scavenging abilities of the samples were directly correlated with the total phenol, total flavonoid and condensed tannin contents. Identification of phenolic compounds is done by comparing UV absorbance patterns and retention times of unknown peaks with standards reported in literature. By comparing the UV spectra of the standards to those of the individual extracts, the classes detected in *A. thunbergii* were hydroxybenzoic acids and hydroxycinnamic acids. Flavonol, hydroxybenzoic acids and hydroxycinnamic acids were detected in *C. gynandra*.

References

Synthesis of oximes of mono-keto curcumin derivatives and evaluation of their antioxidant and antimicrobial activity

**J. Shomeya, P. Shanika*, R. Hans and C. Mukakalisa**
*Department of Chemistry and Biochemistry, University of Namibia*
Abstract
Curcumin is a well-studied natural product for its antioxidant activities, however, due to its β-diketone moiety which is rapidly metabolized in the liver, it limits its use in the prevention and treatment of both infectious and non-infectious diseases. It has been shown to display antibacterial activity against both gram negative and gram positive bacteria and play a preventative role against pathological conditions caused by oxidative damage of DNA as well as free-radical-mediated peroxidation of membrane lipids and proteins[1-2]. Oximes are of significant interest in drug discovery and development because of their synthetic value as intermediates in various organic syntheses. It has been previously reported that oximes display potent antiviral activities with low toxicity[3]. Therefore, in the present study, a series of symmetrical mono-keto curcumin derivatives of oximes were designed, synthesized and evaluated for their antioxidant and antimicrobial activities.
The synthesis of oxime curcumin derivatives was done via the Schiff base reaction. Compared to the control, vitamin C, the synthesized analogues displayed moderate to poor in vitro antioxidant activity in the 2,2-diphenyl-1-picryl-hydrazyl free radical (DPPH) assay. Compared to the oxime derivatives, the mono-ketone curcumin intermediates displayed poor antioxidant activity with less than 40% inhibition. Good results were obtained from the in vitro antimicrobial Broth dilution test, with some compounds displaying bactericidal activity. However, none of the synthesized analogues showed in vitro antimicrobial activity against the four microbial strains - *Escherichia coli*, *Staphylococcus aureus*, *Klebsiella pneumoniae* and *Candida albicans* - tested in the Agar dilution method.

References

Synthesis of Asymmetrical Mono-Keto Curcumin Analogues and Evaluation of Their Antioxidant and Antimicrobial Activities

L. M. Kamberipa, C. Mukakalisa, R. Hans, and P. S. Shanika*
Department of Chemistry and Biochemistry, University of Namibia

*Author for correspondence
Abstract
With the development of new diseases, drug resistance, more medicines with improved efficacy, potency and safety profiles are desperately needed at a time of global ageing and expanding populations. Therefore, the natural product curcumin, exhibiting a wide range of biological activities such as antioxidant, anticancer, antimicrobial and anti-inflammatory activities, was used for further SAR exploration in this research. To improve on curcumin’s bioavailability, a series of asymmetric mono-keto curcumin analogues were synthesized via a chalcone intermediate [1]. The chalcone was synthesized by a base catalysed aldol condensation reaction of vanillin and acetone. It was then reacted with various aromatic aldehydes to form target compounds. The antioxidant activities of these target compounds were evaluated with the DPPH free radical scavenging assay. Compound 1 (Fig 1) showed good antioxidant activities with a percentage inhibition of 67%.

The Broth dilution test showed that the intermediate chalcone and six of the seven target molecules displayed bactericidal effect against *Escherichia Coli*, *Staphylococcus aureus* and *Klebsiella pneumoniae*. The synthesized analogues were characterized by GC-MS and literature melting point data.

References

Antioxidant potential of patent medicinal plant products,
Tian Immune Booster (TIB)

N.V. Ndozi-Okia, P. Kapewangolo*
Department of Chemistry and Biochemistry, University of Namibia

*Author of correspondence
Email: pkapewangolo@unam.na; Tel.: +264 61 2063384

Abstract
Tian Immune Booster (TIB) is a Chinese herbal medication used clinically in central Africa, mostly in Kenya, to treat amongst others Human Immunodeficiency Virus by reducing the
replication of the virus. TIB is also used for anticancer therapy and a number of other ailments. The present study investigated the antioxidant potential of TIB extracts by employing 2,2-diphenyl-1-picrylhydrazyl (DPPH), ferric reducing power and hydrogen peroxide (H₂O₂) scavenging assays. The extracts demonstrated good antioxidant activity with 50% inhibitory concentrations that ranged from 21.54 - 176.5 µg/mL for DPPH and 12.53 - 68.76 µg/mL for H₂O₂. The reducing power of TIB extracts increased as the concentration increased which confirmed the presence of antioxidants in the extracts. These findings suggest that TIB extracts has good in vitro antioxidant activity, which may attribute to its traditional success.

**Keywords**: Tian Immune Booster, antioxidant activity

---

**Synthesis of symmetrical mono-keto curcumin derivatives and evaluation of their antioxidant and antimicrobial activities**

B. Chunga, C. Mukakalisa, R. Hans and P Shanika*

*Department of Chemistry and Biochemistry, University of Namibia*

*Author for correspondence*

Email address: pshanika@unam.na | Tel: +264 621 206 4590

**Abstract**

Curcumin is the natural product scaffold selected for this study because of its low molecular weight, minimal toxicity and reports on its anticancer, antitumor, anti-inflammatory, antioxidant and antimicrobial activities [1]. However, curcumin is associated with structural instability, first pass metabolism and low systematic bioavailability, therefore various diketo curcumin and mono-keto curcumin analogues have been synthesised to optimise the pharmacokinetic and activity profile of curcumin analogues [2]. Oxidative stress resulting from the disruption of the balance between reactive oxygen species or free radicals and anti-oxidants play a role in the pathophysiology of diseases such as cancer, diabetes, Alzheimer’s and cardiovascular diseases [3]. Antioxidant drug discovery is aimed at sourcing compounds to prevent and treat these diseases and is an area of active research. In addition, bacterial resistance to the antimicrobial agents poses a serious threat to public health. The objective of this study is therefore to synthesize symmetrical mono-keto curcumin analogues and evaluate them for their antioxidant and antimicrobial activity.

The target compounds were obtained via the Claisen-Schmidt condensation reaction between acetone and benzaldehyde derivatives and were partially characterized using GC-MS analysis. All synthesized compounds were then evaluated for their in vitro free radical scavenging properties in the 2,2-diphenyl-1-picryl free radical (DPPH) assay and ascorbic acid was used as the control. Analogues with hydroxy-groups on the aromatic ring displayed moderated to good antioxidant activity with percentage inhibition ranging between 39-71% which is less than the 85% inhibition recorded for ascorbic acid. Bactericidal activity against *Klebsiella pneumoniae* was detected for four of the eight target molecules synthesized, with the Broth dilution assay.
The results suggested that the symmetrical mono-keto curcumin analogues do have potential as antioxidant and antimicrobial agents and can serve as lead compounds in a curcumin-based drug development program.

References

**Phytochemical screening and antimicrobial susceptibility testing of *Eucalyptus dalrympleana* leaf extracts**

D. Nanhapo, M. Nyambe, M. K. Hailume, N. N. N. Nandjebo*

Department of chemistry and biochemistry, University of Namibia

*Author for correspondence*
Email: pewanadjebo95@gmail.com; Tel: +246-81-448 5783

**Abstract**

*Eucalyptus dalrympleana* is medicinal plant from the genus *Eucalyptus*, and of *Myrtaceae* family. The plant is originally from Australia, and widely distributed throughout the world and comprise of about 800 species of tall trees. They primarily grew for timber, paper pulp and volatile oil purposes. Apart from the aforementioned purposes, the leaves and oil from *E. dalrympleana* are traditionally used by indigenous people as herbal remedy to relief respiratory ailments and feverish conditions such as asthma, bronchitis, coughs, diarrhoea and flu as well as for skin problems like burns, ulcers, and wounds.

Transformation of natural products from plants as herbal remedies, is a great inspiration on research; therefore the study focused on extraction of five (5) crude extracts from the leaves of *E. dalrympleana*, using different solvents (hexane, dichloromethane (DCM), methanol (MeOH), water and mixture of DCM: MeOH) in order of increasing their polarity. Phytochemical screening on the plant extract revealed the presence of some biochemical compounds such as saponins, alkaloids, phenolic, tannins, and flavonoids. Screening on the 5 extracts, only MeOH and DCM: MeOH extracts showed promising results although, all the five extracts were tested for antimicrobial activity against microbial strains such *Klesbscilla pneumonia* (ATCC 13883), *Staphylococcus aureus* (ATCC 25923), *Escherichia coli* (ATCC 25922) and *Candida albicans* (ATCC 10231) through disk diffusion method. A mixture of DCM: MeOH extract shows a great inhibition against growth of all the aforementioned strains. Quantification of biochemical
compounds reveal the presence of flavonoids as most abundantly in DCM: MeOH extract (40.8558g) and least in MeOH extract (27.0636g), followed by saponins which reported to be in low quantity in DCM: MeOH (2.4088g) and high quantity in MeOH (3.5750g). Alkaloids, tannins and phenolic compounds were present in small amounts as follow; in plant material (1.5258g), DCM: MeOH extract (0.03185g) and MeOH extract (0.03027g). Since flavonoids are present in large amount in comparison to other compounds, it is concluded that flavonoids are responsible for the antimicrobial activity shown by the mentioned extracts.

References

Monomeric composition of polysaccharides from selected Namibian legumes using thin layer chromatography

E. F. Kaudinge, H. Stuurmann and K. M. Kalili*
Department of Chemistry and Biochemistry, University of Namibia
Department of Biological Sciences, University of Namibia

*Author for correspondence
Email: kkalili@unam.na; Tel: +264-61 206 3589

Abstract
Polysaccharides are complex polymeric carbohydrate molecules consisting of a large number of monosaccharide units bound together by glycosidic linkages [1]. Natural polysaccharides from different sources have long been studied and widely used in different applications such as food, medicine, pharmaceutics and papermaking. The current study aimed to isolate and determine the monomeric composition of the polysaccharides from the seeds of four native Namibian legumes. Polysaccharides were extracted from the powdered seed endosperms by means of precipitation with ethanol followed by filtration. Individual monomeric units were obtained through cleavage of the glycosidic bonds using hydrochloric and sulphuric acids. Degradation products were analysed using thin layer chromatography (TLC) and high performance liquid chromatography.
(HPLC). In TLC, optimal separation of individual sugar standards was achieved on silica gel using a mobile phase based on ethyl acetate, propanol, acetic acid and water. Attempts to use HPLC as an alternative technique for the determination of the polysaccharide monomeric compositions did not yield any results with UV detection at 190 nm and suitable derivatisation reagents were not available in the department to allow UV detection at other wavelengths. HCl proved to be a better hydrolysis reagent for polysaccharides than sulphuric acid, although the HCl hydrolysis products were poorly separated resulting in inconclusiveness with regard to the monomeric compositions of the samples of interest. In conclusion, it can be said that TLC provided good separations for the individual sugar standards with the tested mobile phases and the results indicate presence of carbohydrates in the samples of interest even though the exact monomeric compositions of the extracts could not be established. Future studies should explore the option of derivatising the sugars before or after the column as this method would provide more conclusive results regarding the success of the hydrolysis methods and monomeric compositions of the polysaccharide extracts.

References

Synthesis of Mannich Bases of Mono-Keto Curcumin Derivatives and Evaluation of their Antioxidant and Antimicrobial Activity

K. Handunge, R. H. Hans, P. Shanika*, and C. Mukakalisa
Department of Chemistry and Biochemistry, University of Namibia

*Author for correspondence
Email address: pshanika@unam.na | Tel: 061 2064590

Abstract
Studies have shown that curcumin is a powerful free radical neutralizer that supports a balanced immune function. However, reports have shown that curcumin undergoes rapid metabolism which accounts for its reduced general bioavailability [1]. Drug design strategies aimed at circumventing the rapid metabolism of curcumin lead to the metabolically more stable and biologically active mono-ketone curcumin analogues which are the focus for this study [1,2]. Mannich bases act as pharmacophores and serve as starting material for medicinal agents [3]. Despite the many applications of Mannich bases the synthesis of mannich base, mono-keto curcumin derivatives are relatively unexplored. This study therefore aims to design and synthesize mono- and bis-mannich bases (fig. 1) of mono-keto curcumin derivatives and to evaluate their antioxidant and antimicrobial activities.
Figure 1. General structure of Mannich bases (target molecules)
The intermediate was obtained by reacting acetone and vanillin via the Claisen-Schmidt condensation reaction. The Mannich reaction of the mono-keto curcumin intermediate with the iminium ion, formed by the condensation of various secondary amines and paraformaldehyde, afforded a mixture of products. Five of the synthesized compounds including the intermediate (mono-keto curcumin) were tested for their antioxidant as well as antimicrobial activity against *Escherichia coli*, *Staphylococcus aureus*, *Klebsiella pneumoniae* and *Candida albicans*. Bacteriostatic activity against *Klebsiella pneumoniae* was detected for two of the five tested compounds with the Broth dilution assay. Results from the DPPH assay showed that all the tested compounds, including the intermediate mono-keto curcumin analogue, displayed antioxidant activity albeit less potent compared to the positive control, vitamin C (94% inhibition).

References

Physicochemical properties of polysaccharides from selected indigenous Namibian legumes

V. N. Nghidipa¹, H. Stuurmann² and K. M. Kalili¹*
¹Department of Chemistry and Biochemistry, University of Namibia
²Division of Science and Technology, Multidisciplinary Research Centre

*Author for correspondence
Email: kkalili@unam.na; Tel: +264-61 206 3589

Abstract
This paper reports on the physicochemical characteristics of the polysaccharides extracted from the seeds of four indigenous Namibian legumes. The seeds were homogenised, extracted and
purified by precipitation with ethanol to yield a white, fluffy extract. Solubility of the extracts was tested using organic and inorganic solvents at temperatures ranging between 10 and 90 °C. The polysaccharide samples were not soluble in the selected polar and non-polar organic solvents, but do dissociate in water and inorganic solvents forming viscous solutions. As expected, solubility was found to increase with temperature. All extracts exhibited water holding capacities greater than 1 g/g of the extract, but the water holding capacities of the extracts were significantly lower compared to the commercial polysaccharide (Xanthan gum), which was found to have a water holding capacity of 14 g/g of sample. Furthermore, the intrinsic viscosity of the extracts obtained using the Billmeyer equations [1] was in the range 9.5 dL/g>ƞ>11 dL/g, which were significantly lower compared to the commercial gum, which had an intrinsic viscosity of 94.85 dL/g at the measured concentration of 0.08 g/dL. Specific gravity of a 1% gum solution was obtained by taking the ratio of the density of the gum solution to that of the solvent (water). The calculated specific densities were close to that of water. The optical rotation results indicate that the samples were dextrorotatory before addition of HCl and became levorotatory after addition of HCl. The change in optical rotation of the sample solutions suggests that the sugars underwent mutarotation, which is an indication that these carbohydrates can be digested by enzymes in the human body [1]. This implies that the polysaccharides can be used as additives in food and medicines, e.g. weight loss food products to reduce appetite and relieve constipation and related chronic functional bowel ailments [1,2]. In conclusion, the study contributed additional data to the profiles of these plants although the physicochemical properties were not studied exhaustively within the timeframe of the project.

References

**Qualitative Structure Property Relationship (QSPR) Study Of Edaravone: A New Drug Molecule for Treating Amyotrophic Lateral Sclerosis (ALS)**

**F.V.N Jakob**, **C. Maritz** and **Edet F. Archibong**

1Department of Chemistry and Biochemistry, University of Namibia, Windhoek, Namibia
2Department of Pharmaceutical Chemistry, University of Namibia, Windhoek, Namibia

*Author for correspondence*
Email; nfnambinga@gmail.com Cell +264-81-8247800

**Abstract**
Amyotrophic lateral sclerosis (ALS) is a rare disease involving selective and progressive degeneration and disappearance of motor neurons. As with other neurodegenerative diseases, the pathobiology of ALS is not well understood, but it is believed that oxidative stress caused by free radicals contribute to its pathogenesis. RADICAVA™ is a prescription medicine used to treat people with ALS. It is administered in form of an injection. The active ingredient in RADICAVA is Edaravone, a free radical scavenger of peroxyl radicals and peroxynitrite. Edaravone has been shown to inhibit motor neuron death by reducing oxidative stress. Patients taking this drug experience common side effects such as allergic reactions, difficult breathing, feeling light-headed, and renal dysfunction. The drug only helps serve a person’s function longer but does not stop the underlying disease mechanism from occurring in motor neurons. The present study was undertaken to study the Qualitative Structure Property Relationship (QSPR) of Edaravone as a new drug for treating ALS. We aim to compute analogues of Edaravone, study their physiochemical properties and gain knowledge on how they might improve Edaravone’s activity. The calculations were performed on Spartan software using Merck Molecular Force Field (MMFF) and MO6 variant of Density Functional Theory (DFT). Seventeen (17) analogues were obtained using a Craig Plot. Statistical analysis on QSAR results were carried out using R-program to obtain the Regression Coefficient ($R^2$), adjusted $R^2$, Bayesian Information Criterion (BIC), and P-value. The best model has a BIC of -21.8398 and $R^2$ of 0.879. These results indicate that lipophilicity, polarizability, dipole moment and ovality play important role in the drug’s activity. Lastly, water-Edaravone complexes were studied by interacting one and two water molecules with Edaravone molecule via hydrogen bonding.

Fig 1. From left to right: Edaravone, Br Edaravone analogue and Edaravone-water complex showing hydrogen bonding.

References
Quantitative Structure Property Relationship (QSPR) Studies of Galeterone:
A New Drug For The Treatment of Prostate cancer

J.N. Nande1*, C.Y. Maritz1, Edet F. Archibong2,
1Department of Chemistry and Biochemistry, University of Namibia, Windhoek, Namibia
2Department of Pharmaceutical Chemistry, University of Namibia, Windhoek, Namibia

*Author for correspondence
nandejohannesc@gmail.com, cell: +264812553171

Abstract
Prostate cancer is a life threatening disease associated with men and it is believed to be the third most common cause of cancer-related deaths in men. Prostate cancer is not easy to treat. However, the use of new agents like androgen receptor-targeted drugs abiraterone and enzalutamide, have resulted in substantial improvements in value of life and survival of patients battling prostate. Galeterone is a new drug molecule. It is an effective anti-androgen drug candidate that is about to enter pivotal phase III clinical trials for the treatment of prostate cancer. As with many drugs, optimization of Galeterone as a lead is an important step towards development of possible desired analogues. This project focuses on optimising Galeterone and analysing properties of different analogues and assessing their drug-favourability characteristics. The computations were done in vacuum using Merck Molecular Force Field (MMFF) and B3LYP variant of the Density Functional Theory (DFT). For the latter, the 6-31G* bases set was used. In addition to the QSPR studies, the interaction of Galeterone with water molecules was also investigated using the MMFF and DFT approximations.

The best model obtained in this study using ClogP as the dependent variable combines the Hammett constant, lipophilicity constant and ovality with R^2 of 0.885, adjusted R^2 of 0.854 and BIC of -21.6.

References

Waste water treatment using activated carbon from Banana peels at different temperature

R. Ateeq, D. Nanhapo, J. Ndashivika*
Department of Chemistry and Biochemistry, University of Namibia

*Author for correspondence
Email: arahman@unam.na; Tel: +264612063111

Abstract
Water pollution has a negative effect on environmental, health is one of the greatest challenges globally. The Presence of dyes in plastics, cosmetic, pharmaceutical, food and other industries generates huge volume of wastewater every year. Given that Namibia is a dry country and contamination of water doesn’t make it any better. Hence due to low rainfalls in Namibia, the treatment of contaminated water will benefit people countrywide, and will provide another process of clean water supply in term of hygiene and free people from common diseases. It was reported that residents of Omahahi village in Ohangwena Region, Namibia, have been eagerly trying for clean water for 25 years. Though it has not yet been tried at large scale, the Banana peels activated Carbon could successfully remove different contaminants from waste/dirty water, such as dyes, salts and Organic wastes from Gammams waste water dam as proved in this project. Initially, the contaminated water samples were analyzed for pH, color, concentrations of metals and non-metal elements. Then about 5.25 g of sample will be mixed with 300 ml of water sample in a beaker. It would be stirred for about 4 hours at room temperature. The properties of the carbon samples on average include moisture content of 9.75%, volatile matter of 10.56%, and
ash content of 8% on average. Sample has an x/m of 403.63 mg/g and a C 0.063, B has the x/m value of 426.36 with C of C 0.0604, and sample C has x/m 501.70 mg/g and C 0.055. Where x/m is the iodide absorbed per gram of carbon mg/g and C is the residual filtrate. All these enable to calculate Iodine number. Hence, activated carbon obtained from waste banana peel is an environmental green approach for treatment of waste water.

REFERENCES

Protein diversity between drought exposed and well-watered plants of Marama bean (Tylosema esulentum).

M. Kahiriri, C. Mukakalisa and A. Ekandjo*
Department of Chemistry and Biochemistry, University of Namibia

*Author for correspondence
email; aekandjo@unam.na; Tel: +264-61-2063114

Abstract
Marama bean, or scientifically known as Tylosema esulentum, is a plant that grows in Sub-Saharan Africa mainly in counties such as Namibia, Botswana and South Africa where little precipitation normally occur. The plant is adapted to its drought resistance ability due to its leathery leaves and stems of up to 3m and roots that store water even in dry season for its survival. The specific objectives were to grow marama bean under different conditions, extract and quantify protein from roots, bark and leaves of drought exposed and well-watered marama bean plants, and to observe and compare the protein diversity of the extracted protein and provide information for other researchers. Firstly, the seedlings of the marama bean were grown in the University of Namibia greenhouse under different conditions (well-watered plants, plants deprived of water for 4 days, plants deprived of water for 8 days and plants left to wilt) from two different site (Epukiro and Osire). Relative water content (RWC) was done on wilting plants to measure the leaves hydration status. Secondly, protein extraction was done in leaves, roots and bark as illustrated by the protein extraction protocol adopted by Milca B. Vilhena et al (2015) with few modifications followed by the standard biuret assay adopted by Z. Galewska at al (2013) to determine protein concentration using Bovine serum albumin (BSA) as a standard. In addition, protein hydrolysis and visualization of hydro-lysate on TLC adopted by C. Mukakalisa (2011) was followed. Results showed a significant difference in proteins found in well-watered plants compared to the drought exposed (e.g. well-watered leaf from Osire 91.3 mg/ml vs 13.0 mg/ml wilting leaf from Osire) with roots having the highest protein content overall. However,
the hindrance of amino acids incorporation have been considered in water-stressed plants and the presence of proline and aspartate found in wilting plants (from both sites) which showed a significant difference to that of plants deprived of water for 8 days as well as well-watered plants. In plants, proline acts as an osmolyte as well as a protein synthesizer when a plant is exposed to harsh conditions while aspartic acid acts as a common precursor in the synthesis of essential amino acids (e.g. lysine, isoleucine etc.). Since cells in water-stressed and well-watered plants are adopted to different environments for survival, it should be taken into account that their biological activities will be significantly different. Therefore, identifying enzymes whose activities are most grievously hindered by water stressed plants will be intriguing and can give more clarity on the two conditions. Further studies can be done by performing the SDS-PAGE to visualize bends of different proteins and their sizes.

References

Synthesis of pyrimidine derivatives using mono-keto curcumin analogues as precursors and the evaluation of their antimicrobial and antioxidant activities

S. Mulife, C. Mukakalisa, R. Hans, P. Shanika*
Department of Chemistry and Biochemistry, University of Namibia

*Author for correspondence
Email address: pshanika@unam.na | Tel: +264 61 206 4590

Abstract
Natural products are vital in drug discovery and continue to be the main source of novel compounds with therapeutic potential. Curcinum is a hydrophobic polyphenol derived from the rhizome of the herb Curcuma longa Linn (turmeric) which is naturally found in India and used as traditional medicine [1]. The pyrimidine nucleus is a structural component of nucleic acids and derivatives containing this moiety reportedly display antimicrobial, antioxidant, antitumor, antimalarial, antiHIV and anti-inflammatory activity [2]. In this study, the intermediate monoketone analogues a (fig. 1) were prepared using the Claisen-Schmidt condensation reaction with methanolic NaOH as catalyst. A condensation reaction of the intermediate a with urea, thiourea, and guanidine hydrochloride, respectively, afforded pyrimidine derivatives b (fig. 1, [3]), which
were subjected to antioxidant activity and antimicrobial activity testing using the 1,1-diphenyl-2-picyrlhydrazyl (DPPH) and Broth dilution assays, respectively.

\[\text{Reagents and conditions: (i) NaOH, MeOH, (ii) EtOH, HCl}\]

The structure of the synthesized compounds were tentatively confirmed using gas chromatography-mass spectrometry (GC-MS) analysis and the biological result revealed that the pyrimidine derivatives b are more against microbial strains (Escherichia coli, Staphylococcus aureus, Klebsiella pneumoniae, and Candida albicans) compared to the intermediates a. The results further confirmed the potential of pyrimidine derivatives as potential lead compounds for microbial drug research.

References

Characterization and antioxidant activity of crude protein extracted from different landraces of Bambara groundnut seeds

J.P Hango, A. Ekandjo, and C. Mukakalisa*
Department of Chemistry and Biochemistry, University of Namibia

*Author for correspondence
email: cmukakalisa@unam.na; Tel: +264-61-2063484

Abstract
Bambara groundnut is a popular herbaceous with creeping stems at ground level crop in the whole of Sub-Saharan Africa and its scientific name is called, Vigna subterranea. Antioxidants
are any substances that significantly delay or inhibit oxidation of a substrate (lipid and other biomolecules), by preventing inhibition of oxidizing chain reactions by radicals or through quenching the propagation of those chain reactions. This study was focused on four different landraces of Bambara groundnuts namely known as; S.19/3(Black), Unisma Red, KFBN0116 and KFBN0105.

The study aimed at evaluating the quality of protein from the different landraces of Bambara groundnut; specific objectives were: (1) extraction of crude protein from four different Bambara groundnut seeds, (2) quantification of extracted protein, (3) screening for the presence of essential amino acids in extracted protein, and (4) evaluating antioxidant activity of extracted crude protein.

The seeds were obtained from the department’s seed store; they were ground into fine powder and dispersed in water (1:10 w/v). The extraction was done using pH variation method (1M NaOH and 1M HCl solutions for pH regulation) and the precipitated protein was then purified with cold acetone and the yield was recorded. Protein was quantified using the biuret test with bovine serum albumin (BSA) as a protein standard. A calibration curve was prepared and concentrations of protein in the samples were obtained using the standard graph equation. Protein was hydrolysed in 6M HCl containing 0.1% phenol and lysate were run on TLC using n-butanol: acetic acid: water [3:1:1] as a mobile phase along with amino acid standards.

Different antioxidant assays were also carried out, namely; radical scavenging (DPPH), nitric oxide method and reducing power. Ascorbic acid was used as a positive control in all these assays and IC50 values were recorded. The crude protein yields obtained for the different landraces were; S.19/3(Black):41%, Unisma Red: 54%, KFBN0116: 55% and KFBN0105: 64%.

The concentration based on biuret test showed that KFBN0105 had the highest protein concentration of about 117 mg/dry mass while KFBN0116 and Red had 108 mg/dry mass and lastly Black that had 105 mg/dry mass concentration. The TLC profile showed the presence of all plotted essential amino acids (Histidine, isoleucine, leucine, lysine, methionine, phenylalanine, threonine and tryptophan) in the protein samples.

To conclude, Red sample had the highest % inhibition and lowest IC50 in DPPH assay. Black had the highest % inhibition in nitric oxide assay although KFBNO116 had the lowest IC50 value. Red sample also showed the highest concentration (mg/ml) based on the reducing power assay compared to other three samples.

References
An investigation on the presence of parasite eggs along the Goreangab Dam

L. U. Heita¹, M. C. Tjiurutue¹, and E. Haindongo²*
¹Department of Chemistry and Biochemistry, University of Namibia
²Department of Biochemistry and Microbiology, University of Namibia

email; ehaindongo@unam.na; Tel: +264-61-2065043

Abstract
The Goreangab dam on the outskirts of Windhoek may be the most reliable source of water for residents living in that area. The water from the dam and the riverbeds that flow into the dam may not be good for human consumption and may cause serious health risks such as infections by parasite eggs. These infections could be explained by the anthropogenic activities that take place along the dam. To ensure that the people living in the informal settlement of the Goreangab dam are using clean water, an investigation was done focusing on the presence of parasite eggs in the dam water, riverbeds and soil, because most parasites are most infectious as eggs. This was done by identifying various eggs in both soil and water samples, and comparing proportions of eggs along the various sampling locations. Water and soil samples were collected from three different locations, whereas the first and the second location was near the residential area, while the third location was the recreational area of the Goreangab dam. The sugar flotation method was done for both samples, whereby the prepared solution mixtures contained Sheather’s sugar solution, followed by centrifugation. This was done for the eggs to float and obtain them for microscopic examination using a light microscope. Differential diagnosis was done to identify the eggs. Embryonated eggs such as Hymenolepis nana was identified as well as the Schistosome egg and Trichuris eggs which were more compared to the two species mentioned. These eggs were found in locations close to the residential areas. The parasite eggs favour mild and humid climates like the rainy seasons and thus areas would increase the abundance of different species of the eggs. It would be more relevant to have a lot of samples for the study and the right tools to differentiate true parasite eggs from artifacts.

References
[1] Goreangab residents use contaminated water.
[3] Sheather’s flotation Solution
Investigating the antimicrobial properties of selected hydrazone based ligands

E. N. Iita, P. Kapewangolo, and C. Mukakalisa*
Department of Chemistry and Biochemistry, University of Namibia

*Author for correspondence
Email: cmukakalisa@unam.na; Tel: +264-61-2063484

Abstract
Hydrazones are organic compounds, with an azomethine –NHN=CH- group. They are derived from the reaction of hydrazines or hydrazides with aldehydes or ketones. Azomethine group contains carbon and nitrogen active atoms, which are responsible for the physical and chemical properties of hydrazones. Furthermore, hydrazone compounds are known to have different biological activities such as, anti-bacterial and antifungal, amongst others. The study was aimed to (1) screen for antimicrobial activity of the selected hydrazone based ligands and to (2) evaluate the compounds for antibiofilm abilities. The study was done by (1) screening the compounds for antimicrobial activities. The compounds that showed activities were tested further using the (2) minimum inhibition concentration method using five different concentrations. The zones of inhibition of the above two methods were measured. The four strains namely Staphylococcus aureus, Escherichia coli, Klebsiella pneumonia and Candida albicans were (3) Screened for the biofilm production, (4) the abilities of compounds to inhibit the biofilm formed was tested, and finally (5) the compounds were analysed for their ability to remove the biofilm formed. To determine the degree of biofilms, the optical densities were measured at 630 nm in a UV spectrophotometer. The screening of antimicrobial activities against the four microbial strains showed that, compound 1, 5, and 7 did not have the antimicrobial properties, compound 12 indicated positive antimicrobial activities against the four strains while compound 8 only showed activity against K. pneumonia and C. albicans. Both compound 8 and 12 against the strains used, gave the MIC of 1.25 mg/ml, except for compound 8 against C. albicans which gave the MIC of 2.5 mg/ml. Compound 8 with (75%, 64%) was more effective against C. albicans in both biofilm inhibition and eradication than compound 12 with (62%, 23%). Compound 12 with 62 % was slightly more effective against C. albicans in comparison to other strains (S. Aureus (59) and E. coli (58)). In conclusion, compound 12 gave greater antimicrobial activities while compound 8 gave stronger antibiofilm properties. As the antimicrobial resistance continues to be the global issue in health sectors, the potential hydrazone compounds with different biological activities are still to be designed and synthesised.

References
Characterization of Ag/TiO$_2$ composite thin films

J.T. Shuuya and L.S. Daniel
Department of Chemistry and Biochemistry, University of Namibia

* Corresponding author
Email: daniels@unam.na; Tel: +264-81-6067609

Abstract
In this study, pure TiO$_2$ (100% Titania precursor solution (S$_{Ti}$)), pure Ag (100% silver precursor solution (S$_{Ag}$)) thin films and Ag/TiO$_2$ composite thin film or COMP-Ag50 (a mixture of 50% S$_{Ti}$ and 50% S$_{Ag}$), were fabricated by the application of the Molecular Precursor Method (MPM). The thin films were fabricated by heat-treating the precursor film spin-coated on a quartz glass substrate with the mixed of required precursor solutions, at 600$^\circ$C in air for 30 minutes [1, 2]. The crystal structure, chemical composition and surface morphology of the thin films were investigated by using X-Ray Diffraction (XRD), Field emission scanning electron microscopy (FE-SEM) and Energy Dispersive X-ray spectroscopy (EDS), respectively. On the basis of the XRD results, the Ag/TiO$_2$ composite thin film (COMP-Ag50) was found to consist of a mixture of two phases of Titania (rutile and anatase). The correlation between the elemental mapping and EDX spectrum of the composite thin film, shows the presence of carbon (C), silver (Ag), titanium (Ti) and Silicon (Si) in the thin films, with which the presence of Carbon and silicon obviously arise from the quarts glass [2-4]. The FE-SEM results revealed that, Ag/TiO$_2$ composite thin film (COMP-Ag50) shows three different shapes (black spots; sub-rounded (Ag-Np), white spots; spherical and rod-like which can be either crystals of rutile or anatase), identical size (0.5-1.0 nm) that are randomly distributed.

References
Photochromic Properties of Silver/Titania Composite Thin Films
Characterization of Ag/TiO₂ composite thin films

J. TI Shaalukeni and L.S. Daniel
Department of Chemistry and Biochemistry, University of Namibia

* Corresponding author
Email: daniels@unam.na; Tel: +264-81-6067609

Abstract
In order to investigate the photochromic property of Ag-nanoparticle/titania composite thin films, metallic Ag-nanoparticle/titania (Ag-NP/TiO₂) composite thin films, with different concentration of silver (0.00 ≤ Ag% ≤ 100) to titania, were fabricated on a quartz glass substrate at 600°C using the molecular precursor method. Respective precursor solutions for Ag nanoparticles and titania were prepared from Ag salt and a titanium complex. The photochromic property of fabricated thin films was investigated using UV/Vis spectrometer after keeping the thin film under the dark and also after exposed the fabricated thin film under light. All the composite thin films samples exhibited a significant change in color after a number of exposures which increase with further light exposure. It could be deduced that the photochromic properties observed are based on the reversible growth and dissociation of silver nanoparticles within the titania matrix. The fabricated thin films have the potential to be used for shade arrangement (mostly for sun glasses formation) and as well as in reflect generation industry (mostly in mirror production industry).

Figure 1. Absorption spectra the fabricated thin films after exposed to (a) dark and (b) to light for 1hour.

Carbohydrates in the mesocarp and phytochemicals in the peels of unripe and ripe Oongongo (Sclerocarya birrea) and Oonyandi (Diospyros mespiliformis) fruits

L.N. Amupala1, W. Embashu2, K. Nantanga3*, M. Kandawa-Schulz1
1Department of Chemistry and Biochemistry, Faculty of Science, University of Namibia
2Science and Technology Division, Multidisciplinary Research Center, University of Namibia
3Department of Food Science and Technology, Faculty of Agriculture and Natural Resources, University of Namibia

*Author for correspondence:
kantanga@unam.na; Tel: +264 61 206 3241; Fax: +264 61 206 3013

Abstract
Fruits and vegetables are common in diets of humans. Some fruits have been commercially harvested and sold, especially in developed nations. In developing nations, indigenous fruits and vegetables are commonly locally consumed but hardly commercialised. In Namibia, a number of indigenous fruit trees are part of the agro-silvi-pastoral system of farming. Among these are Marula (Sclerocarya birrea) and Jackal berry (Diospyros mespiliformis) bearing trees. Their fruits are important to the livelihoods of most rural communities. The nutrient content of ripe Oongongo and Oonyandi [1, 2] and the phytochemical content of the Marula juice [3] have been studied. However, there is no data in literature on the type of sugars in the mesocarp of these fruits before and when they are ripe for human consumption. It is generally reported that phytochemicals are usually concentrated in the outer layers (peels) of the fruits [4]. There is also no information in literature on the phytochemical composition in the peels of these fruits, when unripe and when ripe. Therefore, this study explored the type of sugars and phytochemicals present in the mesocarp and peels, respectively of Oongongo and Oonyandi. It also determined the amount of moisture and reducing sugars using the Nelson-Somogyi method [5] in the mesocarp of unripe and ripe Oongongo and Oonyandi.

The moisture contents were determined which was 73% for ripe Oonyandi, 59% for unripe Oonyandi, 93% for ripe Oongongo and 71% for unripe Oongongo. The qualitative tests revealed the presence of monosaccharides, in both ripe and unripe of all the fruits investigated. Starch was not present in all fruits, ripe or unripe. The phytochemical analysis revealed the presence of terpenoids, flavonoids and quinones in both ripe and unripe of all the studied fruits. Alkaloids were not present in all fruits. The concentration of reducing sugar of ripe Oonyandi was 32.11 mg/mL and that of unripe Oonyandi was 16.70 mg/mL, ripe Oongongo had a reducing sugar content of 97.03 mg/mL and unripe Oongongo had 14.88 mg/mL. This indicates that ripe fruits had a higher reducing sugar content than unripe fruits for both Oongongo and Oonyandi.

Keywords: Phytochemicals; tannins; sugars; indigenous fruits; Sclerocarya birrea: Diospyros mespiliformis

References
Chemical analysis of *Diospyros lycioides* Roots and Stems

**L. N. Wanaango*, C. V. Raidron**

*Department of Chemistry and Biochemistry, University of Namibia*

*Author for correspondence*
Email; luiselozzenly@gmail.com; Cell: +264 814725487

**Abstract**

*Diospyros lycioides* is commonly known as Bluebush, Star-apple or Monkey plum in English and this plant has a wide range of local uses, for food, medicine and various commodities. The roots and stems of this plant are used traditionally as herbal medicine for various human diseases e.g. colds, coughs, abdominal pains and infertility in women.

This study aimed to isolate compounds from organic and aqueous extracts of the roots and stems of *D. lycioides* and also to determine the bioactivity of the purified fractions obtained.

The roots and stems of *D. lycioides* were collected from Tsumkwe, a settlement in the Otjozondjupa Region in Namibia. Samples were dried at room temperature, finely ground and stored in dark glass bottles at room temperature until further analyses. Known masses of the roots and stems were extracted sequentially starting with hexane followed by ethyl acetate, then methanol and finally with water. The organic and aqueous crude extracts obtained were concentrated at 40 °C using a Büchi rotary evaporator and dried under vacuum in a desiccator. Thin-layer chromatography (TLC) screening was performed for all aqueous and organic extracts. Vanillin was used to stain the plates. The methanol extract of the stems displayed the best separation profile and was used for preparative TLC and the mobile phase was 6:2:1 dichloromethane: methanol: water. Three main fractions were obtained and the antioxidant activity was evaluated for fraction 1 (top layer) using 2, 2-diphenyl-1-picryl-hydrazyl (DPPH) free radical scavenging assay and ascorbic acid was used as reference. Absorbance was measured at 517 nm using a plate reader (brand). Data was collected in duplicate and recorded as IC$_{50}$. A good scavenging capacity of the fraction was obtained, with inhibition ranging from 48% to 92%
which is comparable to the standard ascorbic acid which showed inhibition of up to 85% at the highest concentration. The fraction showed a good activity with IC$_{50}$ of 41.43 µg/mL.

The results of this study support the ethnomedicinal use of this plant, however further studies to confirm the safe use of the plant are recommended.

References

Extraction of alkaloids from Nymphaea nouchali var. petersiana from Zambezi Region, of Namibia

M. Ntinda, M.M. Nyambe, and P. Kapolo*
Department of Chemistry and Biochemistry, University of Namibia, Namibia

*Author for correspondence
email: pkapolo@unam.na; Tel: +264-81-6144121

Abstract
Alkaloids are a large group of natural products, and they have been identified in many various medicinal plants in the world [1, 2]. The structural elucidation and detailed study of alkaloids advanced after the discovery of the first alkaloid, morphine, from opium poppy [3]. Hence, plants that have medicinal properties and have been found to contain specific types of alkaloids could be good candidates for the development of new medicine [4]. The study was based on the isolation of alkaloids from Nymphaeaceae plant. The study aimed at (1) extracting the alkaloids from the plant, Nymphaeaceae plant, (2) quantifying of alkaloids present in this plant species. Dried powdered tubers were tested for the presence of alkaloids were then tested using alkaloid tests, namely; Dragendorff’s, Mayer’s, Wagner’s, Tannic acid and Hager’s tests. Two methods of alkaloids extraction was used, the surfactant assisted extraction method and acetic acid assisted method. To confirm the presence of alkaloids in the extracts, TLC was used with the following solvent systems as the mobile phase: chloroform: methanol: ammonia (8:2:0.5), toluene: acetone: ethanol: ammonia solution (10:10:1.5:0.5) and chloroform: methanol (15:1). Chloroform: methanol: ammonia (8:2:0.5) proved to be a good mobile phase. Dragendorff’s was used as a spray reagent. The presence of orange spots, confirmed the presence of alkaloids. The surfactant assisted extraction method gave a good yield of 23.1% crude Alkaloids while the acetic acid assisted method only gave a yield of 0.58% of Alkaloid extraction given above. The qualitative test revealed that Nymphaea nouchali var. petersiana tubers contains alkaloids as all
the five tests showed positive results for alkaloids. The study revealed that the tubers contains good amount of alkaloids and so it could be a good source of compounds for drug development.

References

Antioxidant analysis of *Boscia albitrunca* (Shepherd’s Tree) traditional drink at various time points from Erongo region of Namibia

MDR. Daniel, C. Mukakalisa and MC. Tjiurutue*
Department of Chemistry and Biochemistry, University of Namibia

*Author for correspondence: MC. Tjiurutue
E-mail: mctjiurutue@unam.na; Tel: +264-61-206 3919

Abstract
The Shepherd’s Tree (*Boscia albitrunca*) fruits are used by the locals from the Erongo region in Namibia to prepare a traditional drink known as ‘Omuha’. The drink is prepared by mixing the fruit with water and shaking vigorously until a consistent orange colour is observed. Scientifically known as *B. albitrunca* [1], the Shepherd’s Tree belongs to the family Capparidaceae [1]. The tree has been preserved by locals in Namibia due to its many benefits, including medicinal, food and other uses [2, 3]. Even though the Shepherd’s Tree has been studied extensively for its medicinal benefits, there is very limited information about the nutritional benefits of the ‘Omuha’ drink. Therefore, the aim of the study was to test for the radical inhibition power of the drink by performing antioxidant assays and to determine the best time period to benefit most from the antioxidant value of the drink. The fruits were collected from the Erongo region, and the juice was prepared using traditional knowledge provided by the locals from the Erongo region. The drink was tested for antioxidant activity using the DPPH radical scavenging method; Ferric Chloride Reducing Power assay and the Nitric Oxide Reducing Power assay. Additionally, quantitative analysis for total phenolic and flavonoid content was carried out using the Folin-Ciocalteu and Aluminum Chloride methods [4] respectively, as evidence for the presence of antioxidants in the drink. Results have shown that the ‘Omuha’ contains high levels of antioxidants and this was supported by the presence of both phenolics and flavonoids. Based on the results, it is recommended to consume the drink at 48
hours after its preparation to benefit from the high antioxidants. The Omuhao drink seems promising and merits further research on the other nutritional values that it might possess.

**Keywords:** *Boscia albitrunca*, Phenols, Flavonoids, DPPH, Nitric Oxide, Ferric Chloride, Omuhao, antioxidant assay

**References**

**Types of sugars in the mesocarp and phytochemicals in the peels of ripe and unripe Berchemia discolor (Oombe) and Vangueria infausta (Oombu) fruits**

M. M Otto¹, W. Embashu², K. Nantanga³*, M. Kandawa-Schulz¹

¹Department of Chemistry and Biochemistry, Faculty of Science, University of Namibia
²Science and Technology Division, Multidisciplinary Research Center, University of Namibia
³Department of Food Science and Technology, Faculty of Agriculture and Natural Resources, University of Namibia

*Author for correspondence: knantanga@unam.na; Tel: +264 61 206 3241; Fax: +264 61 206 3013

**Abstract**
Berchemia discolor and Vangueria infausta are some of the indigenous trees that contribute to the livelihoods of majority of northern rural Namibian communities. Various products from these trees are used such as wood or barks for colouring in palm-basket making or as fodder. These trees bear edible fruits. Fruits of B. discolor and V. infausta are called Oombe and Oombu in Oshiwambo, respectively. Both humans and animals compete for access and consumption of the sweet-tasting fruits. They thus contribute to primarily the carbohydrate portion of the human diet in several communities in sub-Saharan Africa. Carbohydrates are a major component in most but not all human diets, with intakes ranging from 40-80% of the total energy requirements [1]. About 68% of ingested carbohydrate is converted to sugar in the human body [1]. The fruits of these trees are apparently a source of phytochemicals, which may have beneficial health effect to humans [2].The fruits of these trees comprises of the outer layers (peels), the soft tissue (mesocarp) and the pit or seed. Typically, the sugars are concentrated in the mesocarp of ripe fruits and the outer layer is where majority of phytochemicals are located. There is however limited knowledge on the carbohydrate and phytochemical composition of these fruits before they are ripe and when they are ripe for human consumption. To provide baseline information on these aspects, this study aimed to explore qualitatively the carbohydrates (starch,
monosaccharides, reducing sugars, ketoses and pentoses) present in the mesocarp tissues of the ripe and unripe Oombu and Oombe. A quantitative comparison of reducing sugars between ripe and unripe of these fruits was made using the Nelson-Somogyi method [2]. Ripe Oombu had more of reducing sugars (4.425 mg), followed by unripe Oombu (3.050 mg), ripe Oombe (2.215 mg) and finally unripe Oombe with 0.6617 mg of reducing sugars. Furthermore, screening of phytochemicals, namely the tannins, alkaloids, saponins, flavonoids, terpenoids and quinones present in the peels of these fruits, both ripe and unripe was conducted. The phytochemical tests showed that only tannins and saponins were present in both ripe and unripe fruits. Flavonoids yielded positive results for the fruits of Vangueria infausta and ripe fruits of Berchemia discolor. Alkaloids and quinones were absent in these fruits. The tests for monosaccharides, reducing sugars and ketoses yielded positive results. Tests done to find out if starch and pentoses are present in these fruits gave negative results. This revealed their absence.

**Keywords**: Sugars, Berchemia discolor, Vangueria infausta, phytochemicals; tannins; indigenous fruits.

**References**

**Evaluation of the Antimicrobial and antioxidant activity of extract from Myrothamnus flabellifolius plant**

M.N Jegonia, A. Ekandjo, C. Mukakalisa*
Department of Chemistry and Biochemistry, University of Namibia

*Corresponding author
email: cmukakalisa@unam.na

**Abstract**
*Myrothamnus flabellifolius* is amongst one of the wild African plants that have constantly been used by natives of southern Africa as a remedy to many ailments such as asthma, hypertension, backaches, kidney problems, microbial infections, diabetes and hypertension. The study was targeted at investigating the antimicrobial and antioxidant activities of extract from the resurrection plant *Myrothamnus flabellifolius*. Extraction of grinded twigs and branches of *Myrothamnus flabellifolius* was done through maceration in 95% ethanol. Antimicrobial screening of the ethanolic extract was performed against Staphylococcus aureus, Escherichia coli, Klebsiella pneumoniae and Candida albicans using disk diffusion method. Antioxidant
analysis was done using the 2, 2-diphenyl-1-picrylhydrazyl (DPPH) free radical scavenging assay, and reducing power assay. IC₅₀ values were reported for scavenging assay. Total phenolic content was evaluated using the Folin-Ciocalteu method and reported as mg GAE/g dry mass, while TFC was evaluated with AlCl₃ colorimetric method and reported as mg QE/g dry mass. The extract showed very good activity against all 4 test microorganisms however the extract had the greatest activity against *Staphylococcus aureus*. Minimum inhibitory concentration (MIC) of less than 1.25mg/ml was demonstrated by the extract against all four microorganisms. DPPH free radical scavenging assay calculated the IC₅₀ as 1.978 ± 0.8739 µg/mL, DPPH serving as the control. Reducing power assay revealed that the extract’s absorbance was concentration dependent, as the absorbance up surged with increasing concentration. The Total Flavonoid Content (TFC) and Total Phenolic Content (TPC) of the extract measured 173.782 ± 13.189 mg equivalence for quercetin (QE) /g and 11.345 ± 0.544 mg gallic acid equivalent (GAE)/g. The study illustrated excellent antimicrobial properties as well as good antioxidant activities for the *Myrothamnus flabellifolius* plant extract. This was consistent with conclusions of prior studies done on the same plant.

References


Analysis of Urine-Contaminated Soil

M.N Nakanyala¹, E. Haindongo², C. Tjuurutue¹*
¹Department of Chemistry and Biochemistry, University of Namibia
²Department of Microbiology, University of Namibia

* Author for correspondence
e-mail: miljamnakanyala35@gmail.com; Tel: +264816297539
Abstract
Public urination is the act of openly urinating outdoors in public places. Poor hygiene, overpopulation and inadequate facilities encourage the indiscriminate urination in public places. This study was conducted to quantify and identify bacteria in urine-contaminated soils. The study employed a non-invasive approach, by collecting soils from three urine contaminated areas of Otjomuise 8delaan informal settlement. A sequence of steps was employed, these were aseptic collection of soils samples, culturing of pathogens on MacConkey agar, enumeration of pathogens, sub-culturing of pathogens as well as the identification of pathogens by biochemical means. The culture work was performed using MacConkey media which is selective and differential for gram negative organisms. Soil samples were cultured on MacConkey agar, bacteria were isolated and purified by streaking four times on the same media. A total of 30 bacteria were isolated, Klebsiella was the most common (33.3%) isolate followed by Pseudomonas (26.67%), Enterobacter (20%), Proteus (6.67%) and Shigella (6.67%) with the same number of isolates and lastly Escherichia Coli (3.3%). A colony counter machine (Sunex) was used and colonies were counted in triplicates. The first dilution (10⁻¹) of all the areas had uncountable colonies. Area 3 had the highest cfu/ml (847155 x 10³ cfu/ml), followed by area 2 (664091 x 10³ cfu/ml) and lastly area 1 (549837 x 10³ cfu/ml). There was no statistical significant difference in the number of colonies between the areas, one-way ANOVA: (F=1.639), p=0.207. Further studies remain necessary to establish whether these are indicators of asymptomatic urinary tract infections or transfers from the normal flora (i.e. colonization).

Keywords: UTIs, colony counts, uropathogens, urine contaminated soils, biochemical tests.

References

Phytochemical screening of Boscia albitrunca (Shepherd’s Tree) fruit peel extracts

MS Angula and MC. Tjiurutue*
Department of Chemistry and Biochemistry, University of Namibia

*Author of correspondence: MC. Tjiurutue
Email: mctjiurutue@unam.na; Tel: +264-61-206 3919
Abstract

*Boscia albitrunca* is conventionally used as a medicinal plant including treating of eye infections and epilepsy using the plant green fruits [1]. Therefore, the plant and in particular, the fruits are believed to exhibit phytochemicals [2]. This study evaluated phytochemicals present in the fruit peels. Preliminary phytochemical screening was carried out on the dry grounded fruit peels and on two extracts with methanol and 70% ethanol on the fruits peels respectively. Additionally, quantitative analysis for total phenolics, total flavonoids and total tannins was carried out on both methanol and 70% ethanol extracts. Phytochemical screening on dry powder indicated high presence of saponins, anthocyanins and glycosides but low presence of alkaloids and tannins. Phytochemical screening with methanol extracts indicated higher presence of all tested phytochemicals compared to 70% ethanol extracts. The quantitative analysis was carried out following Folin-Ciocalteu method for phenolics, Aluminium chloride method for flavonoid and Vannilin method for tannins. Overall, total flavonoids were present in higher amounts compared to total phenolics and total tannins that were present in trace amounts. Comparative results of two extracts showed that total phenols was slightly higher in 70% ethanol extract compared to methanol extracts while total tannins was high in methanol extract compared to the ethanol extract. However, total flavonoids content was the same for both methanol and 70% ethanol extracts. To the best of our knowledge, this is the first study to show that the fruit peels from the Shepherd Tree contain phytochemicals that could be used for medicinal purposes and other applications.

**Keywords:** Anthocyanins, *Boscia albitrunca*, Flavonoids, Glycosides, Phenolics, Phytochemical screening, Quantitative analyses, Qualitative analyses, and Saponins

References


The synthesis and characterization of a chemosensor for the application of detecting ions in organic aqueous soluble medium

**V. Uahengo, J. H Naimhwaka, S. T Ndjabila**
*Department of Chemistry and Biochemistry, University of Namibia*

*Author for correspondence*
Email: msaddy7@gmail.com Cell: +264 812401737

Abstract

Detection of Heavy Transition Metal (HTM) ions as well as toxic anions is necessary for the safety of living beings [1]. The identification and removal of these harmful anions and cations is a vital practice in medical diagnostics, food and products quality control, and environmental
chemistry. Thus, in this chemosensing ensemble, a highly selective and sensitive cation sensor, referred to as sensor SN was synthesized, characterized and spectroscopically analysed. The sensor recognition properties towards various biologically important anions as well as several cations was investigated through naked eye observation and spectroscopic methods such as UV-Vis in water soluble DMSO-H2O. The addition of 3 cations, Ag^{3+}, Hg^{2+}, Fe^{2+} has resulted in a visible colour change from clear to light orange, green, yellow respectively, as well as Cu^{2+} from light green to dark green. Further studies were carried out on the ions, Fluorescence which was intended to observe the quenching or enhancing of the spectra due to the interaction of the chemosensor with ions of interest, which in this case was only performed against Hg^{2+} and Cu^{2+} as they presented plausible spectra during UV-vis titration studies [2]. The addition of Cu^{2+} and Hg^{2+} to chemosensor SN has induced plausible absorbance changes. It’s notable from the fluorescence spectra that Cu^{2+} and Hg^{2+} induce what is called the chelating-quenched effect on SN. The quenching of emission is attributed to the dissociation of the –NH and –SH groups of SN upon the coordination with Cu^{2+} and Hg^{2+} respectively, resulting in the formation of a non-emissive SN-Cu and SN-Hg complexes [3].

References

Assessment of aflatoxin and fumonisin levels in open market vended sorghum malt samples from Windhoek

P. N. Namundjanga¹, C. M. Tjiurutue¹, and J.M. Misihairabgwi²*  
¹Department of Chemistry and Biochemistry, University of Namibia  
²Department of Chemistry and Microbiology, Hage Geingob campus, University of Namibia

*Corresponding author
email: jmisihairabgwi@unam.na; Tel: +264612065039

Abstract
Most countries in Southern Africa use sorghum malt as an ingredient to prepare traditional beverages both alcoholic and non-alcoholic. In Namibia, sorghum is cultivated and processed into sorghum malt which is used as an ingredient to produce alcoholic and non-alcoholic
beverages such as *omalodu*, *otombo*, *oshafuluka* and *oshikundu*. This study aimed at determining the total aflatoxin and fumonisin levels in open market vended sorghum malt samples from Windhoek. A total of 21 samples were analysed for aflatoxin and fumonisin levels using total aflatoxin and total fumonisin ELISA test kits. Total aflatoxins and total fumonisins were quantified in sorghum malt samples from the two open vended markets. Aflatoxin was quantified in 100% of the sorghum malt samples with 43% sorghum malt sample having levels above the European union regulatory limit of 5µg/kg, (mean: 12.95±0.054 ppb, range: 0.200-90.565 ppb). Aflatoxin levels were significantly higher in sorghum malt meant for making *oshikundu* compared to sorghum malt meant to make *omalodu*. The study also shows that 50% of the samples from Single Quarters and 36% of the samples from Okuryangava were contaminated with aflatoxin above the European union regulatory limit of 5µg/kg. Fumonisin was quantified in 100% of the sorghum malt samples with 19% sorghum malt sample having levels above the European union regulatory limit of 2000 µg/kg and (mean: 1239.02± 0.036 ppb, range: 81.85-3990.33ppb). Fumonisin levels were higher in sorghum malt meant for making *omalodu* compared to sorghum malt meant to make *oshikundu*. The study shows that Okuryangava open vended market samples have the highest average concentration of fumonisins with 1399.71 ppb compared to Single Quarters with 1092.93ppb. The study also shows that 27% of the samples from Okuryangava and 10% of the samples from Single Quarters were contaminated with fumonisins above the European union regulatory limit of 2000 µg/kg.

**Keywords:** mycotoxins, sorghum malt, alcoholic and non-alcoholic beverages

**References**


**Small Scale Synthesis of α-Pinene Derivatives**

**W. Shikudule and S. Louw**

*Department of Chemistry and Biochemistry, University Of Namibia*

*Author for correspondence*
e-mail: slouw@unam.na; Tel: +264-61-2063566
Abstract
α-Pinene is a monoterpenoid with a [2.2.1] bicyclic structure [1]. α-Pinene is naturally found in many plant species and it has been determined that it has biological activities such as anti-leishmania, anti-bacterial, anti-fungal, anti-ulcerogenic, anti-inflammation, chronic diarrhea, and anti-cancer in humans [2]. Its transformation provides α-pinene derivatives with higher solubility in water and pronounced activity against Staphylococcus aureus and Escherichia coli [3]. It has been discovered that there are increasing cases of antibiotic resistance and this has forced researcher around the globe to find alternatives to treat illnesses caused by bacteria and fungi. Plant’s essential oil and their derivatives are one of the alternatives being considered in order to discover alternative biologically active compounds [4]. Therefore, the focus of this study was to synthesize α-pinene derivatives with potentially improved biological activity. The project started with the conversion of myrtenol (naturally occurring hydroxylated analogue of α-pinene) to myrtenyl chloride in the presence of fresh copper chloride. Myrtenyl chloride was further reacted under anhydrous condition to produce its Grignard reagent which was again reacted further with verbenone to give an hydroxylated α-pinene dimer. The synthesis of myrtenyl chloride was successful which yielded an oily product with a yield of 92.7%. Using GC-MS it was confirmed that the conversion was successful, with a single major chromatographic peak present in the total ion chromatogram and the molecular ion of myrtenyl chloride observed at m/z 170. Fragment ions observed at e.g. m/z 134, 91(base peak) and 79 are the same as those observed in the mass spectrum of myrtenol. Unfortunately the preparation of the dimer was unsuccessful.

References

Synthesis and characterization of a dual chemosensors for detecting anions and cations in organic soluble aqueous environment

V. Uahengo, J. Naimhwaka, J. Shileka*
Department of Chemistry and Biochemistry, University of Namibia

*Author for correspondence
Email: shilekajoseph@gmail.com Cell: +264817763892
Abstract
The dual sensor for cations and anions was synthesized, characterized and spectroscopically analyzed. The synthesis involved the reaction of cyanuric chloride and naphthylamine using acetone as a solvent, the mole ratio of naphthylamine to cyanuric chloride was 1:3, yielding a sensor that contain three molecule of naphthylamine bonded to on cyanuric molecule. The binding site of the sensor are three NH groups which have higher affinity towards anions, and these interact via hydrogen bonding [1]. The sensing of environmental and biological important anions and cations were tested through naked eyes observation and by spectroscopic method such as fluorescence and UV-vis in a water soluble solvent DMSO [2]. It was found that sensor selectively detects CN−, F−, Ag+ and Fe2+ ions through classical analysis, where for CN− and F− the color changed from the original colorless sensor solution to orange upon addition of the anions. Fe2+ and Ag+ exhibited a milky colour change from the initial colourless sensor solution. This ions detection ability was confirm using UV-Vis titrations with the observation a broad peak attributed to intermolecular charge transfer. Furthermore, the sensor displayed fluoresensce chelating-quenching effect during fluorescence titrations [3].

References

Isolation and Characterisation of the Potentially Toxic Metabolites from Trachyandra laxa a Toxic Plant Responsible for Livestock Losses

M.O. Shipiki and S. Louw*
Department of Chemistry and Biochemistry, University of Namibia

*Author for correspondence
e-mail: slouw@unam.na; Tel: +264-61-2063566

Abstract
Trachyandra laxa is a poisonous plant that belongs to the family Asphodelaceae. This plant is mainly found in southern African countries namely Namibia, Zambia, Botswana and South Africa. Poisoning by Trachyandra laxa affects mostly sheep, goats and cattle. Animals that graze this plant shows clinical signs which involve moving with difficulty, knuckle over the fetlock joints and various degrees of hypersensitivity and muscle twitching. The toxic metabolites of this
plant has not been identified yet. However, the preliminary results of a previous study indicated the presence of \( \alpha,\beta \)-unsaturated lactones which could potentially be responsible for the plant’s toxicity. In this study, a dichloromethane extract was prepared from the powdered leaves of the plant. Subsequently, the crude extract was subjected to column chromatography for fractionation using mixtures of chloroform and acetone as eluent in ratios of increasing polarity from 1:0 to 0:1. A total of 25 fractions were collected. Gas chromatography - mass spectrometry (GC-MS) analysis of the fractions revealed that the compounds of interest (\( \alpha,\beta \)-unsaturated lactones) were present in two of the fractions. Fraction 4 was a complex mixture of compounds, but fraction 9 consisted of 2 major constituents (including one of the \( \alpha,\beta \)-unsaturated lactones) and was hence further purified using preparative thin layer chromatography.

Quantitative analysis of different batches of *Colophospermum mopane* seed essential oil

P.K. Siriya and S. Louw*

*Department of Chemistry and Biochemistry, University of Namibia*

*Author for correspondence*
e-mail: slouw@unam.na; Tel: +264-61-2063566

Abstract

*Colophospermum mopane*, commonly known as mopane, is a leguminous tree or shrub belonging to the *Fabaceae* family. It grows in hot and dry areas with shallow alkaline soils which do not drain well [1,2]. Mopane essential oil is a volatile natural oil obtained from mopane seeds by steam distillation. The Opuwo Processing Facility (OPF), a unique essential oil producer in Namibia, produces essential oil from a number of indigenous plant species and the oil is sold commercially [3]. In this study, a number of different batches of the essential oil produced from *C. mopane* seeds by OPF was analysed using GC-FID. The relative quantities of the 12 major constituents were compared between the different oil batches. The compound that was found to have the highest concentration in all the oil batches was 3-carene. On average the percentage of 3-carene in *Colophospermum* mopane seed essential oil was found to be 79%.

References

Assessment of Aflatoxin Levels in Open Market Vended Raw Peanuts from Windhoek, Namibia

T. Pea¹, M. C. Tjirutue¹, J. Misihairabgwi²*
¹ Department of Chemistry and Biochemistry, University of Namibia, Namibia
²Department of Biochemistry and Microbiology, Hage Geingob Campus, University of Namibia

*Email: jmisihairabgwi@unam.na; Tel: +264-612065039

Abstract
Peanut (Arachis Hypogaea) is an important legume food crop in sub-Saharan Africa that is grown mainly for its edible seeds. The nut is consumed worldwide, including in Namibia but is reported to be prone to mycotoxin contamination, posing health risks to consumers and consequent economic losses. The study aimed to quantitatively test for the presence or absence of aflatoxins, to determine the levels of total aflatoxin contamination, compare aflatoxin levels in raw peanuts samples from different vendors and to find out if the levels of aflatoxins obtained from the open market vended raw peanuts sourced from an open market in Windhoek, Namibia are within European Union regulatory limits. A total of 21 raw peanut samples were purchased randomly from Okuryangava open market and analysed for total aflatoxin levels by use of the MaxSignal Total Aflatoxin ELISA Test Kit. The results indicated that 100 % of the collected raw peanut samples were contaminated with aflatoxigenic fungi. Aflatoxin levels ranged from 0.05 ng/mL to 255.54 ng/mL. Twenty four percent (24 %) of the samples highly exceeded the maximum allowable limit of aflatoxin set by the European Union (2 ng/mL for AFB₁, 4 ng/mL for total aflatoxin for cereals and nuts intended for direct human consumption), being above 100 ng/mL. The study revealed that high level of contamination in the samples could be due to poor storage conditions and there is a need for food hygiene and quality education among vendors and for sanitary regulations to be enforced as well as legislation for the control of aflatoxins in Windhoek, Namibia. Further research needs to be done in order to understand the supply chains of peanut trade in informal markets so that interventions are well directed on a national rather than a regional level.

Keywords: Peanut (Arachis Hypogaea), Mycotoxin, Aflatoxin, Aspergillus, Windhoek, Namibia, Health impact, ELISA.

References
Diversity, domestication levels and utilization of Spider plant (*Cleome gynandra*, L.) amongst ethnic groups of northern Namibia

*Chataika, B.*¹, Akundabweni, L.*¹*, Dako, A.*²*, Sibiya, J.*³*, Kwapata, K.*⁴* and Thomas, B.*¹*

¹University of Namibia, Crop Science department, Namibia; ²University of Abomey-Calavi, Laboratory of Genetics, Horticulture and Biotechnology, Benin; ³University of KwaZulu Natal, Crop Science department, South Africa; ⁴Lilongwe University of Agriculture and Natural Resources, Department of Horticulture and Biotechnology, Malawi.

*Corresponding author: barkhataika@gmail.com;* Cell: +264 81 331 6996

Abstract
Spider plant (*Cleome gynandra*, L.) is an indigenous vegetable with high nutritional, medicinal, insecticidal and cultural values yet continues to be neglected in research. The objective of the study was to investigate indigenous knowledge on the species diversity, domestication levels and utilization in five regions of Northern Namibia. Semi-structured questionnaires were administered to 100 and 24 randomly selected producers and consumers, respectively, in Omusati, Oshana, Ohangwena, Oshikoto and Kavango West regions. Four key informant interviews and one focus group discussion were also conducted. The results suggest that only the green petiole, green stem morphotype exists (100%) and are associated with high organic matter (75%), suggesting the need to consider soil fertility when devising agronomic technologies aimed at promoting cultivation and consequently domestication. Fifty eight (58)% of the respondents observed that abundance continues to decline due to declining soil fertility. Domestication level was found to be at 1.56 using model proposed by Vodouhe & Dansi, 2012, and this implied that the species is spared in the fields and most often benefits from some care
for its growth. Despite the low morphological diversity and lack of initiatives to domesticate Spider plant, the study found that ethnic groups of Northern Namibia place higher nutritional, medicinal and traditional/ritual values on it than any other vegetable. The vegetable is cooked as relish (29.1%), sold (20.6%), used in most cultural, traditional and religious functions (22.8%) as source of honour, to bring luck and for protection. The value placed on Spider plant offers an opportunity that catalyzes adoption of technologies developed to address production and utilization challenges in the value chain. Furthermore, the results constitute a key step towards designing client-focused breeding programs.

**Keywords:** Orphan vegetable, Morphotypes, Domestication, Ethnobotanical study, Nutraceutical potential

---

**Synthesis and characterization of thiophene based metal free dye sensitizers for solar cells, their photo-response properties in visible region and their chemosensing properties.**

**I. P Shikangala*, V. Uahengo**

*Department of Chemistry and Biochemistry, University of Namibia, Namibia*

Email: [ishikangala@gmail.com](mailto:ishikangala@gmail.com); cell: +264-814823281

**Abstract**

In 1991, Michael Grätzel developed a new photovoltaic cell known as Dye Sensitized solar cells (DSSCs), these photovoltaic semiconductor devices convert solar radiation directly into electricity [1]. Metal free sensitizers such as organic dyes and natural dyes have received attention as alternative DSSC applications and have been extensively developed [2]. Two novel Thiophene based metal free dyes will be reported in this thesis. These Thiophene based dyes are prepared through Schiff base synthetic methods, which are easy to follow. Moreover this dyes will also be used for anions and cation sensing.

![Dye1](image1.png) ![Dye 2](image2.png)

Thiophene based metal free dye sensitizers dye 1 and dye 2 are synthesised. These dyes absorb light in the visible light region. Sensing properties for these dyes were tested. With dye 1 being sensor 1 and dye 2 being sensor 2. Their recognition properties towards various ions were investigated by naked eye observation and spectroscopic methods such as of UV-vis in water
soluble DMSO. The addition of fluoride (F⁻), acetate (AcO⁻), and cyanide (CN⁻) indicated a red shift of charge transfer absorbance band concomitant detectable with naked eye.

References

Antioxidant potential of selected hydrazone ligands

S.H. Kanalelo, V. Uahengo, P. Kapewangolo*
Department of Chemistry and Biochemistry, University of Namibia

*Author for correspondence
Email; pkapewangolo@unam.na; Tel: +264 61 2063384

Abstract
Hydrazone based ligands are known to possess a wide range of biological activities, including antioxidant property. Antioxidant compounds possess the ability to prevent oxidative damage in biological systems. The present study investigated the in vitro antioxidant potential of 3 hydrazone ligands 7, 8 and 12 using 2,2-diphenyl-1-picryl hydrazyl (DPPH), Ferric reducing power and Hydrogen peroxide (H₂O₂) scavenging assays. Ligand 12 demonstrated good antioxidant activity with an IC₅₀ value of 9.88 ± 0.53 µg/ml for DPPH. The other two ligands, 7 and 8 showed low DPPH scavenging activity. The H₂O₂ assay showed that all 3 ligands demonstrated high antioxidant potential with IC₅₀ values of 0.56 ± 0.13, 0.04 ± 0.009 and 0.05 ± 0.025 µg/ml for ligand 7, 8 and 12, respectively. The reducing power for the Hydrazone ligands increased with the increase in concentration. The results of this study suggest that compounds 7, 8 and 12 have the potential to be developed as synthetic antioxidants.

Key words: Hydrazone ligands, Antioxidant activity, antioxidant, DPPH, Reducing Power, IC₅₀

Synthesis of Silver Nanoparticles Using Pearl Millet (Pennisetum Glaucum) Husk and Its Application in Wastewater Treatment and Catalytic Oxidation of Benzyl Alcohol

Paidamoyo S.F Musere, Ateeq Rahman and Veikko Uahengo
Department of Chemistry and Biochemistry, University of Namibia
**Abstract**

Metal nanoparticles are endowed with optical, electrical and chemical properties. Among them, silver nanoparticles (Ag-NPs) have distinctive physico-chemical and biological properties such as antimicrobial, chemical stability and catalytic properties [1]. Namibia is a semi-arid country in Southern Africa, and man-made dams play an important role in obtaining water for potable use. These dams are however periodically frequented by microalgae blooms that pose devastating effects on the water quality [2]. On a different note, several noble metals such as Platinum, Titania, Gold and Palladium nanoparticle catalysts have been reported in literature with regard to the conversion of alcohols to aldehydes [3]. Nevertheless, the attention received by Ag-NP catalysts for the oxidation of alcohols is very limited [4]. The aim of this study was to synthesize Ag-NPs using a biological method and investigate their antimicrobial and catalytic properties in wastewater treatment and catalytic oxidation of benzyl alcohol respectively. Ag-NPs were formed under optimum conditions of Pearl Millet husk extract (reducing and capping agent), concentration of silver nitrate, pH and incubation temperature and time. UV-Vis Spectroscopy, Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM) and Fourier Transform Infra-Red spectroscopy (FT-IR) were used to characterise the Ag-NPs formed. The antimicrobial activity of the Ag-NPs was tested to determine effectiveness on algae obtained from the Von Bach Dam and Swakop River. Algae was incubated in an Ag-NP solution for 7 days and Chlorophyll concentration measured periodically. Catalytic properties of Ag-NPs adsorbed on charcoal were tested by oxidation of benzyl alcohol to benzaldehyde using hydrogen peroxide and acetonitrile solvent. The UV-Vis analysis of Ag-NPs revealed a characteristic Surface Plasmon Resonance (SPR) peak at 429 nm. SEM and TEM showed spherical shaped and polydispersed nanoparticles with an average size of 17 nm and of a crystalline nature. FT-IR affirmed the role Pearl Millet Extract as a reducing and capping agent of silver ions. Incubation of algae with Ag-NPs resulted in a 41.31% reduction in Chlorophyll production at 3.75 mM concentration of Ag-NPs. High Performance Liquid Chromatography (HPLC) confirmed the oxidation of benzyl alcohol to benzaldehyde, with 90% conversion. The study revealed that Pearl Millet synthesized Ag-NPs can be used for algae treatment in wastewater and also as a catalyst for benzyl alcohol oxidation to form benzaldehyde. The study recommends use of Ag-NPs as an antimicrobial against algae in wastewater treatment and to further investigate shape and size influence of Ag-NPs on antimicrobial activity on algae inhibition. The catalytic property of Ag-NPs adsorbed on charcoal requires further study to determine the catalytic mechanism of Ag-NP catalyst on oxidation reactions.

**Keywords:** Silver nanoparticles, antimicrobial, catalysis, oxidation

**References**

2. Garus-oas CH. Abundance of Diversity of Microalgae in Freshwater Eutrophic Systems of Namibia and Optimization of Lipid and Biomass Production in Nannochloropsis
Estimating the density of two independent leopard (*Panthera pardus*) populations using hierarchical spatial capture recapture in Namibia

Kakove, M. N.1, A. Andreas2, Fabiano, E. C.1*

1 Faculty of Agriculture and Natural Resource, Department of Wildlife Management and Ecotourism, University of Namibia
2 Ministry of Environment and Tourism

fabianoezekiel@gmail.com; 0817547327

Abstract

The African leopard (*Panthera pardus*) is a solitary, solitary and adaptable species in the Felidae family (Ntefeleng, 2015). The species is classified as near threatened by the IUCN Red Data Book (Stein et al., 2018). This species has the widest geographic distribution of all felid species (Turnbull-Kemp, 1967). However, estimating and assessing trends in the population size of leopard and other carnivores, is a challenge for conservationists and wildlife managers. This has resulted in the lack of information about local population demographic status, inability to ascertain whether conservation measures are being effective and of identifying areas of conservation concern where intervention may be needed. Such information is critical given the multitude of threats that carnivores face across their range including in Namibia. Remote camera trapping and spatial capture recapture (SCR) methods have become the survey and analytical methods of choice when determining various ecological parameters of a carnivore population(s). However, to date, the application of SCR in Namibia has been limited to density point estimates. In this study, the Multi-Session Sex-Structured Spatial Capture-Recapture model was applied, to demonstrate the potential of such models to estimate leopard density and space use patterns, by combining data from two independent leopard populations and analyzing it as a single dataset. Remote camera trapping was conducted in 2011 from April to May in central Namibia and from October to December in southern Namibia for 60 days each. A total of 23 and 26 Reconyx Hyperfire (HC500 model) cameras were deployed along trails in central and southern sampling sites, respectively. A total of 16 candidate models including covariates on encounter probability (sex, sampling site and constant), density (site and constant) and movement parameter (sex and constant) were fitted. Cameras in central Namibia accumulated a total of 1560 camera trap nights, which yielded 53 leopard photographs which were identified as belonging to 12 individuals, 6 males and 6 females. In turn, cameras southern Namibia accumulated a total of 230 trap nights, 56 leopard photographs which were identified as belonging to 7 individuals, 2
males, 3 females and 2 cubs. The best model which accounted for study area and sex specific estimated a density of 1.37 ± 0.58 male and 3 ± 1.67 female leopard per 100 km² for the central Namibia study site, and of 0.28 ± 0.17 male and 0.6 ± 0.32 female leopard per 100 km² for southern Namibia study site. Leopards were significantly less detectable in the study area in the south than the one in central Namibia (-1.58 ± 0.62, $p = 0.01$) while male leopards had a significant higher detection probability than the female leopards (1.55 ± 0.73, $p = 0.034$). On average leopards irrespective of study area or sex moved 3.84 ± 0.61 km. The study demonstrated that it is important to account for various sources of variation when estimating ecological parameters and that combining datasets has the potential of improving parameter estimation. Despite the low precision associated with density estimates, higher female density may indicate healthy populations. This study provides the first empirical SCR based density estimates for leopards and demonstrates a framework for combining data from individual populations in different habitats to derive national density estimates.

References

**ANTIBACTERIAL ACTIVITY OF SILVER-NANOPARTICLES-TITANIA COMPOSITE THIN FILMS FABRICATED BY THE MOLECULAR PRECURSOR METHOD (MPM)**

**M. Joseph**, L. Daniel, M. Hedimbi

1,2Department of Chemistry and Biochemistry, University of Namibia

2Division of Microbiology Biology, School of Medicine, University of Namibia

E-mail: mjoseph@unam.na Mobile: +264 81 756 6638

Abstract
Titania (TiO$_2$) as a photocatalyst produces free radicals upon receiving light energy; thus, it possesses antibacterial properties. Silver (Ag) is an antibacterial agent that disrupts bacterial physiology. The antibacterial property of silver nanoparticles on the surfaces of visible light-responsive silver-doped TiO$_2$ photocatalysts (Ag-TiO$_2$) could be further enhanced by visible light illumination, which also widens its practical applications. However, the major limitation of this Ag-TiO$_2$ composite material is its poor miscibility; it is difficult to obtain a homogeneous
solution for silver concentrations above 18 mol% using conventional methods such as the sol-gel method [1]. As a result, the antibacterial property of the material decreases markedly due to fewer amounts of silver nanoparticles in the Titania matrix. To overcome this limitation, the MPM was adopted as a synthetic method for the fabrication of Ag-NPs/TiO₂ composite thin films with various and unprecedentedly high amounts of Ag (up to 80 mol %). Different parameters, including silver and Titania amounts were examined in the composite thin films. Crystal structures, surface morphology, nanostructures and absorption spectra of the synthesized thin films were studied using the X-ray diffraction (XRD), RAMAN, FE-SEM, and UV/Vis spectrometry, respectively. The antibacterial behaviors of resultant thin films containing various silver molar concentrations (mol%) were investigated against a gram negative bacterium, *Escherichia coli* (*E*-coli) as a model, both in the dark and under visible light by using the Antibacterial Susceptibility Testing method.

References

Investigation of biological activities of Crude and Lead Like Enhanced (LLE) Extracts from Selected Namibian Medicinal Plants used in the Treatment of Malaria and Tuberculosis

C. Raidron¹*, R. Hans¹, S. Louw¹, D. Warner², P. Smith³, K. Chibale⁴,⁵,⁶, S.N. Sunassee⁴,⁵

¹Department of Chemistry and Biochemistry, University of Namibia, Windhoek, Namibia, ²MRC/NHLS Molecular Mycobacteriology Research Unit, University of Cape Town, Rondebosch 7701, South Africa ³Division of Pharmacology, Department of Medicine, University of Cape Town, Observatory 7925, South Africa ⁴Chemistry Department, University of Cape Town, Rondebosch, 7701, South Africa ⁵South African Medical Research Council Drug Discovery and Development Research Unit, University of Cape Town, Rondebosch 7701, South Africa
Abstract
By virtue of their structural and chemical diversity natural products still remain the mainstay in drug discovery efforts, but there is a need to expedite the isolation of drug-like and lead-like compounds from crude plant extracts. We report here the biological activities of organic and aqueous crude as well as lead-like enhanced (LLE) extracts prepared from eight Namibian medicinal plants against the chloroquine-sensitive NF54 strain of \textit{Plasmodium falciparum} and the \textit{Mycobacterium tuberculosis} H37Rv-GFP strain. Aqueous and organic crude extracts were obtained by maceration of the powered plant material in purified water and a DCM:MeOH (1:1) mixture, respectively. The LLE extracts were prepared by solid phase extraction (SPE), using Strata-X as adsorbent to separate drug-like compounds from the crude extracts, according to a method developed by Camp et. al. The results obtained, showed that 10 crude extracts (8 organic and 2 aqueous) displayed antimycobacterial activity, and 4 crude extracts (1 organic and 3 aqueous), antiplasmodial activity. The LLE extracts of \textit{Terminalia sericea} and \textit{Sarcocaulon marlothii} displayed superior antimalarial activity with \textit{IC}_{50} values of 3.3 µg/mL and 2.1 µg/mL, respectively, compared to their crude extracts - \textit{IC}_{50} values of 8.78 µg/mL and 8.8 µg/mL respectively. None of the LLE extracts displayed antimycobacterial activity. A comparison of the NMR profile of the crude organic and LLE extracts of \textit{S. marlothii} - a plant species which is endemic to Namibia - and the application of preparative thin layer chromatography lead to the isolation of five compounds that are currently undergoing spectral analyses. Selecting plants based on ethnopharmacologic knowledge may enhance the probability of finding species with antimalarial and anti-TB action.

References

Total synthesis of prenylated and non-prenylated flavonoid from natural products: Synthesis of lupinifolin and 5, 7-dihydroxy-2-(2-hydroxy-4-methoxyphenyl) benzopyran-4-one

\textbf{D. Nanhapo* and P. Kapolo
Department of Chemistry and Biochemistry, University of Namibia

*Author for correspondent:
Abstract
Prenylated flavonoids are class of flavonoids which are naturally occurring and widely distributed all over the plant kingdom. They are structurally unique, due to prenylated side chain in their structures. They consist of two aromatic rings and a heterocyclic ring in their structures. Prenylated flavonoids are structurally unique to other flavonoids, because of prenylated side chains which are responsible for increasing the antioxidant activity, reduction in polarity of compounds, increasing in bioactivity as well as decrease the probability of a compound to be absorbed into blood system.

Synthetic compounds tend to display better biological activity in comparison to the parent natural product. Synthetic lupinifolin and 5,7-dihydroxy-2-(2-hydroxy-4-methoxyphenyl) benzopyran-4-one were prepared and characterized using 1H and 13C NMR spectroscopy, Infrared spectroscpe and melting point. The two syntheses were done according to the method as proposed by Khupes and Yong. The synthetic compounds obtained as yellow powder and brownish powder respectively, The two compounds were confirmed to be *Lupinifolin* and 2,3-Dihydro-5,7-dihydroxy-2-(2,4-dihydroxyphenyl)-H-1-benzopyran-4-one respectively by comparing the IR and 1H-NMR spectral data with the literatures. The two compounds were successfully synthesized and the synthetic compounds were confirmed to be *lupinifolin* and 2, 3-Dihydro-5, 7-dihydroxy-2-(4-dihydroxyphenyl)-H-1-benzopyran-4-one respectively by comparing the obtained IR and NMR spectral data with the literature. The compounds were further compared to the natural occurring compounds that were isolated during the study and the identities were confirmed through several analytical tests.

Keywords: Prenylated flavonoids, lupinifolin, bioactive compounds, Synthetic compounds, and Natural products

References

Computational Studies of the Structure and Electronic Properties of Ag and Au – doped (TiO₂)ₙ Cluster (n=2-6)

Elizeth Humba* , Likius Daniel and Edet F. Archibong
Department of Chemistry and Biochemistry, University of Namibia

* Correspondence Author
email: elizethumba@gmail.com; Tel: +264813800129
Abstract
The investigation of the optical and electronic properties of TiO$_2$ constitutes important areas of contemporary research because of the usefulness of the oxide in photocatalysis and photovoltaic applications. The TiO$_2$ clusters are aggregates of TiO$_2$ molecules that are intermediate in size between a molecule and bulk phase material. It is known that molecular clusters exhibit unique properties as a function of size, composition, and atomic configuration. The goal of this study is to investigate variation in the structure and electronic properties of Ag and Au - doped TiO$_2$ as the cluster size increases. It is of interest to determine the size limit where the cluster properties mimic that of the bulk material.

The results reported in this work were obtained using BPW91 and B3LYP variants of Density Functional Theory (DFT) theoretical approximation. The 6-311+G (d) one particle basis set is used for oxygen and the outer orbitals of titanium while the core of the latter is represented with the Stuttgart-Dresden (SDD) effective core potential. High level calculations were also done for the smaller cluster (n=2-3) using the coupled cluster approximations.

The neutral and anionic doped clusters assume three-dimensional (3D) structures for n= 2-6. Bond distances and bond angles of doped clusters are slightly smaller compared to the undoped forms. Vertical electron detachment energies (VEDE) have similar values for Ag and Au doped TiO$_2$ of a given stoichiometry and increases with the clusters size from n = 2-6. Other properties such adiabatic electron detachment energies (AEDE) and adiabatic electron affinity (AEA) vary from 0.10 to 1.00 eV. The HOMO-LUMO gap (HL) was used as an approximation to the band gap, and it ranges between 0.33-3.59 eV and 0.18-3.24 eV for Ag and Au, respectively. Doped clusters with n = 2 and n = 6 have the smallest HL gap.

References


Synthesis and Characterization of Ruthenium-Based Dye Sensitizers for Solar Cells and their Photoresponse Properties in the Visible Region: Experimental & Theoretical Studies

P. T. Endjala$^{1,*}$, V. Uahengo$^1$ and Edet. F. Archibong$^{1,2}$
Dye Sensitized Solar Cells (DSSCs) are promising third generation photovoltaic devices that offer the conversion of light energy into electricity at a lower cost. At the heart of this device is a sensitizer (dye) adsorbed on \( \text{TiO}_2 \)-photoanode which is responsible for the harvesting of visible light energy. However, the currently used sensitizers offer little improvement to the overall cell efficiency and this constitutes the main challenge to this technology. This work reports a combined theoretical and experimental study for the synthesis, characterization and solvatochromic effect of the designed ruthenium-based dye complex (\( \text{D4} \)) as a potential sensitizer for use in DSSCs. Theoretical studies of \( \text{D4} \) were performed using computational approaches such as density functional theory (DFT) and time-dependent DFT (TD-DFT) at the B3LYP/6-31G** level. The structure was fully optimized and characterized as genuine minimum by computing the Hessian index (0). The optimized geometry was used to compute excitation energies via TD-DFT. Aided by computed results, \( \text{D4} \) was selected and synthesized. Its photoresponse properties were investigated using UV-vis spectrophotometry and fluorescence and its structural identification was carried using Fourier Transform Infrared spectrometry. Both theoretical and experimental absorption spectra indicate that \( \text{D4} \) displays a well enhanced metal-to-ligand charge transfer band (MLCT) in the visible region. This character is defined by an absorption maxima of 452 nm experimentally which is in good agreement with 482 nm obtained computationally. Solvatochromic studies of \( \text{D4} \) shows that acetonitrile is the best choice of solvent in terms of photocatalytic enhancement and tetrahydrofuran is the best solvent in terms of bathochromic effect, with a broad low intense red shifted band. \( \text{D4} \) shows excellent photoresponse properties (\( \lambda_{\text{max}} \) and absorption band in the visible region) which makes it to be a potential candidate for DSSCs. Further investigation of \( \text{D4} \) such as construction of the solar cell device is needed in order to determine its efficiency.

![Figure 1](image.png)

**Figure 1.** UV-vis spectra of complex D4 in acetonitrile (A), its optimized structure at B3LYP/6-31G** (B) and synthesized structure (C).
Evaliisa N Haukongo, Ndollkelwa Patricia Petrus*, Tulimo Uushona and Vonai Charamba
Faculty of Agriculture and Natural Resources; Department of Animal Science, University of Namibia

Author for correspondence
ppetrus@unam.na | Tell: 061-206 4035

Abstract
Pig farming is one of the livestock sub-sectors with great potential to support economic growth and ensure sustainable food security in Africa [1]. Sows are prolific producing large number of offspring with a short gestation period [2]. In addition, pigs consume almost any feed as compared to ruminants. However, due to shortage of documented information, a survey was conducted to evaluate how farmers manage their sows and piglets at household level. Data collection concerning housing, feeding, health, farrowing, weaning and constraints facing smallholder pig producers were obtained through the use of semi structural questionnaire. Additional information such as demographics, breeding were also addressed. Farmers interviewed in Okaku constituency were selected using the networking sampling technique to identify the pig owners and non-pigs owners within the three different villages (Ondukutu, Epilangapi and Omuzilembungu). Results indicated that smallholder pig farming is predominated by female farmers (76.3%), aged between 40-49 years (27.5%) and generating income through self-employment (37.5%). The majority (90.0%) of the smallholder farmers did not receive any training in pig farming, but most of them (51.4%) reached secondary education. The total number of pigs kept is 4.8 on average and most of the farmers have farming experience of 10.8 years on average. The mortality of piglets experienced is 4.7 and the most piglets affected were aged on average of 3.1 weeks old. The feeds used mostly by the communal farmers to feed their pigs are; mahangu products, Kalahari melons and commercial pig feed. The main challenges faced by the farmers were; insufficient feeds due to unaffordable expenses (66.3%), diseases outbreaks (9.3%), lack of knowledge on pig farming (9.3%), lack of time (6.5%), destruction of crops (3.7%) and losing of pigs once they allowed to roam on the outside (3.7%). Cluster analysis was done to classify households according to socio-demographic characteristics. It was noted that houses with low income, less years of farming experiences, no agricultural training, completion of secondary education and mostly owned by females experienced most of the challenges highlighted in pig production. The study served to assist in establishing reasons to why there is minimal pig production in communal areas so that it can be useful in coming up with services that will enhance pig farming.

References
**Keywords**: pig farming, feeding, housing, furrowing, pig farming constraints

**References**

**Effects of spontaneous and controlled yeast fermentation on the volatile aroma, flavour compounds and physicochemical properties of “Omalodu” from malted pearl millet**

**H.T. Hamutenya¹, K. Nantanga*, S. Louw¹**

¹Department of Chemistry and Biochemistry, University of Namibia, Namibia  
²Department of Food Science and Technology, University of Namibia, Namibia

*Author for correspondence  
email: knantanga@unam.na; Tel: +264-61-2063241

**Abstract**
Fermented foods and beverages form one of the components of the dietary culture of most, if not all communities in the world. Pearl millet and sorghum can be used to make traditional products such as porridges and beers. In Namibia, sorghum or pearl millet malt is used in the production of a traditional beer known as “Omalodu”. This traditional beer is very rich in calories, B-group vitamins including thiamine, folic acid, riboflavin and nicotinic acid, and essential amino acids such as lysine [1]. “Omalodu” is commonly made using sorghum malt, but it can also be made from pearl millet malt, which is widely grown in Namibia. Yet, the quality of beers from pearl millet is not known. For instance, no studies have been performed on the effects of brewing conditions on the aroma and sensory quality of “Omalodu” made from pearl millet malt. Therefore, this study investigated the effect of spontaneous and controlled fermentation on volatile compounds that contribute to the sensory quality of “Omalodu”. The pearl millet grain to be used in this study were malted using the procedures adopted from Pelembe [2]. The Kangara grains were steeped for 4 hours and germinated for three days at 30°C in a proofer with continuous monitoring to check whether there is water to maintain the saturation. The malted grains were ground and the brewing was done following the procedures as described by Chengye [3]. The wort was fermented using a starter culture and uncooked pearl millet as spontaneous fermentation adjunct. The brewing of “Omalodu” and flavour analyses using GC-MS are underway.

**Reference**
PERFORMANCE ENHANCEMENT OF Ag-NANOPARTICLE/TiO₂ USING CHLOROPHYLL AS DYE SENSITIZER

L.M. Kalipi*, V. Uahengo and L. Daniel
Department Chemistry and Biochemistry, Faculty of Science, University of Namibia

*E-mail: meglamer@gmail.com; Tel: +264 81 4667 646

Abstract
To study the absorption spectra of metallic silver nanoparticle/titania/Chlorophyll (Ag-NP/TiO₂/Chlorophyll) thin films, sandwich arrangement thin films were fabricated on a quartz glass substrate at 550°C using the molecular precursor method (MPM). Respective precursor solutions for Ag-nanoparticles and titania were prepared from Ag salt and a titanium complex using molecular precursor method. The Chlorophyll dye was extracted from the Colophospermum Mopane leaves (Mopane tree) and Hyphaene petersiana (Makalani tree) leaves using methanol as a solvent extract. The Ag-Nanoparticle/TiO₂ thin films are then immersed in the Chlorophyll dye for 24 hours, to produce Ag-NP/TiO₂/Chlorophyll dye composites thin films. The absorption properties of the thin films were studied using UV/VIS spectroscopy. The absorption of the entire visible region for thin films with Ag-NPs was stronger than that for the thin film without Ag-NPs, which could be explained by the product of two distinct effects; firstly the absorption peak attributed to the surface plasmon resonance (SPR) of metallic silver nanoparticles in the TiO₂ matrix was red-shifted and broadened due to the high refractive index of anatase TiO₂; and secondly a well-separated Ag-NPs with wide range of size and shape exhibited a broad band, improving the absorption throughout the entire visible region. The Ag-NP/TiO₂/Chlorophyll dye thin films showed wide-range absorption. This can be explained by the coupling between the dye and plasmon resonance properties of the Ag-NPs. The band gap of the fabricated thin films is in the range of 1.4 and 3.65 eV, with 75%Ag-Np/TiO₂/Chlorophyll dye thin film with the lowest band gap of 1.4 eV and the highest band gap of 3.52 eV obtained from an undoped TiO₂ thin film. This chlorophyll dye in Ag-NP/TiO₂ reduced the band gap of TiO₂. The band gap engineering mechanism to explain this observation was proposed.
Figure 1 demonstrates an engineering mechanism explaining the observation happening between the Chlorophyll dye and metal semiconductor during the action of visible light. D₀, D¹ and D⁺ are the sensitizer in the ground, excited, and one-electron oxidized states respectively.

References

Optimization of Haul Trucks Utilization by Minimizing Refueling Delays at Husab Mine

M. P. Tomas and J. M. Akande
Department of Mining and Metallurgical Engineering, University of Namibia

E-mail address: martinptomas@gmail.com and jakande@unam.na
Abstract
The study was conducted at Swakop Uranium, Husab Mine, with its main drive being to investigate the factors that cause delays in the refueling processes of haul trucks and find possible solutions for eliminating these factors. It has been observed at the mine that trucks spend an extended amount of time on refueling thus increasing the refueling delays period. The extended refueling delay reduces the trucks utilization and results in reduced trucks utilization. Truck haulage nowadays is the most common means which is used for moving ore / waste in open-cast mining operations. The truck haulage is usually the costliest unit operation in a truck shovel open cast mining [1]. In order for the desired variable parameters to be observed and analyzed, other parameters that are not part of the research were assumed to be constants. Equipment refueling delay occurs in three stages: travel time of trucks from their current location to fuel bay; queuing/waiting time at fuelling locations; and amount of time that would be spent to refuel truck [2]. To support the data from observation, required data for comparison were obtained from DISPATCH - which is the Fleet Management Software used at the mine for communication between control and the Haulage equipment operators. Analysis of Variance (ANOVA) was used to determine the relationship between the observed data (refuel duration and refueling delay) and the data from Fleet Management Software (DISPATCH duration). The results from analysis of variance showed that there is a significant variation between the utilization obtained with current delays as compared to the achievable refueling duration, hence the need for optimizing process and sustainable development for the mine.

![Comparison of refuel delays durations from observation and as recorded on the system.](image)

Figure 2: Comparison of refuel delays durations from observation and as recorded on the system.

References:
Phytochemical screening of *Boscia albitrunca* (Shepherd’s Tree) seed extracts

HC. /Uiras and MC. Tjiurutue*
Department of Chemistry and Biochemistry, University of Namibia

*Author of correspondence*
Email: mctjiurutue@unam.na; Tel: +264-61-206 3919

Abstract
Phytochemicals are natural products produced by plants to defend themselves against pathogens and predators. The aim of this study was to investigate the phytochemicals present in *Boscia albitrunca*’s seed extracts and to analyze total phenolic content (TPC), total flavonoid content (TFC), and total condensed tannins in both methanol and 70% ethanol extracts. TPC was quantified following the Folin Ciocalteu method, TFC Aluminium Chloride method and total condensed tannins using Vanillin-HCl method respectively. Phytochemical screening revealed the presence of tannins, saponins, flavonoids, phenols, terpenoids and alkaloids in both extracts. Overall, total flavonoids was highest compared to total phenolics which had the least amounts. In addition, methanol extracts yielded higher amounts compared to ethanol extracts for all phytochemicals. Specifically, total phenolic content was found to be 0.0195 ±0.0155 mg GAE/100g (methanol extract) and 0.014±0.002 mg GAE/100g (ethanol extract), total flavonoid content was found to be 0.222±0.022 mg QE/100g (methanol extract) and 0.00153±0.000345 mg QE/100g (ethanol extract) and total condensed tannins was found to be 0.0626±0.0015 mg CE/100g (methanol extract) and 0.0079±0.0031 mg CE/100g (ethanol extract). The seedlings of *B. abitrunca* exhibit antimicrobial activity to protect themselves, and the presence of higher flavonoids and tannins present in the seed extracts could be responsible for this activity.

Keywords: Alkaloids, Antimicrobial, *Boscia albitrunca*, Flavonoids, Phenolics, Phytochemical screening, Quantitative analyses, Qualitative analyses, and Saponins

References
Beneficiation of Namibian aluminosilicate minerals for synthesis of ZSM-5 based catalysts: An attempt for economic rehabilitation of underutilized resources

Endifenge Haikela¹* and Josia Shilunga²
¹ Department of Chemical Engineering, Durban University of Technology, Durban, South Africa
² Department of Geology, University of Namibia, Windhoek, Namibia

*Author for correspondence
Email address: EndifengeHaikela@gmail.com

Abstract
ZSM-5 (Zeolite Socony Mobil-5) is a synthetic zeolite manufactured from aluminum and silicon source chemicals. This material was first discovered by the oil company Mobil in the 1960’s. Important applications of ZSM-5 include: catalysis especially in the petrochemical processing, ion exchange, adsorption and membrane manufacturing amongst others. The conventional methods for manufacturing ZSM-5 use expensive chemical reagents, energy intensive technologies and sophisticated equipment. In order to produce ZSM-5 in an environmentally friendly and cost effective manner, the use of naturally available aluminum and silicon sources such as aluminosilicate minerals using hydrothermal synthesis was reported to be successful by several authors [1–3]. Another remarkable benefit of this synthesis approach for ZSM-5 from beneficiation of aluminosilicate is the use of an organic template free synthesis. It was reported that this method further reduces the raw material costs and pollution associated with decomposition of the template compound [4].

Namibia has an abundance of aluminum and silicon rich minerals such as zeolite, andalusite, kyanite, sillimanite and clay minerals that may be beneficiated to manufacture ZSM-5 class of zeolite catalysts. The geologic settings of zeolites include primarily deep-sea sediments; low-temperature open hydrologic systems; burial diagenesis, and hydrothermal-geothermal systems [5]. In Namibia, the reported major occurrences of zeolites are in fracture fillings and amygdules in the Etendeka basaltic lava flows in northwestern Namibia [6]. In addition, numerous occurrences of zeolites in sedimentary rocks of diverse lithology, age and depositional environment in Namibia have been recorded. Although most zeolites in these sedimentary rocks occur as microscopic crystals; their deposits are voluminous and have a great geologic significance and economic potential. Besides zeolites, other aluminosilicates such as kyanite and sillimanite occurrences have been reported in different parts of the country [7]. Major kyanite production in Namibia has come from deposits associated with basic dykes in gneisses of the Hohewarte Metamorphic Complex [8] in the Rehoboth and Windhoek Districts. A remarkable kyanite deposit is the Kyanite Kop, with estimates of reserves which span between 55 000 tons [8] and 132 000 tons [9]. Several sillimanite deposits occur in the sillimanite-garnet-biotite schist of the Namaqua Metamorphic Complex in the Bethanie and Karasberg Districts [7]. Heine and Völkel, (2010)[10] defined seven clay mineral provinces in Namibia, which occur in fluvial, pan and cave environments. At this junction, these mineral resources should be sufficient to manufacture ZSM-5 materials in a cost-effective manner and environmentally friendly approach.
References


Computers have come to be an important component to our everyday life because of the improved technology worldwide. The World Wide Web did a great influence to a lot of enterprises which use this mechanism for data sharing within the enterprise and also outside the enterprise [1].

At the University of Namibia (UNAM) since the beginning, students have to physically visit the dining hall for booking their meals and to see the menu. Also the dining hall staff has always used a manual system when it came to the booking of meals by students. The same applied to the daily menus. The problem with both is that they can only be done onsite and if a student cannot go to the dining hall they cannot book a meal or access the day’s menu and it is also time consuming since students and staff have to deal with long queues just to take bookings.

Therefore, this research was focused on developing an online food ordering system for UNAM that can be used to automate the ordering system that is currently being implemented at the dining hall.

Hence, the importance of this system is to help both students who are unable to go to the Dining Hall to book for their meals onsite and it will also help the Dining Hall management to easily keep track of students who booked for meals for a certain day, who booked for a lunch meal or a supper meal and also if the student collected or did not collect their meal for the day.

In addition, the system being developed for the Dining Hall will be a web based system that can be accessed by the students and management (Administrators/employees) online and the Personal Extreme Programming methodology will be used for the development of the system. Personal Extreme Programming (PXP) is a software development process designed to be applied by software engineers individually that focuses on lightening Personal Software Process (PSP) by reducing the number of scripts being followed and the amount of data to be filled in the forms [2].

References

Two-Stage Vehicle Tracking and Ignition Lock Disabling System (ILDS) using an App

B.Z. Groenewaldt* and N. Suresh
Department of Computer Science, School of Computing, University of Namibia

Author for correspondence
Email address: zbgroenewaldt@gmail.com | Tel: +264 81 419 5848

Abstract
Every year there are a number of vehicle thefts taking place in Namibia especially in the Northern parts. There have been exactly thirty seven (37) in the year twenty sixteen (2016) according to The Namibia [1]. This is due to the fact that vehicles can’t be tracked or do not have any system in place to avoid thieves from stealing them. For this reason, this research study is based on delivering a cheap and affordable system where private or enterprise-owned vehicles can easily be protected by the use of an ignition lock disabling system (ILDS) as the first stage of protection and a vehicle tracking system as the secondary. There has been some studies done on vehicles being tracked using a microcontroller [2], but they lack any type of vehicle disabling system to prevent the vehicle from moving. On the other hand, studies has been done on vehicle disabling and tracking systems but without the use of a mobile app [3]. This research study is therefore presented to incorporate all these missing features and with hopes to possibly decrease the amount of vehicle thefts in Windhoek by a noticeable margin. Life-threatening carjacking events may be avoided all together because of the positive reputation and reinforcement of this system. The suspects of the carjacking may be brought to justice and victims receiving potential closure. For this system, Design Science Research Methodology (DSRM) is used. DS is of importance in a discipline oriented to the creation of successful artifacts [4]. The proposed system partially exists between an in-vehicle device used for both vehicle location and immobilization and a mobile application (app) that can control the vehicle through the in-vehicle device. The system will be both hardware and software based. The hardware side of the system consists of an Arduino UNO, Global Positioning System (GPS) and Global System for Mobile communication (GSM) shields, relay switch, Direct Current (DC) brush Motor and a Liquid Crystal Display (LCD) shield. These are all used to track the vehicle and to enable and disable the ILDS. On the software development side, an Android app will be developed to easily communicate with the hardware and to visually monitor the vehicle movement through built-in Application Programming Interfaces (APIs) such as Google Maps and to enable or disable the ILDS. With this in mind, the user will have the option to send a Short Message Service (SMS) to the nearest police station with the exact latitude and longitude coordinates of the stolen vehicle to help them in finding it. This will only be done if the thieves bypassed the ILDS. All of this will be conveniently be done through the android mobile app. The
researcher intends to successfully implement this system in the real-world and gain positive feedback from potential users and expand the system to more vehicles and look into perfective maintenance in the near future. Technology is advancing every day and with Android-powered smartphones getting cheaper and more powerful it is a near to optimum time to implement this system because anyone can easily download and use the Android app and protect their vehicle/s from potential theft.

References

Silas Ndapuka Heavy transport online bus ticket reservation system

M. Hekandjo* and V. Hashiyana
Department of Computer Sciences, School of Computing, University of Namibia

*Author for correspondence
Email address: hekandjo.ponhofi@gmail.com | Cell: +264814640183

Abstract
In Namibia there are many bus transportation companies that transport people across the country. Ndapuka has been in the transport business for decades [1]. He used to transport people only to and from the Northern parts of Namibia [1]. Today Silas Ndapuka Heavy transport is one of the major privatized transport company that runs the buses all over the country. At present, they are using a manual system to sell tickets. Sometimes, customers stand long queues especially when its holiday time, to buy bus ticket and ask for information. Customers also lose their bags from thieves because they don’t know who is truly working at the counter. An online bus ticket reservation system is a web-based application that allows visitors check bus ticket availability, buy bus ticket and pay the bus ticket online [2]. For this reason, an efficient system for booking tickets online is developed for Ndapuka.
This application is set up on xampp server with apache and phpmyAdmin that has temporary tables but will be deployed in the remote web hosting eventually to be accessed by the
customers. The payment module in the created application is temporary not linked because Ndapuka has no online payment system and there is no payment gateway in Namibia. Observations and interviews were grounded to articulate functional and non-functional requirements. End users of this system were given an opportunity to explore the system and suggestions were made that the system will be of great since it’s online and most of the people have access to internet. The study uses waterfall model software methodology. The system is important to the company because their transactions, customers and buses information will be stored in a database with a backup. Customers can access the system remotely and anytime which can save their valuable time.

References:

A news summarization and recommendation system using natural language processing

M.Mumba* and K. Mufeti

Department of Computer Science, School of Computing, University of Namibia

*Author for correspondence
Email address: makmumba28@gmail.com | Tel: +264816540526

Abstract
Information on the World Wide Web and in other electronic form is increasing tremendously. [1] It can be noted that a significant amount of web content is news. Now a days most people would prefer looking for news on the web via mobile devices as compared to the more traditional method of purchasing paper based newspaper and reading the news. Online news reading has become very popular as the web provides access to news articles from millions of sources around the world. As a result, news websites are daily overwhelmed with plenty of news articles [1]. The motivation of this study is to provide people with an effective way of accessing the most important information in the shortest amount of time with reference to topics of interest and information content. The system will utilizes a summarization approach using Stanford NLP library and the system will use firebase as a backend that will store user profiles for recommendation purposes. Sample datasets will obtained from google and will be used for the testing process. The development process of the application will done using Personal extreme programming which allows for iterative process of development [2].

References
Designing secured WAN using IPsec VPN: Case study University of Namibia

A. Bratha* and V. Hashiyana

Department of Computer Science, School of Computing University of Namibia, Namibia

*Author for correspondence
Email address: abratha@gmail.com Tel: +264 811410722

Abstract
Most organizations connect to their branches using WAN Point to Point VPN links that are supplied and managed by third party internet service providers (ISP) where the cost /Mbps is significantly higher than a traditional broadband internet access. On top of the already costly WAN link by the service provider, UNAM is left with no other option but to trust their internet service provider in terms of the UNAM network security and availability. This research main focus was to design and implement a secure, reliable and cost-effective wide area network (WAN) using IPsec virtual private network (VPN) with broadband internet for the University of Namibia [1], furthermore the security of the connection is managed locally as opposed to the WAN point to point VPN links that are managed by the internet service providers. The study designed and implemented a model simulation of broadband IPsec VPN connections that demonstrated network security, reliability and affordability [2]. The study also reviewed and compared available WAN connections that are in operation. The study finally gave recommendations to the Unam computer center management on how to implement the designed solution for connecting Unam main campus and regional centers using IPsec WAN. The IPSec VPN solution is way cheaper than the current MPLS VPN that is currently in operation.

References

Preserving Indigenous Knowledge: Natural Language Processor for English to Shona text-based translation

T.A. Chanakira*, G.T Nhinda and N. Suresh

Department of Information Technology, School of computing University of Namibia

*Author for correspondence
Email address: tate.audrie.charks@gmail.com | Tel: +264-818 477 316

Abstract
A significant number of indigenous communities in most parts of Africa are struggling to maintain their rights and traditions in a system that is still dominated by a western world view [1]. This paper focuses on the Shona language and uses Natural Language Processing (NLP) techniques to process natural language through implementing a text to text-based translation from English to Shona. The preservation of historical data particularly indigenous knowledge (IK), has widely evolved and has also progressively improved from oral tradition to manuscripts, audio recordings, documentaries and artefacts among many others. However, these techniques have taken us this far but are now struggling to keep up with time, and this has resulted in data loss through the dying oral traditions due to urbanization, eroded manuscripts due to their longevity in dusty archival store rooms to mention just a few. Artificial Intelligence has revealed its utmost potential for the future where machines can learn a concept and be able to analyse, process and preserve. As evidently highlighted by [2] that a considerable number of African native languages have already gone extinct, this knowledge shows that indeed preserving IK is a problem in Africa as such this study seeks to utilize the most advanced technological approach to address this problem through the use of NLP. Although the use of the Shona language is not an explicit case in this context, the researcher used this language as an example of a natural language.

The Participatory Action Research methodology was used for this research and it enabled the researcher to have access to cycles of knowledge that produce on the ground change, through working in participatory ways that value local knowledge. A qualitative method was used that enabled the researcher to sample a small population of 10 people in order to have participation, observation and feedback from the selected users. Personal Extreme Programming (PXP) was the software development methodology that was used.

The objective of this research was to construct an appropriate data set, to apply a supervised learning method and finally to produce a Basic English to Shona text-based translation. The data set was constructed using the basic Shona words and an NLP library Deep Speech was implemented using Python code to achieve the text translation as the desired output objective. The translation was based on a terminal interface where a user can enter an English word and the output will be the Shona based meaning of the word. Additionally, other languages where also used to test the system and this confirmed that the system only understands/recognizes English words only in order to give the desired output. This research has brought more insight when it comes to dealing and manipulating natural language with common issues that cannot be ignored that include lexical ambiguity, syntax level ambiguity as well as referential ambiguity.
common issues are recommended to be well analysed and taken into consideration for future studies. With many NLP systems being developed to solve other problems, there is an additional sense of urgency in trying to preserve IK. With this great revelation, this study provided a more technologically advanced approach to preserve neglected spoken languages that will encourage linguist and Africanist alike to work to protect them through using AI.

References

A Mobile App for Student Classroom Records

Petrus Hishekwa* and Rafael Rodríguez Puente
Computer Science Department, School of Computing, University of Namibia

*Author for correspondence
Email address: phishekwa@gmail.com | Tel: +264 81 447 4390

Abstract
Computers can as well learn just like humans do though it is not as accurate as humans can do. However, they faster to learn and find patterns from a lot of data within a shorter time than humans. In today’s world the terms Artificial Intelligence and Machine Learning are playing a major role in the advancement of technology for today and the future[1]. Programs ranging from mobile, web and desktop applications are being developed to ease our everyday activities. In the educational industry most of the activities have to be computerized to facilitated the processes and improve efficiency and efficacy.

This paper is looking at the design of a mobile application that strive to facilitate some of the main activities in educational industry such as taking attendance and recording marks that a lecturer or a teacher has to do. The designed app uses Artificial Neural Networks to automatically identify students from the student card, and it will also be able to record marks by pointing the camera cell phone to the student scripts after the lecturer mark them. The training of the model is done with TensorFlow, an open source machine learning framework made by Google. This app is facilitating the process of having an updated register of student attendance and continuous assessments, and it is especially useful for classes with a large number of students.

Reference
SECURED RASPBERRY PI CLUSTER CLOUD STORAGE (R-πC2S2) FROM DDOS ATTACKS

F.E.D. Muhongo * and N. Suresh
Department of Computer Science, School of Computing, University of Namibia

*Author for correspondence
Email Address: fielmuhongo@gmail.com | Tel: +264-81-3463318

Abstract
Cloud computing is the next paradigm shift in the IT industry, it provides wide range of services to organizations. It is mostly open source yet, it ensures enough storage capacity and less use of human resources such the cost of buying new infrastructure, training of new personnel or licensing new software. Cloud infrastructure provides a scalable anytime or anywhere services accessed through the web from multiple devices with no worries on how or where those services are installed, maintained or located.

Cloud Storage Security is an area that brings attention of researchers and IT technicians as the Cloud providers outsource user’s data and users don’t own control over their data. On the other hand Distributed Denial of Service (DDoS) are attacks that attempts to block authentic users from accessing a specific network resource on Cloud. If security is not properly addressed, it may impede the successful deployment of the Cloud architecture [1, 2].

DDoS attacks are frequently the main source of cloud service interferences. Due to use of robust botnets, DDoS attacks are harder to detect at the firewall, therefore an efficient technique is needed to mitigate DDoS attacks in Cloud environment [3]. Many algorithms have been developed to provide data integrity, therefore more studies are needed in order to provide more efficient and secured Cloud platform to the users.

Due to the need of further research on mitigation techniques for DDoS attacks in Cloud platforms, this study aims to simulate a secured Cloud platform by designing/constructing a Secured Cloud Storage using Raspberry Pi Cluster, using the best practice algorithms to provide safe storage services and to conduct intrusion penetration tests upon the Cloud platform.

The R-πC2S2 is a product based prototype designed using Design and Creation methodology in which focuses on the creation of new IT products also called artifact It is a typical problem-solving approach and uses an iterative process involving five steps: awareness, suggestion, development, evaluation and conclusion [4].

The R-πC2S2 has a very simple system architecture which consists of 3 clustered Raspberry Pi nodes where the servers will be running, 2 hard drives for storage, one switch to connect all the nodes together and allow communication between them and one router that governs secure communication between the system and end users using either laptop or a smartphone. My SQL is the database used to store user’s credentials and data.

During the evaluation stage, intrusion detection attacks will be conducted in order to find loopholes on the Cloud platform and ensure it is secured and reliable to outsource user’s data.

This proposed study, expects secured cloud storage with a simple designed application where lecturers and students can upload they data (assignment’s, unfinished work, books), and access
them from anywhere without worrying about being able to access without denial or even tempering of their data.

References

Prototype of an online blood bank management system

K.Kozonguizi¹ and P. Sheetekela²
¹Department of Computer Science, School of Computing, University of Namibia, Namibia
²Department of Information Technology, School of Computing, University of Namibia, Namibia

Email address: lapsie989@gmail.com | Tel: +264-81-7677698

Abstract
Many medical advances that have improved the treatment of serious illnesses and injuries have increased the need for blood transfusion for patients’ survival to support them through recovery or to maintain their health. Blood is vital to life and for many people, blood donors are their lifeline. Currently only 0.8% of the Namibian population donates blood, but 1 in 3 people will need blood in their lifetime [1]. There is also no known substitute for blood and it cannot be replicated due to its complexity. Although lost blood volume can be temporarily replaced by synthetic solutions in trauma situations, these do not contain the necessary constituents to sustain the patient. Donor blood can (and often does) mean the difference between life and death [1]. Demand for blood is driven by an array of factors needed in major surgeries, traumas, accidents, burns, injuries, obstetric haemorrhages, blood replacement in neonates, prematurity, and other causes of acute and chronic anaemia [2]. A blood bank is a place where blood is collected from donors, typed and separated into components, stored and prepared for transfusion to recipients [3]. A blood bank management system (BBMS) is designed to store, process, retrieve and analyse information that is concerned with administrative and inventory management within a blood bank. The existing system that is used by NAMBTS is a manual system. A donor first visits NAMBTS center or a donation camp and goes through the process of filling in a medical donation forms before being allowed to donate blood. If blood is required for a patient the center will assess whether blood is available and if not they search for a donor in files. This process is
time consuming. The existing system requires more manpower and more paper work. Therefore computerizing the existing system eliminates the need to maintain a separate record of different donors, filling out medical history forms manually which is time consuming. It also reduces the amount of papers used which would cut costs and impact the environment/climate in a positive way. This project was guided by the following objectives; to develop an online blood management system (BBMS) and to interoperate Namibia Blood Transfusion Service (NAMBTS) existing system with the BBMS to provide online information of blood bank to medical practitioners within the health sector of Namibia. The project includes three main modules namely admin, donor and medical practitioner.

This project is carried out at NAMBTS, Windhoek. The project follows prototyping development methodology. During the software design phase two prototypes were created. The first was a low-fidelity prototype that used paper sketches. The second prototype was a high-fidelity prototype that was designed according to the results of the first prototype where improvements and adjustments were made from the first paper sketches. Through this system, any person who is interested in donating blood can register. Moreover if any medical practitioner wants to search and request for available blood types they can do so with the help of this website. Interviews, document reviews and observations were done to analyse the existing system. All the system processors were identified and described by using use case diagram and flow chart. The web based system was developed using angular 2, cascading style sheets (CSS) and hyper-text markup language (HTML) which compiles to JavaScript on the client side and nodejs was used on the server side. Mongo dB was used to design the prototype database.

The prototype shows the total amount of units of particular blood group, it eliminates the manual procedure of donor registration now the entries are done online, manually discard those units which become unhealthy due to some technical fault and admin can upload information of blood donation camps in the city so that the end user can view the details. For future work, it is recommended to implement a complete online blood bank management system by enriching it with additional functionalities such as knowledge based component, a short message service to remind donors to donate blood or invite friends.

References

An Integrated Information Sharing System for Agriculture Stakeholders

K. Kazauana* and T. K. Mufeti
Department of Information Technology, University of Namibia
Abstract
Traditional subsistence and commercial agriculture are both key sectors of the Namibian economy [1]. The agricultural sector in Namibia is however, hampered by the lack of timely, accurate information that is tailored to specific locations and conditions [2]. This paper reports on the development of web-based application aimed at creating an integrated information sharing platform for the Agri-community in Namibia. The platform connects farmers and Agri-experts across the country, thereby enabling access to relevant information and effective delivery of extension services. The application is developed around the idea that agriculture is more than just producing and marketing food products; [3] it is also about educating and transforming the society. Many smallholder farmers in Namibia live far from cities and towns and are often poorly served by roads, making it difficult for them to obtain information at the right time regarding their farming activities [4]. The application targets key strategic information challenges faced by agricultural stakeholders in Namibia and enables information sharing and advisory on soil fertility, fertilizers, weather information, pests, and diseases. Using design and creation research method, the study identified the types of information needed as well as the accessibility challenges currently experienced by agricultural stakeholders in the Grootfontein district. An information sharing application was then designed, and the application was developed using web technologies such as mithril framework, HTML5, CSS3, JavaScript, Bootstrap, PHP, and XAMPP. A key feature of this application is a moderated Message Board open to farmers, advisory services, agronomists, researchers and companies. The Message Board allows participants to post questions on the use of a specific technology in farming, dissemination of events, surveys for testing new products or needs, etc. for the build-up of an open community of practice on smart farming. The developed system will allow farmers to share information on patterns of diseases, breeding areas, and certain livestock farming systems. It also provides a platform for farmers to contact extension officers and seek advice or provide more information about particular problems based on locations. Moreover, the system provides access to information such as disease breakouts, adapting farming to weather conditions and where the best breeding animals are found. The study was demonstrated to 19 farmers and 2 extension officers who indicated that the system is useful to them. The study demonstrated how an Information Sharing System is a critical, and highlighted the need to build more targeted systems aimed at addressing the information gap in the agricultural sector in Namibia.

References
Tracking and management system for the oasis

G. Musweu* and K. Muffeti

Computer Science Department, School of Computing, University of Namibia

*Author for correspondence
Email address: giftmusweu@gmail.com | Tel: +264-81 4439023

Abstract
Most of the people in Namibia use public transportation as their transport means to reach their destination, especially in rural areas or the less wealthy suburbs [1]. In order to get good support from passengers, bus companies need to perform good services and facilities. Therefore, to generate the best customer services, the company management should be more effective and efficient. By computerizing the manual system and bus operation, the management of the transport company can become more effective and a good performance of services might be increased [2]. Automation of Bus transport has been gaining more importance because they provide accurate information of buses like reservation, fare charges, route information, bus information from anywhere and anytime [3].

The main objectives of this study is to create a system to find out the location of the bus using GPS (Global Positioning System) and GSM (Global System for Mobile communication) by a message request from the user’s mobile phone and without using internet at the user’s end. Using GPS and with GSM the passenger can know the location of the bus by sending an SMS (Short Message Service)

A computerized system has a potential to be a medium that can minimize user memory load and avoid data from lost or damage. It can make the company operation runs smooth easy and stress free for the owners, not just in making bookings and reservations but also knowing where their busses are and the direction their moving in.

In conclusion the system manages the booking and searching of busses by customers and gives the information of where the bus is, the direction it is moving in, place and current time. It also gives the person who is getting out of the bus, time and where he is getting down. So that we can know the number of persons remaining in the bus at particular instant of time and can also know that who is getting into bus, by using this system we can provide the security and better management to the business.

References
Augmented reality navigation system

I.J.W.J. Kapapero * and R.R. Puente
Department of Computer Science, School of computing, University of Namibia

*Author for correspondence
Email address: johnkapapero@gmail.com | Tel: +264-81-6769424

Abstract
Navigations on any large plane field can be challenging and difficult. Imagine looking for a destination in a town, city, or even a university without having a clue as to where you are going? It can be a very tedious and time consuming experience. This then is the sole motivation that led to the pursuit in this particular area. With augmented reality the navigation experience can be made easy with the push of a button on a mobile device making it one of the convenient ways to solve this navigation problem. Augmented reality in a new technology that allows the placement of 3D or virtual objects in the real world. Additionally, it is a new technology that uses the real world’s environment and adds new information on top of it [1]. In some research related to marker AR mobile navigation and display system, Wang et al. [2] proposed an AR interactive display system using a set of marker labels, and demonstrated that the use of AR to display exhibits can enhance users’ learning effects [2]. From the information above, the problem here is that navigation on the UNAM main campus is quiet difficult and time consuming. For this research, personal extreme programming software development methodology was utilised. This research involves placing 3D objects in augmented reality camera view, an online tool called Mapbox studio to strategically place the 3D object at the coordinates and give them targets or unique identifiers for distinct navigation purposes. After the placement process, the testing process starts and its main purpose is to see if a 3D object appears at right position. Object placement is a very tough process because a slight misplacement of an object can result in it appearing several kilometers away from the intended position. Additionally, since this system uses the GPS on the mobile device, obstacles such as buildings can cause the GPS to give some wrong readings resulting to inconsistent real-time feedback.

In conclusion, the system will help new students, visitors and some staff member. Therefore the system will make navigation better and easier. Future improvements to the system can employ wireless sensors and Bluetooth beacons to improve accuracy and track a user’s position continuously.

References

A prototype of Comparison of the performance of the learning algorithms for verification phishing uniform resource locator (URLs) using machine learning

L.M. Kephas*, G.T. Nhinda and N. Suressh
Department of Information Technology, School of computing, University of Namibia

*Author for correspondence
Email address: Kephas.loide.m@gmail.com | Tel: +264 81 433 9296

Abstract
Phishing is an online criminal act that occurs when a malicious webpage mimics a legitimate webpage to acquire sensitive information from the user [1]. Detecting phishing websites is one of the crucial problems facing the internet community specifically via emails because of its high impact on the day-to-day online transactions performed. Moreover, there is no doubt that phishing, as a phenomenon, is both highly successful and generally difficult to detect and prevent in a reasonable amount of time [2]. Namibia has experienced its own share in cyber-attacks in the ream of electronic banking transactions which prompt the Namibia government to come up with a draft bill on electronic transactions and cybercrime [3]. Despite a number of solutions to mitigate phishing by previous researchers, there is still no conclusive solution to phishing attacks particularly in the universities environment, and university of Namibia (UNAM) is not an exception. Therefore, this study aims to evaluate the performance of learning algorithms (Naïve Bayesian, Decision tree, and Logistic regression) for verification of phishing URLs using machine learning techniques. Furthermore, the study provide a better understanding on two or more machine learning algorithms that could be used to verify and confirm compromised and phishing URLs in the cyberspace. The study focused mainly on experimental research approach and principle of Personal extreme programming (PXP) development methodology is used for this prototype. PXP is designed to be applied by individual software engineers and is iterative. Applying its practices allows developer to be more flexible and responsive to changes [4].

The experiment is performed using a 7030 URLs dataset, which were divided into two samples: training and testing, 80% for training and 20% for testing and the observed result showed that decision tree provided the best accuracy of 91% as compared to Naïve Bayesian 58% and Logistic regression 85% respectively. Figure 1 show the models results.
Using IoT to Develop an Automated Irrigation System for Crop Farmers in Namibia

S. S. Ndakolute1*, G. I. Iyawa2 and A. Limbo1

1Department of Computer Science, School of Computing, University of Namibia
2Faculty of Computing and Informatics, Namibia University of Science and Technology

*Author for correspondence
Email address: ndakolutes@gmail.com | Tel: +264813250995

Abstract
Technology is advancing at a fast pace and IoT devices are also part of that advancement. They have made it possible to monitor and automate elements in our environment that was not possible a few years ago. With the effects of global warming making weather prediction more and more difficult, there is need to employ IoT devices in agriculture to improve food production. Irrigation is of great importance to the farming world, this has therefore led to the need of automating systems in the agricultural sector. The use of automated irrigation can ensure that the farmer is not under or over watering the crops, this also helps the crops in the long run as...
irrigation can be controlled according to a certain crops’ water requirements. Farmers in Namibia currently operate their irrigation systems manually, this increases labor and regular attention, especially for large farms. This leads to inaccurate moisture in the soil as there is little mechanisms to measure soil moisture. Automated Irrigation in farming has rarely been practiced to date in Namibia, [1]. This project aims at designing and developing an automated irrigation system that will be monitoring soil moisture and activating the water pump when a certain threshold is met, based on the crop being farmed.

The main objective of this research is to automate irrigation using an approach that meets the soil moisture requirements needed for adequate growth of a particular crop. The proposed system employs IoT devices and actuators which are centric to an Arduino microcontroller which the managing the devices in the system. Other components include soil moisture sensor, water pump, GSM shield. The sensor gets the moisture value in the soil and sends it to the Arduino microcontroller. The microcontroller is programmed with threshold moisture values that determine when to turn the water pump on or off, this is done with the help of the relay device which initiates the automation of the water pump. The information acquired from the sensor is stored onto an excel sheet in real-time. Data stored on the excel spreadsheet is uploaded on a web server. The data is availed onto a web-page in chart formats where farmers can analyze to find certain patterns, and therefore help to maintain and improve crop production. The approach used to design the system prototype is Design Science Research Methodology (DRSM). The creation of new knowledge through design of innovative artifacts and the analysis of the artifact’s use and performance are two activities that improve and understand the behavior of aspects of Information Systems [2].

References


Mobile application for classifying rocks

N. Mutoko*, R.R. Puente1 and E. Shalimba2

1Information Technology Department, School of Computing, University of Namibia
2Department of Geology, University of Namibia

*Author for correspondence
Email address: noblemutoko@gmail.com | Tel: +264816431762

Abstract
Usage of mobile devices in Namibia has increased drastically in the past years, this has been shown by network service providers increasing the coverage to ninety-five percent for more
connectivity [1]. This has allowed for mobility of users from one place to another. Applications have been developed to classify rocks, which rely on internet access to be able to access the server to send images for classification [2]. In Namibia there are places where there is no internet connection, which does not enable usage of applications that rely on internet in such places. However, this study enables classification of rocks in the places where there is no internet connection and hence processing can be done on the same device. The objectives of the research are to create a mobile application that classifies the rock type and save the data of the location were the image was taken from on the device.

This research study develops a mobile application prototype that enables classifying rocks without internet connection. A sample dataset obtained from google which has been cleaned by experts from the geology department will be used for the training purposes. A convolutional neural network which is useful in places where the server backend is not available or the communication link is not available or unreliable and transfer learning which enables training on a small dataset will be used to train the images that have been collected. The development process of the application will done using Personal extreme programming which allows for iterative process of development [3]. The application will enable users to classify rocks and save the location where the rock would have been taken from without need for internet access.

References

Design and Implementation of an Automated Cyber Security Scanner for Security Vulnerabilities

B. Handubo1* and G.E. Iyawa2
1 Department of Information Technology, School of computing, University of Namibia
2 Faculty of Computing and Informatics, Namibia University of Science and Technology

*Author for correspondence
Email address: bhandubo@yahoo.com | Tel: +264-81-2174434

Abstract
In the era of global convergence, everything is now revolving around information security, requesting for an intense practice of ensuring the three pillars of information security. There is a major challenge in hindering a rigorous adoption in cyber security with the difficulty of providing safety and a secure computing environment.

The design of the automated cyber security scanner is created with the aim to address the miscreation for the previous fails on the work previously done in the same area of study. Previous work has failed to address the accompanying deformities: the key point is to scan ports loophole, and the testing capacity for some other secondary passage provisos is exceptionally feeble and almost does not exist.

According to Cavelty [1], the sort of security that develops straightforwardly from the desire to guarantee digital security is one that apparently with security, at any rate in the primary occurrence. Even though Goel and Mehtre [2] argue that a solitary device is not appropriate to discover all kind of vulnerabilities, it is necessary to ensure that most of the known test cases are performed by the automated cyber scanner.

A recent study by Mukhopadhyay and Nath [3], explains that ethical hacking is a piece of a general data risk administration program that considers progressing security enhancements. Thus, with the scanning machine connected to a network of other machines, the installed scanner is able to scan all IP addresses and give a display of the vulnerable machines’ IP addresses and names on the network, scan and find open ports, DNS and gateway IP addresses on the network. The automated scanner is also able to sniff and monitor ongoing communications between two points revealing critical information like the types of protocols involved in the communication.

The explicit goal of the project is met as the potential users of the application are able to run a security scan right after launching a service to detect security vulnerabilities with the known methods by the application before any future attack is perpetrated by the attackers.

Reference

Mobile Tour Guide Application for Supporting Tourists in Windhoek

S. Limbwambwa* and R. R. Puente
Department of Information Technology, School of Computing, University of Namibia

*Author for correspondence
Email address: limbwambwa.sir@gmail.com |Tel: +264-81 4332955
Abstract

“Mobile tourism” represents a relatively new trend in the field of tourism and involves the use of mobile devices as electronic tourist guides [1]. At the moment, more and more mobile tour guides, deployment of wireless Wi-Fi hotspots and GPS module, as a powerful complement of AGPS positioning technology, providing low power consumption, precise positioning technology have greatly improved tourism [2]. The current traditional tourist methods in Namibia of paper maps, centralised information canters, guided tours, present a lot of challenges; tourists have to visit the Windhoek information tourist centre for information about places in the city tourist might want to visit.

In this research, we present Windhoek City-Guide, an android mobile tour guide application that supports travellers in Windhoek city. This work discusses design and implementation issues of a “mobile tour guide”. The application features include (Geolocation, which enables the application to determine users’ current location and calculates distances. Interactive map with clickable places, Map layers (normal, satellite, hybrid, terrain), Static map image, Navigation, current distance to the POI (place of interest), Support for metric and imperial units, Phone call and e-mail intents, Open web link of the POI, Share POI (place of interest), Rate app on Google Play, Images can be loaded from the Internet or locally, caching images Application works in offline mode, Responsive design and tablet support, Multi-language support, Google analytics to track the app usage and Support for Jelly Bean (Android 4.1) and newer.

Mobile tour guides has great significance as it can assist tourists to easily get timely information, about a place of interest, it will also provide convenience to tourists as they can use the inbuilt features of the application like, call and email intent, offline usage once downloaded and installed, and in addition the application has simple and easy navigation features. Furthermore all places have descriptions of the kind of services they offer for tourists to easily make informed decisions, with accordance to their interest.
References


DEVELOPMENT OF A MOBILE APPLICATION FOR DIAGNOSIS AND MEDICINE PRESCRIPTION

S. Sheetekela*, G. Nhinda and A. Limbo
Department of Information Technology, School of Computing, University of Namibia

*Author for correspondence
Email address: spnsheetekela@gmail.com | Tel: +264-81-4973789

Abstract
With advanced technology and ever changing medical conditions, the need for accurate diagnosis has increased. Even though there are several ways of medical diagnosis in Namibia, the doctors still use face-to-face contact sessions for patients seeking medical assistance. This problem is exacerbated by the shortage of health professionals in Namibia, resulting in high ration of patients per healthcare professionals.

To address this, we present an Android mobile medical expert system application that aims to provide the same services in the absence of a doctor. An expert system seeks to adopt human knowledge to solve a specific problem that is usually solved by humans based on artificial intelligence, [1] [2]. A typical expert system has an inference engine, which is the component of the system that applies logical rules to the knowledge base to deduce new information.

The app allows patients to seek for medical advice, perform self-diagnosis for common diseases from a remote place was developed. The graphic user interface displays screens of the smartphones and incorporates the medical data needed by the expert system to interpret and respond by giving a correct diagnosis which was 85% accurate.

A naïve Bayes classification algorithm is used, to classify the diseases and compare the effectiveness, correction among them. Naïve Bayes algorithm which is an efficient technique is used to model real life problems and reasoning under uncertainties, hence naïve Bayes was used because of its simplicity (simple) [3]. In addition, when assumption of independence holds, a naïve Bayes classifier performs better compare to other models like logistic regression, hence it does not need a lot of data to train the model [3].

Extreme Programming methodology was used for the development of the system [4]. The iterative nature of this methodology allowed the developer to be more flexible and responsive to changes (Dzhurov, Krasteva, & Ilieva, 2009).
References


Android App controlled Lawnmower

T.K. Shishiiveni* and V. Hashiyana
Department of Computer Science, School of Computing, University of Namibia

*Author for correspondence
Email address: shishivenitk@gmail.com | Tel: +26481 443 3646

Abstract
In Namibia, most house owners grow lawn in their yards and on average they spend nearly 50 hours or so a year dealing with lawn care and most of them do it after working hours. Some individuals use grass shears or manually controlled Reel mowers and the cost of such equipment, as well as the cost of maintaining them could be high. There is also potential risk associated with mowing, as most lawn equipment are dangerous and can cause injury if they are not handled properly. Some equipment such as riding lawn mowers produce fumes that can be quite harmful to human beings. Additionally, people that do the lawn mowing chore in the sun without protection are exposed to the risk of contracting cancer and other skin diseases [1].

The basis of this project was to design a lawn mower (controlled via smartphone), and a mobile application that would control the lawn mower. The innovation would allow house owners to trim their lawn from the comfort of their house using their smartphones. The whole idea is to eliminate the disadvantages associated with the existing lawnmowers such as the ones mentioned above.

The lawn mower consists of an Arduino board, breadboard, motors, wheels, motor shield, HC-05 Bluetooth module, batteries, camera, razor saw. The mobile application has options such as Forward, Backward, Right, Left, Stop, Neutral, and voice note. The mobile application was developed in MIT Android App Inventor and provides extensive flexible features that enable the user to control the lawn mower easily. The mobile phone and lawn mower communicate via
Bluetooth. In conclusion, this innovation could be perceived as a great aspiration as it would help house owners to cut out costs and stay safe.

References


Interactive text based query chatbot: to assist with students frequently asked questions at the University of Namibia

T.T Egumbo* and N. Suresh
Department of Information Technology, School of Computing, University of Namibia

*Author for correspondence
Email address: tangeniegumbo@gmail.com | Tel: +264 81 5761452

Abstract
A chatbot (also known as a talk bot, Bot, chatterbox, Artificial Conversational Entity) is a program designed to counterfeit a smart communication on a text or speech [1] [2]. Chatbot’s recognize user input as well as by using pattern matching to provide a predefined acknowledgment. The traditional phenomenon at University of Namibia (UNAM) is very worrying fact of getting information or enquiry about any problem that a student might have, the only way is by going physically to the University. Upon going to the University in order to get information or enquire about anything that you want, one has to queue up for that which is time consuming and costly. The purpose of this project is to identify the features as well as the benefit of using a Student information/Query chatbot to answer student queries about the University specifically frequently asked questions (FAQs).

Research suggests that the development of an Information/Enquiry Chatbot could help resolve the traditional way of assisting students with enquiries, The chatbot application (app) helps the students to access the university related information from anywhere with internet connection. The significance of this study will help the student to have an interactive platform with the chatbot based on frequently asked questions (FAQs) at UNAM. The objective of this study is to design a chatbot for students to conveniently retrieve information without having to look or browse several web pages to fetch answers. Easing the burden of continuous calls and e-mails on institute authorities and reducing the dependency on humans to answer the queries.

This system prototype is designed using agile programming software design method specifically Personal Extreme Programming (PXP), because of its software-development discipline that organizes people to produce robust systems [3]. Attempts to reduce the cost of changes in requirements by having multiple short development cycles, rather than a long one.

The System Prototype consist of Facebook’s Messenger Platform that will act as the platform where students can interact with the Chatbot, API.ai (Dialog flow) to compare queries posted, retrieval of information, handling the natural language processing and at the same time acting as
the Database. As well as an Ngrok server to allow the app to be accessed through internet (facebook). So for the user to interact with the bot, he/she needs to have a Facebook account, the bot is linked to a Facebook page called “UNAM info-chat”, to interact the user sends a message to the Facebook page, as soon as the server is up and running the bot will starting replying to the user.

References


Using Sentiment Analysis to Find the Sentiment Correlation between Tweets and Newspaper Headlines in Namibia

M. T. Shikomba¹, W. Sverdlik¹ and N. Suresh²

¹School of Computing, Computer Science Department, University of Namibia
²School of Computing, Department of Information Technology, University of Namibia

*Author for correspondence
Email address: tangenishikomba@gmail.com |Tel: +264-81-619-0776

Abstract

Twitter has grown in popularity during the past decades. It is now used by millions of users who share information about their daily life and their opinions on certain topics in the media[1,2]. In order to automatically process and analyze these data, applications can rely on analysis methods such as sentiment analysis [3]. This study tries to find correlations between the sentiments of tweets and newspaper headlines in the Namibian context. This study focused on using Twitter because of its limitation in the length of the text content posted on this platform [4]. The study scientifically reveals the actual correlation between the sentiments of Tweets posted from Namibia to national headlines appearing in local newspapers. Additionally, it will also serve as a starting point as far as sentiment analysis and social media is concerned within the research and academic boundaries of Namibia.

This study aims to track the sentiment score of tweets posted from Namibia onto the Tweeter platform, to find the correlation between these sentiments and those of news headlines appearing in some of the major Namibian newspapers as well as to find sentiment patterns within tweets.
The study is carried out using Design and Creation Method as it involves capturing data from the Tweeter social media platform using an application that has been developed to the needs of the study, headlines from Namibian newspapers will also be captured manually. This application will also track the sentiment score of Namibian tweets in real time. Additionally, the study will also make use of the Qualitative and Quantitative Research Methods to analyze and draw conclusions from the collected qualitative data.

The study analyzed the sentiment score of the tweets and the newspaper headlines collected, the sentiment scores will be graphically plotted to find the sentiment correlation between tweets and newspaper headlines, as well as notable trends. Real-time sentiment analysis of tweets will be carried out to determine the sentiment score of Namibian tweets during a certain period of the day.

The study has shown that there is usually an increase in the positive tweets whenever news headlines appear to be more negative than positive, however when there appears to be more neutral headlines the sentiments on Twitter social media become positive. This shows that there is a very strong sentiment correlation between these two platforms, it also illustrates that negative news headlines are the drivers of positive tweets in Namibia.

References

Development of the educational school finder application in Namibia

T. Fransisko* and G.T. Nhinda

Department of Information Technology, School of computing University of Namibia

*Author for correspondence
Email address: tresiafransisko@gmail.com | Tel: +264 81 862 5519

Abstract
Nowadays, Information Technology (IT) is taking on greater significance and importance for advancing the education system. This is important because education system forms the backbone of every nation. This study addressed the issue of chaotic queues at schools during enrollment and the burden that comes with parents walking long distances trying to identify surrounding schools. In most cases, parents are not aware of the schools available in their area, thus, they go
through so much stress and perplexity to find a better school to enroll their children. It becomes even more daunting for parents who have just relocated to a town with work or with other commitments.

Some schools do not even advertise well enough when it comes to the next intake dates, be it at the beginning of the year or the beginning of each term and as such, you find parents crowding at schools. This issue therefore calls for an urgent intervention. Through a survey conducted to gauge what technology can lend to this problem a mobile application was developed. The mobile application can be used to help parents locate a school for their children with ease.

The application provides a list of schools around the user, using the current Global Positioning System (GPS) location of the mobile device being used. The same application allows user to see the school reviews or rating, which help the user with decision making process when choosing a school. The school finder application as we call it also provides other vital information related to the school such as the contact details, the school history, the category of the school (Elementary School, Junior School or High School), the number of spaces available for each grade and the specialization offered at that school in the case of junior and high schools (Science, Social or Commerce) were applicable. The school finder application enables users to browse and filter schools listed on the school finder cloud-based Firebase database. The schools can be viewed on a Google Maps or browsed through on a list in real time.

Personal Extreme Programming (PXP) development methodology was used to create the software. This approach is iterative and applying its practices allows the developer to be more flexible and responsive to changes[1]. An online survey was carried out and shared with different users in which they gave their opinions about the school finding process. The results of the survey with 66 responses from the participants was obtain. A prototype was created, and different users could test the design, this allows the developer to iron out any flaws and gives a chance to feel how the application will function when it have been designed.

References


CS Challenger: A mobile application to support the learning of computer science concepts through gamification

W. Masikara¹* and G. E. Iyawa²

¹Department of Information Technology, School of Computing, University of Namibia
²Faculty of Computing and Informatics, Namibia University of Science and Technology

*Author for correspondence
Email address: wanamonmasikara@gmail.com | Tel: +264817272586
Abstract
In modern day universities, technological advancements have been used in order to facilitate learning at a faster rate. Slideshows for example, are a common medium of information used by lecturers to convey information to students. The slideshows serve as a beacon towards the information students can be read more about in textbooks or on the internet as they are a compressed form of information.

The motivation for university students to learn new information on their own depends on numerous factors. Some of these factors are each individual student’s effort, the passion they have towards their course of study, the level of understanding they have, their ability to apply the knowledge they have and their overall thirst for knowledge.

The term ‘gamification’ is closely related term to ‘gaming’. Gamification is effectively using game mechanics commonly found in video games to enhance the user’s interactivity in non-gaming contexts [1]. Gaming mechanics are tools used to display gameplay performance such as points, levels, lives, achievements and progression [2].

The purpose of this study is to develop a tailor made mobile application for computer science students studying at the University of Namibia that applies gamification to their lessons can enhance their learning experience.

The objective of developing this mobile application is to help the University of Namibia computer science students find a greater interest in the learning and understanding of computer science concepts. This is supposed to make them more knowledgeable in computer science theories as well as helping to become better programmers by giving them the motivation to learn at any time and location. This project is to be done with the aim of making learning enjoyable and competitive for the students.

The software methodology that will be implemented for the guiding of the development the mobile application is the Iterative and Incremental life cycle model whereby a new application build will be developed after a re-iterative process of design, development and testing [3]. Each build will be an extension of the previous build with more functionality added and satisfying more user requirements.

The mobile application will run on the Android mobile platform particularly on devices running the Android 4.4 KitKat operating system or later. The hardware requirements of running the mobile application on any android smartphone are at least 1GB RAM.

The mobile application will allow students to choose a category which relates to the modules they are studying. Under each category/module is a series of questions that are timed. A user of this application will have to answer these questions in a limited time while scoring points for every correct answer until they have completed all the questions in a category. Feedback will be given to the user as they give a right or wrong answer. A user will be given 3 chances/lives in order to successfully completed all questions in a category without losing to the game and having to start over.

The CS Challenger mobile application includes other features such as profile customisation which involve personalising a user’s profile picture and name. Another feature which is to be included in the development is a leaderboard. This leaderboard will show the top ten players who have had the highest daily score. Internet connectivity will be required for this feature although all the other features and the gameplay of the application will not require internet connectivity thus allowing a user to play and learn computer science concepts at their own convenience.

References
A school virtual laboratory (SVL) system for Grade 8 physical science learners: a case study for A. Shipena secondary school

W. Kamati* and M. Ntinda
Department of Computer Science, School of Computing, University of Namibia

*Author for correspondence
Email address: kamatiwillbard@gmail.com | Tel: +264-81-6870681

Abstract
Namibian Secondary schools are faced with a challenge of conducting science practical experiments, due to the fact that there is a shortage of laboratory essentials needed for practical experiments [1]. Lack of resources reduces the ability to learn, making it difficult for students to implement the knowledge they acquire from books and classrooms. Students opt to memorize theories without a concrete understanding as they have not done the actual practical experiments [2]. There are secondary schools in Namibia with computer laboratories only used for computer related practicals. With the advancement in technology, computer laboratories could be used for both computer practicals and for Physical Science practicals.

The study explored laboratories issues in Namibian secondary schools and development a virtual laboratory system, particularly for the Grade 8 learners enrolled for Physical Science at schools with computer laboratories using the software prototyping development methodology. A virtual lab system is an interactive computer-simulated laboratory that provides a platform for learners to perform practical experiments in a virtual environment. This aims to deliver maximum learning efficiency. A qualitative methodology was employed in this study were two teachers at A. Shipena Secondary School were interviewed by means of a questionnaire. The study found that there is a need for an offline virtual laboratory at A. Shipena Secondary School.

References

Budgeting application with receipt scanner to minimize manual data entry

W. Kavetu and N. Suresh
Department of Computer Science, School of Computing, University of Namibia

Author for correspondence
Email address: wisekavetu@gmail.com | Tel: +264-81-6124303

Abstract
In history there have always been those who are rich and those who are poor, but in the last few decades a middle class has risen and with it improvement in living standards. The middle class earns more money but equally spends more money as well and with credit cards and bank loans some of them end up falling into debt. But both the poor and the middle class can get out of debt or not fall into debt in the first place if they spend their money wisely and do more with what they have. One of the tools that can help with this is budgeting, by budgeting a person can improve their financial situation not only for the present but also for the future, but with budgeting it can require a lot of data entry sometimes on a daily basis, which deters some people from budgeting and others who started may stop down the line because of the same issue [1] [2] [3] [4].

To solve this problem a web application will be developed. The application will have 10 predefined categories and using the graphical user interface the user will be able to enter a budget for any category[5]. Once they have done so they will be able to enter their expenses throughout the month and by doing so they will be able to see if their staying on budget or not and thereby help to prevent them from falling into debt or help them to get out of debt.

In order to reduce some of the manual data entry required a branch of artificial intelligence called computer vision is used specifically Optical Character Recognition. OCR will be used to recognize characters from a user’s receipt which will then be entered into the application automatically. On receipts are printed some of the users daily expenses which without OCR they will have to enter manually which would be a great burden so OCR helps a lot in this aspect.

The application was tested using a professional tool called lighthouse which tests for performance, best practices, accessibility etc. and the application scored well across the board. The OCR was also tested and it returns results within 2 or 3 seconds with 90% accuracy most of the time.

Since this involved the creation of a software artifact design and creation research strategy was used which consists of five steps awareness, suggestion, development, evaluation and conclusion.

References
Using Social Network Technologies to support online playing of Oshiwambo Riddles (eengano)

S. Mateus* and K. Mufeti
Department of Computer Science, School of Computing, University of Namibia

*Author for correspondence
Email address: sacky4e@yahoo.com | Tel: +264 811 433930

Abstract
Indigenous peoples’ appropriation of social media offers research opportunities for Indigenous scholars. In this research, an experiment was conducted to determine how social media can be used to persist language, cultural values and beliefs. We trialled Facebook, WhatsApp and Instagram (the most commonly used social platforms in Namibia at the time of the research), with younger and older people, to determine the potential of using these platforms for playing ‘Eengano’ online.

‘Eengano’ is an extensive, undocumented collection of proverbs and riddles common in all Oshiwambo dialects of northern Namibia. It consists of brief sayings, often with obscured meaning, characterized by a question and answer structure. Traditionally, families played ‘Eengano’ around the evening fire, where the Head of the House or mother initiated the session aimed at entertaining and educating the youth. These play crucial part in shaping the development of societies in Africa [1]. Since ‘Eengano’ are largely undocumented, parents are regarded as walking encyclopaedias who use the ‘Oxungi’ occasion (family evening gathering) to transmit and preserve this oral culture of the Oshiwambo tribe. Due to increased rural-to-urban migration and rural use of technology (e.g. cell-phones, social media), the younger generation is increasingly becoming unfamiliar with ‘Eengano’. This contributes to language loss and cultural gaps between older and younger generations. So over time cultural distinctions between similar communities blur and becomes monolithic: Just like the further you move away from an object the smaller and less distinguishable it becomes [2].
The research design employs a qualitative method using an interpretivist research approach, comprising of an observation of online participation and telephonic interview with the participants. To discover knowledge and patterns, and to acquire a deeper understanding of how the participants used social media to practice riddles, text mining was used for data analysis. A total of 26 participants were selected in the trials of Eengano between June and September 2017, where 11 were men, aged between 19 and 35 years, and 15 were women, aged between 20 and 45 years from different corners of Namibia and even one Oshiwambo participant took part while based in America.

The study analysed the use of social media, as well as the perspectives and opinions of participants, regarding how and when the use these networks benefitted/hindered them most. The findings led to the conclusion that social media networks can be used to successfully play Eengano, providing unique affordances such as permanency and accessibility of content that is missing in the traditional, oral practice. However, social media networks also disrupted the order of play of Eengano with some constraints such as asynchrony, that lets a user participate in the play regardless of the time of day or to start a new discussion irrespective of the rules or riddle trail. WhatsApp was the most used platform for online riddling followed by Facebook, while, Instagram was hardly used. Since the frequency of usage corresponded to the sequential scheduling of play on each of the platforms, the results are inconclusive on the preference of WhatsApp usage over the other two networking sites.

References

Critical Analysis of Intrusion Detection Approaches

H. N. Aludhilu¹* and R. R. Puente²

¹Department of Information Technology, School of Computing, University of Namibia
²Department of Computer Science, School of Computing, University of Namibia

*Author for correspondence
Email address: aludhiluhilma@gmail.com |Tel: +264 81 404 0313

Abstract
Nowadays, intrusion detection systems play a major role in system security. Intrusion detection systems are security systems or software that monitors and analyses computer systems or network traffic for possible attacks, originating from inside or outside the organization and also
for system misuse [3]. Ideally, intrusion detection systems are capable of detecting intrusions in real time to prevent intruders from causing any harm to computer systems. Desirable characteristics of an IDS includes minimum human supervision, ability to update itself by an automated process, high accuracy, low number of false alarm rate, ability to detect attacks and give quick response [1][2][4]. An intrusion detection systems to be developed need to have most of those desirable characteristics of an IDS. Intrusion detection systems are implemented using different intrusion detection approaches, with different strengths and limitations. This study provides a critical analysis of the strengths and limitations of the different intrusion detection approaches, including Statistical-Based Anomaly, Pattern Matching, Data Mining and Machine Learning approach. The study shows that different intrusion detection approaches have their strengths and limitations which could be improved to make the approaches better. The results of the critical analysis shows that the Machine Learning approach is the most suitable approach for implementing intrusion detection system solutions in real time with no (or very small) human supervision, because of its ability to work as an automated process which hardly needs human intervention. Therefore, this study recommends the use of Machine Learning approach in implementing intrusion detection systems that need to be running all the time with no or minimal supervision.

References

Chatbot: An Overview of Conversation Systems

M. M. Maimbolwa1* and R. R. Puente2

1Department of Information Technology, School of Computing, University of Namibia
2Computer Science Department, School of Computing, University of Namibia

*Author for correspondence
Email address: minyoi.maimbolwa@gmail.com | Tel: +264-81-8506760

Abstract
A Chatbot can be described as a computer system that is implemented on the basis of enhancement of Human Computer Interaction (HCI) through the operation of one-on-one conversations between the computer and human beings [4]. The Chatbot operates by receiving oral, typed or automatically gathered queries from a human being and providing correlated
responses, simulating a human conversation. Generally, the relationship between the user queries and the chatbot responses is of key importance in the design of Chatbots [2]. Over the past years, ever since the first Chatbot was developed in 1991, there have been various implementations of Chatbots with a diverse complexity of design implementations based on desired functionality. Results from a quantitative survey of implementations of the chatbot shows that there is still the challenge of implementing a design technique that produces an intelligent chatbot, with the most frequently highlighted cause being that the designs needed larger knowledge bases [1]. Furthermore, results have shown the growing trend, over the past five years, of design implementations based on Deep Neural Networks for continuously learning Chatbots and AIML (Artificial Intelligence Markup Language) for the representation of knowledge inserted into the Chatbot [3]. Therefore, the aim of this research is to show a critical analysis of the different implementation techniques for a goal-oriented chatbot.

References
DEPARTMENT OF GEOLOGY

Age dating of the groundwater in the perched aquifers in Okongo area, Ohangwena Region, Namibia

N L Masule
Hydrology Section, Geology Department, University of Namibia, Namibia

Email; nicco.libuku@gmail.com; Tel/Cell: +264-81-3786915

Abstract
Rural communities in the Okongo area, Namibia depends on perched groundwater as key water sources and supply for livestock, watering and domestic use. However, the occurrence and potential of this perched aquifer system is not fully understood, for the rural community to utilize their water in a sustainable way. Moreover, no studies have been carried out to determine the residence time of groundwater in this perched aquifer system using tritium and sulfur hexafluoride. Therefore, age dating of groundwater in perched aquifers was carried out in the Okongo area in order to determine the residence time of the groundwater, investigate the distribution of recharge areas and how the age patterns are within aquifers and determine whether all recharge to the perched aquifer is from local precipitation or from surface run-off by using Hydrochemistry, Stable Isotopes ($^2$H and $^{18}$O), Tritium ($^3$H) and Sulfur Hexafluoride (SF$_6$). In this study, a total of 18 groundwater samples were collected during the field campaign in October 2016 and April 2017 from six (6) shallow boreholes. The analysis of stable isotopes shows that groundwater in the perched aquifer system is more saturated and subjected to evaporation, which is caused by the high temperatures associated with the prevailing climatic conditions in the area. The ionic composition of the groundwater in the perched aquifer shows three group of water, characterised by mixed zone water, the Na$^+$-K$^+$-HCO$_3$ and Ca$^{2+}$-Mg$^{2+}$-HCO$_3$ water types. The perched aquifer system is dominated by the Ca$^{2+}$-Mg$^{2+}$-HCO$_3$ water type which is a result of the dissolution of calcrete and the formation of carbonate-rich rocks derived from a recent recharge with short residence times. Furthermore, the $^3$H method has indicated that, if the percentage of young water is higher than old water, the tritium concentration will increase and the age of the water will be young. Vise-versa is true, if the percentage of young water is less than percentage of older water tritium concentration will reduces and the age of the water will be old. The concentration of SF$_6$ in the groundwater samples proves that the recharge to the perched aquifer happened during the period of 1970 to 1977 with the groundwater age ranging from 40 to 47 years old. Therefore, this proves that the groundwater in the perched aquifer system is young with a short residence time.
The Geology, Petrography and Geochemistry of Aris Phonolites

L. Hailaula* and M. Teklay
Department of Geology, University of Namibia, Namibia

*Author for correspondence
Email: hlenathe@gmail.com

Abstract
Phonolites of Paleogene age occur at two different localities in Namibia, in central Namibia between Windhoek and Rehoboth (Aris and Staalhart phonolite) and in southern Namibia at Klinghart Mountains. The Aris phonolites belong to the late Tertiary Auas alkaline volcanic province, which extends 25 km from south of Windhoek to Rehoboth. The estimated age of the Aris phonolites is about 32 Ma. In Aris area six individual phonolite bodies occur and this study has been taken on the two bodies: Ariskop and Railway quarries. In both quarries, the phonolites occur as concordant sill bodies intruding the Hohewarte Metamorphic Complex. Ariskop and Railway phonolites are aphanitic, porphyritic and vesicular. Ariskop phonolites are relatively more vesicular than the Railway quarry suggesting that they may be emplaced at relatively shallower depth. Petrographically both phonolites consist of sanidine, nepheline and aegirine as major minerals and apatite, zircon and monazite as accessories. Texturally these phonolites are holocrystalline, pilotaxitic and porphyritic with phenocrysts of nepheline, sanidine and aegirine set in a groundmass of sanidine and nepheline. The phenocrysts confirm that fractional crystallisation played a major role during the solidification of the rocks. On the Total Alkali-Silica (TAS) diagram representative samples from both quarries plot well in the field of phonolites. These peralkaline phonolites are nepheline and acmite normative and exhibit a narrow range of major elements with high concentrations in the alkalis. Phonolites from both areas are enriched in Rb, Zr, Hf, Nb, Ta, Pb, Th, U and Rare Earth Elements (REE), but depleted in Cr, Co, Ni, Ba and Sr. Chondrite-normalized REE patterns of the phonolites are very similar and show a bowl-shaped pattern with negative Eu-anomalies, enriched LREE (normalized La/Sm = 34.4-38.2) and slightly depleted HREE (normalized Gd/Lu = 0.72-0.82). The good positive correlation between the highly incompatible elements Nb, Th, Zr, Ta, and Hf among the phonolites from both quarries suggest similar source. However, the Ariskop phonolites show relatively higher concentrations in these elements suggesting a lower degree or greater depth of melting. The variations in compatible elements Cr, Ni, Sr and Ba together with the Eu-anomalies indicate the role of fractionation of sanidine, nepheline and aegirine in these samples. The enrichment in Nb, Zr and Th together with the bowl-shaped REE patterns suggest the role of minor phases suchapatite in partial melting or fractionation.

The Distribution and Occurrence of Lithium-bearing Minerals in the Helikon 5 Pegmatite in Karibib, Namibia

S. M. Mandeyhu, 1* A. F. Kamona1, A. Vatuva1, S. Kahovera2

1Department of Geology, University of Namibia
2Desert Lion Energy Namibia

*Corresponding author
email: ednasarafina@gmail.com; Contact number: 0814149125

Abstract
The Karibib Pegmatite Belt (KPB), which lies in the Southern Central Zone of the Damara Orogen (Ashworth., 2014), contains valuable Lithium-Cesium-Tantalum (LCT) type of
pegmatites. The pegmatites of this belt are subdivided into the Etusis, Kaliombo-Okongava and Dernburg-Abbatis-Naob portions. Desert Lion Energy is currently exploring for Lithium mineralization in the Helikon pegmatites, which lies in the Kaliombo-Okongava portion of the KPB. The Helikon pegmatites are classified as LCT family following on the petrogenetic classification scheme (Cerny et al., 2005), and are characterized by a high degree of alkali fractionation (Stewart, 1978). The occurrence and distribution of lithium minerals in different zones of the Helikon Pegmatites are not well understood at present, hence the need for this study. This study aimed to establish the zonation sequence, geochemical characteristics, occurrence and variation of lithium minerals in different zones of the Helikon 5 Pegmatite. This was aided by geological mapping, petrography, core logging, XRD and geochemical analysis. Comparison was done with the Helikon 6 Pegmatite, in order to establish criteria to use the internal zonation as a basis to support LCT-type pegmatites exploration.

Both the Helikon 5 and 6 pegmatites occur within the Karibib marble. The attitude of the Helikon 5 pegmatite is 098°/62° SW, which is similar to that of the Karibib marble (105°/48° SW), whereas the Helikon 6 pegmatites dip northwards (250°/48° NW), in the opposite direction to that of the country rock (055°/50° SE). Helikon 5 consists of a 480 meter-long continuous zoned pegmatite, whereas at Helikon 6, there occurs two distinct and zoned pegmatites, with discrete and discontinuous mineralization restricted to areas with well-developed internal zonation. The primary lithium mineralization is characterized by purple and grey lepidolite, with minor amounts of petalite. Furthermore, lithium mineralization occurs as both massive and disseminated at Helikon 5 and 6 pegmatites, but it also occurs as banded at Helikon 6.

Petrographic studies show that the lepidolite zone is mainly associated with quartz and albite. ICP-MS analysis revealed that lithium concentrations average to 1467 ppm in the quartz-albite muscovite zone; 1840 ppm in the lepidolite-petalite zone and 8335 ppm in the lepidolite-albite-quartz zone at the Helikon 5 pegmatite. In contrast, the Helikon 6 pegmatite lithium concentrations average to 865 ppm in the quartz-albite-muscovite zone; 14725 ppm in the lepidolite zone and 3666 ppm in the lepidolite-albite-quartz zone. XRD analysis determined an overall lithium grade of 3.01% Li₂O.

REFERENCES

The Geology and Geochemistry of Granitic Intrusions and Basement rocks in the Upper Khan River

C.P Mbangu*, E. Shalimba, A.F Kamona, and B.S Mapani
Department of Geology, University of Namibia, Namibia

*Author for correspondence
collinp235@gmail.com; cell: 0813122751
Abstract
Preservations of in situ partial melting of country rocks are rare, exceptionally so in areas where intrusions are not hot enough to completely melt country rocks. Ascend of high temperature melt from buried rocks induced by crustal thickening interacts with overlying country rocks resulting in formation of different structures. A field, petrography, major and trace element geochemistry study was carried out in the upper Khan River located in the southern Central Zone of the Damara Belt to identify structures in basement rocks and determine the relations between basement rocks and granitic intrusions. Xenoliths of country rocks observed in granites of the area are evident of shallow crustal contamination during melt ascend. Furthermore, presence of tourmaline in granites along the margin with biotite schists may indicate boron assimilation from basement metasediments during melt ascend. Strain measurements from mixtites suggest a constriction index of deformation in the study area. Foliations in basement gneisses is well developed as shown by the alignment of biotite sheets between quartz grains. Enclosure of early ferromagnesian vein in later felsic vein within the Khan Formation can be explained by the intrusion of segregated immiscible fluids. Petrographic studies show intense alterations of biotite to chlorite in basement rocks and epidotisation of plagioclase in the felsic vein. Geochemistry of basement rocks suggest a sedimentary origin and tend to have higher LREE then granites. Granites point to a magmatic origin and range from peralkaline (Na2O+K2O>Al2O3) to peraluminous (Al2O3 > (CaO + Na2O + K2O)). Due to limited amounts of in situ partial melting is it likely that basement rocks and metasediments are not the sources for the large intrusive bodies.

Keywords: Khan River; intrusions; basement; xenolith; strain; partial melting

References:

MINERALOGICAL AND PETROGRAPHIC CHARACTERIZATION OF THE ONGOMBO DEPOSIT

A. M. Mwandingi*, A. Vatuva, and A. F. Kamona
Department of Geology, University of Namibia

*Author of correspondence
Email: amwanding17@gmail.com | Cell: +264-81-442-4619

Abstract
The Ongombo and Ongeama deposits are some of the known volcanogenic-exhalative, sediment-hosted stratiform, metal sulphide deposits, under the Otjihase Cluster. The Otjihase Cluster is one of the four clusters (Otjihase, Gorob, Matchless and Niedersachen) associated with the prominent narrow northeast-southwest trending Matchless Amphibolite Belt (MAB). The MAB is intercalated in the Kuiseb Formation of the Swakop Group and extends over about 350km within the Southern Zone of the Damara belt. The MAB is associated with a variety of sulphide deposits, of which the Otjihase and the Matchless deposits were major discoveries. The Ongombo and Ongeama are currently under exploration, thus an interdisciplinary project (petrography, mineralogy, geochemistry, structural and economic geology) was initiated to determining the occurrence and distribution of ore minerals in the Ongombo ore deposit.

The Ongombo deposit is the focus of the study and is thought to be a Besshi-type massive sulphide with three main northeast plunging mineralized shoots and a gossan that is poorly developed. Compared to other deposits of the Otjihase Cluster, the gossan at Ongombo has a unique texture different from the rest of the cluster and was divided into a Northern and Southern Gossan, as it is intersected by the White Nossob River. Both the Northern and Southern Gossans show evidence of the movement of hydrothermal fluids and have very distinct styles of mineralization.

Detailed lithological drill core logging identified that the major sulphide minerals in the Ongombo deposit comprise pyrite, chalcopyrite and pyrrhotite. The mineral occurrences included massive, semi-massive, disseminated, veinlets and isolated sulphide grains in a psammitic (quartz-biotite) schist with minor chlorite lenses. Major sulphide mineralization is hosted within the biotite-rich zones of the psammitic schist, and due to remobilization, the sulphides are enriched within the pressure shadows of biotite and quartz porphyroblasts. The psammitic schist with minor to no chlorite lenses is often associated with a magnetic groundmass and magnetic quartzite.

Geochemical assays of mineralized zones using Atomic Absorption Spectroscopy (AAS) and Inductively Coupled Plasma Mass Spectrometry (ICPMS), in both the Ongombo and Ongeama drill cores, indicated that high gold concentrations were associated with high arsenic, iron and sulphur values, as well as low bismuth values. High concentrations were also associated with copper percentages close to 1% and silver concentrations of 4+ grams per ton. Samples with the highest gold concentrations from each drill core were selected for thin and polished section processing to conduct microscopy studies, which identified grains of gold to be associated with chalcopyrite.

**Keywords:** Ongombo; Ongeama; Matchless belt; orebody; mineralization; occurrence

---

**Hydrograph interpretation, establishment of rates and timing of recharge for shallow Kalahari perched aquifers in Ohangwena region, Namibia**

*J. N. Nghipandulwa*, H. Wanke, J. T. Hamutoko

*Hydrogeology Section, Geology Department, University of Namibia*
Abstract
Shallow Kalahari perched aquifers in Ohangwena region, northern Namibia are a crucial portable water source for their respective communities. These perched aquifers are tapped by shallow funnel-shaped and deeper cylindrical-shaped hand dug wells, up to 30 m deep. Although the areal extents of these aquifers have not yet been mapped, Hamutoko, (2018) believes that the perched aquifers are associated with pans, ephemeral rivers and shallow depressions on the surface. An understanding of recharge processes and rates into these aquifers is crucial for evaluating their abstraction potential and subsequent sustainable groundwater management. Due to a lack of continuous water level time series data and understanding of hydraulic properties of the aquifers, however, temporal variations of recharge rates, timing of recharge events and seasonal water level fluctuations have not been evaluated.

This study aimed to use the water table fluctuation (WTF) method to establish recharge rates and its spatial and temporal variations for five (5) observation boreholes tapping Kalahari perched aquifers in the Cuvelai-Etosha Basin (CEB). The established rates were verified with two independent methods, namely the chloride mass balance (CMB) method and isotope parallel shift method. Hydrographs were constructed and classified into fluctuation types and used to evaluate recharge characteristics and the factors influencing water level fluctuations on the aquifer hydrographs. The timing of recharge, the threshold intensity of recharged precipitation events and the delay factors were also established.

Using the WTF method, this study established recharge rates ranging from 21.6 mm/a to 55.9 mm/a, with Oshanashiwa having the lowest and Omboloka having the highest recharge rates. CMB method obtained recharge rates ranging from 23.8 mm/a to 50.6 mm/a, the lowest and highest rates having been recorded at Okamanya and Omboloka respectively, and an outlier of 135 mm/a for Ohameva site. Isotope parallel shift method, an empirical method that determines only maximum and minimum recharge rates for the whole area using the shift of the regression line through the sample plots from the local meteoric water line (LMWL) (Allison et al., 1984), obtained minimum and maximum recharge rates of 6.5 mm/a and 54 mm/a for the area respectively. According to its hydrograph, Epumbalondjaba was classified as Type I, characterised by flashy responses to precipitation and less obvious responses to abstraction; Ohameva and Okamanya as Type II with moderately retarded responses to precipitation and clear abstraction effects; Omboloka as Type III with highly retarded responses to precipitation and no clear abstraction effects and Oshanashiwa with only seasonal responses to precipitation and very clear responses to abstraction. The study has established based on the hydrographs and rain graph comparison that precipitation events of all magnitudes contribute to recharge at Epumbalondjaba; whereas only cumulative precipitation events are recharged at Oshanashiwa, after the rainy season has ended. Other stations are recharged by cumulative precipitation events and individual precipitation events greater than 8mm. Subsequently, isotopic plots confirm that the deeper aquifers are only recharged by larger intensity precipitation events whereas shallower aquifers are recharged by even the smaller precipitation events.

References
Hydrological and hydrogeological characterization of the Rietfontein Catchment, Namibia

M. Nyama*, A. Nakwafila, H. Wanke
Department of Geology, University of Namibia

*Corresponding author
Email: marthanyama@gmail.com, Contact number: 0817867798

Abstract
To produce reliable information for management of groundwater sources, it is crucial to understand hydrological systems through hydrological modelling. Groundwater management in Namibia is critically important due to the arid to semi-arid climatic conditions that exist in the region. The Rietfontein catchment is located in the Omaheke region which lies on the eastern border of Namibia to Botswana and is the Western extension of the Kalahari Desert. Communities within the Rietfontein catchment covering 9424 km² of land receive about 400 mm/a of precipitation and as such rely primarily on groundwater. The characterisation of this catchment paves way for further studies that will ultimately improve management of an already scarce water resource. Crucial elements like climate, topography, vegetation and the geology of the catchment area that contribute to the integration of landforms and man-made features as well as influencing interactions of surface water and groundwater hydrology were studied. The primary aim of this research was to characterise the catchment based on its hydrology and hydrogeology and as such, analyses were performed on groundwater throughout the catchment area. Several water parameters were taken on-site using groundwater drawn at the borehole site and these included pH, temperature [°C], electric conductivity [μS/cm], redox potential [mV] and depth [m] of the borehole. Water samples collected in 50mL glass bottles were brought to the UNAM Hydrogeology Laboratory and analysed for stable isotopes using an off-axis integrated cavity output spectroscope (OA-ICOS, Los Gatos DLT-100) meter. This tool is used to investigate groundwater sources as well as mechanisms of groundwater recharge, age and dynamics (movement), producing data that is crucial to achieving the study’s objectives. There are various methods of data interpretation and these include software such as QGIS which was used to compose and export graphical maps. In addition, graphics such as Schoeller plots and Piper diagrams were also used to display and interpret data on the chemistry of the groundwater in the region.

The average pH, temperature and calculated redox potential of the groundwater samples from all sampled areas was 7.1, 26°C and 104 mV respectively.
Petrography and Geochemistry of Kumbis/Kairab Formations in Sinclair-Helmeringhausen-Awasib Terrane

L.P. Shifeleni*, M. Harris, and B.S. Mapani
Department of Geology, University of Namibia, Namibia

*Author for correspondence
Email address: lpshifeleni@gmail.com, Tel: +264 81 779 0334

Abstract
This study was carried out on the Kumbis and Kairab Formations of the Sinclair Supergroup in the Konkiep terrane, southern Namibia. There is little geochemical data available for the Kumbis Formation as compared to its correlate the Kairab Formation. The project generated reveal clear relationships between the two formations on the basis of petrography (field observations and thin sections) and geochemistry (using ICP-MS chemical analysis). Petrography shows some degree of consistency of felsic units in both formations, with Kairab Formation amounting more mafic rocks intruded by felsic dykes whereas felsic units of Kumbis Formation are mostly intruded by mafic dykes. Intermediate rocks are scarce and intrusive rocks found intruding both formations range from granite-granodiorite to gabbro. Most of the petrographic work done on thin sections agrees with the field observations and it was found that most, if not all, of the Sinclair Supergroup is not intensively metamorphosed as previously thought. Geochemical binary plots of La/Yb – Th/Nb shows a range of tectonic settings responsible for the Kairab/Kumbis Formations, with most samples falling within continental arcs (felsic rocks) and oceanic arcs (mafic rocks). This proposes that the tectonic setting of the area is more of a collisional type then a rift tectonic setting proposed by some authors.
Adaptive Step size Numerical Methods for Solving Ordinary differential equations

Mwanyekange Josefine T.* and DSI Iyambo
Department of Mathematics, University Of Namibia

*Author for correspondence
Email:josefinetuhafeni18@gmail.com

Abstract
This paper is more focused on the methods for solving ordinary differential equations (ODE's). Numerical solutions of ordinary differential equations with integer order has been developed by many researchers and has been a standard topic in numerical and computational mathematics. The exact solution of the ODEs is difficult to obtain, hence it is necessary to develop numerical tools in order to solve the ODEs easily. However, numerical methods have their draw backs through computational cost. Some of the numerical methods do not give accurate results due to the underlying dynamics of a model. Thus for this reason we adapt the domain of the underlying dynamics through two numerical methods, analyse and present our results.

References
Analytical, Semi-Analytical and Numerical Methods for Fractional Differential Equations

D.T. Jinga* and R.B. Gnitchogna
Mathematics Department, University of Namibia

*Author for correspondence
Email: desiretakudzwa@gmail.com

Abstract
In this paper we discussed analytical, semi analytical and numerical methods for fractional derivatives. These methods are operators based Laplace Transform, Mellin Transform, Sumudu Transform, or Adomian Decomposition, Homotopy Decomposition, Green Function, Finite Difference and Gnitchogna-Atangana. We apply these methods on some classic examples, and discussed and compare their performance in terms of their accuracy, convergence order and efficiency.

Reference

A THEORY OF TAIL RISK MEAURES

S. Amaambo* and S. NUUGULU
Financial mathematics, Department of mathematics, University of Namibia

*Author for correspondence
e-mail; sharonamaambo@gmail.com

Abstract
Risk measures have become an important tool in risk management as stated in the recent regulatory documents and many of the financial institutions have been heavily relying on the two main measures of tail risk namely; Value at risk (VaR) and expected shortfall(es). This research work reviews a comprehensive study of the tail risk by carrying out an axiomatic study of properties of coherent risk measures which brings the relevancy of elicitability and sub-additivity. This research work also provides an overview of the extreme theory (EVT) as a method for modelling and measuring extreme risks by using the Peaks-over-threshold (POT) model to estimate the Value-at-risk and the expected shortfall.

**Keywords:** Value-at-Risk (VaR), expected shortfall (es), Extreme Value Theorem (EVT), Peaks-over-threshold (POT).

**References:**

**Fractional Black-Scholes PDE's for pricing Foreign Exchange Options**

**S. Nuguulu and C.M Kafukanya*  
Department of mathematics, Faculty of Science, University of Namibia**

*Author for correspondence  
email; chipomarjory@gmail.com

**Abstract**
By making use of the delta-hedging strategy to obtain a pricing formula and derive fractional Black-Scholes PDE's, this research seeks to address the problem of pricing foreign exchange options that follow the Black Scholes pricing model whilst accounting for transactional costs in a discrete time setting. The study further seeks to investigate the estimator of volatility and some Greeks.

The major concern of the Black-Scholes formula is the fair pricing of derivatives. The classical Black-Scholes framework is dependent on the assumption that the market consists of a risky asset like a stock and a riskless asset such as a bond. In this framework, some cardinal assumptions tend to make the model not particularly realistic. We look at three of these assumptions. The first is that during the lifespan of the contract, a constant rate of return is maintained. This is obviously not the case as interest rates are bound to market forces and thus cannot be constant for a long time in the practical sense.

The second assumption is that of constant volatility. Most traded assets exhibit uneven fluctuations thus assuming constant volatility introduces some measure of risk. The third is that
there are no transaction costs. Majority of traded financial assets do involve transactional costs, taxation as well as dividend payments. To obtain more realistic asset valuation models, it is important to relax some of these assumptions based on the particulars that differ from case to case.

References

Contemporary Approaches To The Modeling Of Financial Bubbles

R. Gnitchogna and A.K Simanga*
Department of Mathematics, University of Namibia

*Author for correspondence
email; alissandrasimanga@gmail.com

Abstract
The testing of the existence of asset price bubbles has proven to be a difficult task, especially doing so in real-time. This paper examines three approaches, The Johansen-Ledoit-Sornette model, Stochastic Process and Option Pricing models, used to identify asset price bubbles in a continuous time model. We start of, by explaining the basis of the stochastic Process and Option Pricing models.
This is followed by defining the approaches and the formulas they are established on. We proceed with a case study, making use of the Stochastic Process, to show the existence and non-existence of asset price bubbles in two stocks. We conclude with the advantages and disadvantages of the approaches.

References
Evaluation of Namibia's household’s indebtedness and its probable impact on the overall financial stability of the country

T. Hamutoko1*, S. Nuugulu1 and E. Jurius2

1Financial Mathematics, Departments of Mathematics, University of Namibia
2National Planning Commission

*Authors for correspondence
Email: tnthamutoko@gmail.com

Abstract
In recent years, Namibia has experienced a relatively increase in housing prices as well as the household debt. This has risen concerns in the housing sector with the population of the country increasing on the other hand. Financial reliability of the household sector matters for the overall financial stability. The aim of this paper is to present and analyze the main measures of indebtedness. We discussed how different factors such as household income, mortgages, household debts and financial prudence influence or fuel the household debts looking at different household characteristics such as income groups, age, gender, educational level and looking at different region separately. To determine the country's household's ability to pay back its debts the household debts was compared with the real GDP. The Cox Regression Model was used to simultaneously explore the effects of several variables on survival of employment. This was done by approximating the probability of staying employed at a given time and this is done because employment is the main source of household income and it has a greater influence in decision making. Different ratio test such debt to income ratio, debt to service ratio, debt to asset ratio and household debt to real GDP were employed in the data analysis. Debt to income ratio shows the percentage of income goes toward repaying someone's debt. We found out that most Namibian household with high incomes or with more wealth tends to have high debts as they are confident that they will pay back this loans.

Keywords: Household indebtedness, debts, income, mortgages and financial stability.

References
Dynamic Loan Loss Provisions in Banks

L. Sofika*, S. Nuugulu
Financial Mathematics, Department of Mathematics, University of Namibia

*Author for correspondence
Email: lahyasofia@gmail.com

Abstract
Losses in the loan portfolios of banks tend to follow economic cycles falling during expansions and rising during downturns. Banks recognize these losses through loan loss provisioning. The pro-cyclical effect of bank capital requirements has attracted much attention in the post-crisis discussion of how to make the financial system more stable. This paper investigates and calibrates a dynamic provision as an instrument for addressing pro-cyclicality. The model for the dynamic provision is adopted from the Spanish banking regulatory system. We studied balance sheets of different banks in three Southern African countries.

Keywords: banks, dynamic provisioning, pro-cyclicality, loan loss provision.

References

Portfolio Optimisation using fuzzy systems

T. Makuvaza*, Vijakumar Kandaswamy
Department of Mathematics, University of Namibia

*Author of correspondence
email; teemakuvaza@hotmail.com

Abstract
The purpose of the research was to solve problems with the Markowitz model which is the first model of Portfolio Theory. Although the Markowitz model is still widely used in modern Financial Mathematics, it can be modified to produce better results if we relax some of the assumption. The problems with the Markowitz model that are addressed in this model are that the investor is risk averse but in the model we consider three possible scenarios which are risk
aversion, risk neutral and risk loving. Availability of computational power makes it less complicated when we are working with many assets. If the investor is not satisfied with the results, the fuzzy problem is resolved with new parameters and the process is re-iterated until the investor terminates the process. The paper investigates performance of listed equities on stock exchanges. The data was collected from Johannesburg stock exchange, NASDAQ, London Stock Exchange and New York Stock Exchange. The data mining process affect the model to a greater extend because bad input will lead to poor results (garbage in, garbage out). The data collected are daily stock prices for the six months. The other problem is the credibility of past data to predict the future. It is not always certain that the future will replicate the past and some financial models are based on the Markov assumption which states that the current data is the only relevant data which is needed to predict the future because past information is already contained in that past data. The problem with calibration which can be defined as a technique to predict future values using past data is that if we calibrate today and then calibrate again the next day, we will get different results. This inconsistency in the output can affect the values of the model to a greater extend. The assumption that there is no tax and transaction costs is unrealistic in practice since these two factors play a critical role in investment strategies carried out by firms. Capturing tax rates and transaction costs is no easy task because we do not know what type of tax the investor is liable to for example income tax, capital gains or corporate tax and the time that tax is paid which makes it difficult to incorporate time value of money techniques. Secondly, tax regulation can change and this may affect the results of our model. We also do not know the transaction costs that the investor has to pay and this makes it difficult to incorporate them in the model.

Keywords: Markowitz Model, Fuzzy set, Membership function, Calibration, Markov assumption

References

Numerical Methods for Black-Scholes Equation

M. Uupindi* and Dr R. Gnitchogna

Financial Mathematics, Department of Mathematics, University of Namibia

*Author for correspondence
email: mariamegauupindi@gmail.com

Abstract
The aim of this work is to compare the efficiency of the numerical approaches mostly used to evaluate solutions of a classic Black-Scholes Equation for European option. Due to the nonexistence of close form solution to Black-Scholes Equations, we will focus on the two numerical methods implicit forward approximation and the Crank Nicholson method. We will use European style option for our application. The purpose of this research work features simultaneously in both Numerical Method for partial Differential Equations and Mathematical Methods of option pricing theory.

References

A Mathematical Model to Determine the Best Selling Price and Optimal Time-on-the-Market of a House

L. Murisa* and V. Kandaswamy

Financial Mathematics, Department of Mathematics, University of Namibia

*Author for correspondence
Email: murisaloraine5@gmail.com

Abstract
The International Monetary Fund’s 2015 report warned of a pending housing bubble burst in Namibia’s housing market. High Demand and a limited Supply of houses pushed prices in Namibia’s capital, Windhoek, in the past decade from an average of N$400000 to N$900000 for
middle income properties. With low income and high mortgage rates selling a house has become a communal frustration in real estate. In this research work, we seek to develop a model that determines the optimal-time-to-market of a house that allows the seller to optimize time on the market and still acquire a minimal difference between selling price and list price. We will show how the skewness of income distribution has caused the Namibian housing market to be flawed.

**Keywords**: housing market, time-to-market, mortgage rate, selling price, demand and supply.

**References**

---

**Taylor series expansion for financial derivatives**

**K. Endjala** and G. Rodrigue  
*Department of Mathematics, University of Namibia*

*Author of correspondence*  
email: chrisshoopala@gmail.com

**Abstract**
An analysis, based on the use of Taylor series expansions, in financial mathematics applications, is developed to determine overall the accuracy of the approach. Estimates for derivatives in one and two dimensions are at times computed by differentiation of a finite-element interpolant or approximation. The analysis focuses on the question of how to actualize asset values efficiently. This work examines the Taylor series expansion as one of the markets technical response to this problem.

**References**
ON THE HIGHER ORDER TAYLOR’S METHOD

David SI Iiyambo, Elise N Lazarus, Linda N Shiikwa *
Department of Mathematics, University of Namibia

*Author of correspondence
email; lindashiikwa@gmail.com

Abstract
This approach is based on applying Taylor methods such as Euler’s method, Runge-Kutta and Taylor method of higher order to some Ordinary differential equations (ODEs). The numerical values are obtained using MATLAB performing the iterations where, the estimated and analytic values are obtained using some differentiation and integration techniques. However for computation the step-size is kept constant throughout the project. Moreover the analytic and estimated values obtained from the three methods are compared in terms of their convergence and accuracy. It is noticed that the higher the order, the fewer the steps.

References

Semi-Simple Lie Algebra

G. Marelli and T. Wilbard*
Department of Mathematic, University of Namibia

*Author for correspondence
Email; evrathomas@gmail.com

Abstract:
Lie groups, whose relevance comes from the fact that they arise as groups of symmetries of geometrical objects, are sets carrying both the structure of group and of smooth manifold in a compatible way. The Lie algebra of a Lie group, which is defined as the tangent space at the identity, is much more than a simple approximation of the Lie group. As algebraic structure, a Lie algebra is a vector spaces endowed with a bracket satisfying suitable properties. After introducing these ideas, we present Engel's theorem, which states that a Lie algebra is nilpotent if and only if all its elements are ad-nilpotent, and sketch a proof of it.

Reference

Analysis of system of parabolic partial differential
Equations modelling tumour cells

S. Haihambo*, A. Shikongo
Department of Mathematics, University of Namibia

*Author for correspondence
email: shafewangehaihambo@gmail.com;

Abstract
The dynamics of cancer diseases, among ourselves and the effect of this dreadful disease, is well-known to us as human beings. Therefore, in my project we consider the composition of a system of nonlinear ordinary differential equations (ODEs), arising in cancer modelling [3]. The composition of the model enables us to modify and/or extend the original model to a system of non-linear reaction-diffusion model. By considering the model without diffusion and/or cross-diffusion, reduces the model to the original model, which is a system of nonlinear ordinary differential equations (ODEs). We carry out the steady state analysis as a determining and presenting the qualitative features of the model. This will enables us to compare our findings for both models and present our results for comparison purposes and for future direction.

References
FINITE DIFFERENCE DISCRETIZATION OF THE FISHER’S EQUATION

Upani J *, DSI Iiyambo
Department of Mathematics, University Of Namibia,Namibia

*Author for correspondence
email; nabbygirl@gmail.com

Abstract
In this research, the Crank-Nicolson-type Finite Difference method is used to study the numerical solutions of the second order nonlinear reaction diffusion equation called the Fisher’s equation. We will be showing illustrative examples that will help us look at the theoretical issues such as existence of solutions, stability, consistency and convergence. The proposed method has the advantage of reducing the problem to a nonlinear system of simultaneous equations, which will be solved using Newton’s method.

References

Is Housing Wealth really a Wealth in Namibia?

L.I. Makupu, V.Kandaswamy

Financial Mathematics, Department of Mathematics, University of Namibia

*Author of correspondence
email: lebohangmmakupul@gmail.com

Abstract
Housing has been perceived as an essential vehicle for storing and accumulating wealth. Property prices are prone to cycle fluctuations. Some key interrogations are for example: will property values continue to escalate at this rate current in the future? Will counties like Namibia be able to cope in the event of a global financial crisis? These are but some of the high risk investment questions that a nation and possible property investors need to be retorted. By doing a quantitative analysis using the Representative agent and Yaari-Blanchard model to determine how a change in the intrinsic value redistribute wealth between long housing and short housing. We begin by examining how through birth rates, credit/collateral effects affect fundamental house values and in essence how they affect aggregate consumption. Moreover this will aid in establishing the wealth effect on consumption by examining a change in housing prices due to a bubble component. In addition the study will further explore how this change in housing prices affect aggregate consumption. Finally a conclusion will be drawn through inferences from the results of the qualitative analysis.

Keywords: Wealth effect; House prices; Speculative bubble

References
Claim Reserving and Longevity risk

K.Joseph*, R.Gnitchogna

Department of Mathematics, University of Namibia, Namibia

*Author for correspondence
e-mail: Josephine.Joseph93@yahoo.com

Abstract
The average life expectancy of the world's population has steadily increased over the last century, however there are trends that indicate that some changes in mortality are to be anticipated and there is great uncertainty about the future development and progression of mortality rates. This type of uncertainty is called longevity risk. This work seeks to assess the current state of evidence of lifelong risk. Firstly the literature on the subject is surveyed to analyse some stochastic models of claim reserving in light of longevity - the Chain-Ladder and exponential run off model Secondly, we consider the importance of longevity risk for the pension's solvency life insurance products. Finally, our reports focus on the various approaches for dealing with Longevity risk. We specifically consider long-term risk management through securitization and / or pension and insurance (re)design.

Keywords: longevity risk, Claim Reserving, Pensions, securitization

References

Symmetries of ordinary differential equations

N.Aludhilu*, A, Shikongo

Department of mathematics, University of Namibia, Namibia
Abstract
Research paper will try to solve ordinary differential equations with the method developed by Sophus Lie a Norwegian mathematician which involves finding a solution of ordinary differential equations based on their symmetry. Topics discussed include different techniques of solving differential equations with the symmetry method such as canonical coordinates, symmetry condition formula and infinitesimal generator which is a method used to solve higher order differential equations by reducing their order. Finally, equations would be solved using numerical solution and seek the connection between the numerical method solution and the analytic solution.

References

An analysis on the Validity and Usefulness of the Black-Scholes Model on Pricing Option and Hedging.

S. Mwareka* and R. Gnitchogna
Financial Mathematics, Department of Mathematics, University of Namibia

*Author for correspondence
Email: mwerekas@gmail.com

Abstract
The general objectives of this study is to determine the validity and usefulness of the Black-Scholes approach through regression analysis. We will assess relevance and validity of the parameters involved in the Black-Scholes option pricing model to predict the option price. We will use various market data for this analysis. We will assess relevance and validity of the parameters involved in the Black-Scholes option pricing model to predict the option price. The main source of data collection was secondary data from the NASDAQ website collected from July 2015 to July 2018.
We will use various market data for this analysis. We started by examining the contemporary critique of the model in the literature, and proceeded with our regression analysis. Our results concurred with some similar analysis in the literature. We found that on an average the mean of
prices calculated by BSM is greater than the actual market prices. As the number of observations increased, the deviation of BSOPM price from the actual market price increased.

References

On regime and non-regime switching models for foreign exchange rates

H Kamupingene*, S Nuugulu
Financial Mathematics, Department of Mathematics, University of Namibia

*Author for correspondence
Email: hitjiza@gmail.com

Abstract
This work serves to investigate the properties of foreign exchange rates in relation to regime switching structures. Daily data on USD/JPY, EUR/USD, GPD/USD and ZAR/USD currency pairs are analysed using a Hamilton (1989)'s type of Markov Regime Switching model as well as a non-regime switching model based on the Exponential Generalised Autoregressive Conditional Heteroscedastic Model (EGARCH). To study the Foreign Exchange Rates the above mentioned models are combined, observing that, all parameter values depend on a continuous time Markov chain. The results obtained from the two models (regime switching Hamilton model and non-regime switching EGARCH model) are compared. Preliminary results indicate that the considered Foreign Exchange Rate pairs exhibits some regime switching properties, characterized by regimes of high volatility and those of calm/low volatility.

Keywords: Foreign Exchange Rates; Regime switching model; EGARCH; Volatility.

References

A Study on the South African Foreign Exchange Market:
Abstract
Are frequent changes in freely floating exchange rates responsible for stabilizing speculation reflecting changes in the fundamental determinants of currencies or are they responsible for destabilizing their behaviour such that it drives away prices from fundamentals, creating excess volatility? In a solely floating exchange rate system currency volatility is the nature of the game as it affects the performance of various macroeconomic variables in any economy, therefore there’s a need to examine the causes and effects of exchange rate volatility. South Africa has a broad background when it comes to foreign exchange rate regimes and like other emerging economies is experiencing high exchange rate volatility; therefore this study assessed the exchange rate volatility in South Africa using ARCH and GARCH models. This paper also under seeks the credible drivers of the Rand using the market based volatility index for the ZAR/US$ exchange rate. Various studies state that the existing high frequency exchange rate volatility has collectively pressed on the Efficient Market Hypothesis (EMH) as its foundation, hence the study also aims to inspect the efficiency of the South African foreign exchange market by examining the weak form EMH using bilateral exchange rates and applying the ADF and unit root tests on the basis that there is a unit root in the time series.

Keywords: Exchange rate volatility; ARCH and GARCH models; EMH; ADF

References

Readjustment of hyper inflated house prices by bubble effect with discounted payoff: Case of Namibia

A. Nuunjango*, V. Kandaswamy
Financial Mathematics, Department of Mathematics, University of Namibia
*Author for correspondence
email: alberxina@gmail.com

Abstract
Namibian housing market experienced substantial price volatility, a significant determinant of default and the defrayal of housing loans. Many researchers believe that significant increase in house price has the potential to produce a house price bubble. The study of the paper provides real time dating algorithm for bubble detection of the housing price data from 1990 to 2017 using right tailed unit root test, focusing on the sup ADF & generalized sup ADF tests of Phillips, Wu and Yu (2011) and Phillips, Shi and Yu (2011). These tests be used in real time to locate the origination and collapse dates of bubbles. We therefore aim to capture the percentages of inflation occurred to the prices of property during the periods when bubble took place. Resulting to readjust the prices with discounted payoff.

Keywords: Housing price, Unit root test, sup ADF test, Generalized sup ADF test, bubble duration.

References

The effects of demand, supply and affordability on the Namibian housing market volatility

RM.Tjiueza* and V.Kandaswamy
Financial Mathematics, Department of Mathematics, University of Namibia

*Author for correspondence
Email: raymond.tjiueza@yahoo.com

Abstract
This study will focus on the volatility clustering effects (ARCH effects), Lagrange multiplier (LM) test and the model of exponential-generalized autoregressive conditional heteroscedasticity (EGARCH) to determine the factors of housing escalations using the historical data from 1990 till 2017. The most effective factors influencing housing price escalations will be determined by region-wise and nationwide analysis. A comparative analysis of income growth and house price growth is done for every region independently and also for nation using statistical programming R. Income and affordability factors are studied in order to establish their effects on the housing market price volatility.
Keywords: Affordability, Income, volatility, supply, demand, EGARCH model.

References

The application of the classical fourth order Runge-Kutta method on the Lotka-Volterra equations

S.S Ngchatanga*, A. Shikongo
Department of Mathematics, University of Namibia, Namibia

*Author for correspondence
email: saimasnghatanga@gmail.com

Abstract
The interactions in which one organism consumes all or part of another, which includes predator-prey, herbivore-plant, and parasite-host interactions, can be viewed as the main linkages within food chains. These are important factor in the ecology of populations, determining mortality of prey and birth of new predator. To understand the interaction, in this project we apply our mathematical skills. Thus, the interaction among predators and prey are well modeled by Lotka-Volterra equations. However, these equations are first order, non-linear, differential equations. In this research work we consider a system of first order non-Linear equation known as the Lotka-Volterra equation. We apply the Runge-Kutta numerical method to obtain the desired result. This project also presents the analytical and Numerical solutions for comparison. The Numerical solution is obtained using matlab code of the Runge-Kutta method. Furthermore, the convergence and stability of the Lotka-Volterra have been studied to understand whether the errors during application of RK4 on Lotka-Volterra system are erased or dumped out.

References
Optimal Portfolio Choice Under Loss Aversion

N Shiimi*, V Kandaswamy
Financial Mathematics, Department of Mathematics, University of Namibia

*Author for correspondence
Email: mekehshiimy@gmail.com

Abstract
Prospect theory and loss aversion play a dominant role in behavioral finance. When confronted with gains a loss averse investor behaves similar to a portfolio insurer. In this research work, we will analyses the optimal investment strategy for loss-averse investor, assume a complete market and a general Ito processes. If the planning time for investors is short, for example less than 5 year, they will reduce the initial portfolio weight of stocks, than investors with a smooth power utility. We will illustrate that most investors invest in short term stock as they fear negative return over the payoff of positive stock returns in the short term horizon.

Keywords: Loss version, Prospect theory, Behavioral finance, General Ito process.

References

Tail–based risk measures and some multivariate dependence structures

JV Halwoodi*, SM Nuugulu
Financial Mathematics, Department of Mathematics, University of Namibia

*Author for correspondence
email:jvhalwoodi2@gmail.com,
Abstract

The pricing model that we look at is not only for vulnerable options which face default risk, but also rare shocks encountered by the underlying asset and the assets of the counterparty. The In this paper we extend the scheme/structure of Tian et al. (2014) to price vulnerable options. Asset prices dynamics are ruled by jump-discussions with two sorts of assets correlated with each other. Jumps are divided into individual component for each asset price and systematic component affecting the prices of all assets. A closed-form valuation formula is derived for vulnerable European options. Numerical analysis compares the results of this model with those of other pricing formulae, and illustrates jump effects on the vulnerable option prices.

Keywords: Vulnerable options; Credit risk; counterparty; underlying asset; call option; jump discussion

References


Portfolio Optimisation under Value at Risk and Conditional Value at Risk

LNM Thomas*, V Kandaswamy
Financial Mathematics, Department of Mathematics, University of Namibia

*Author for correspondence
e-mail:lnmthomas1@gmail.com

Abstract

Measures of risk are a vital part in portfolio optimization for understanding risk exposures and measuring expected losses. Portfolio optimization is the process of choosing the proportions of various assets to be held in a portfolio, in such a way as to make the portfolio better with maximum returns. To create a portfolio with better returns or to optimize a portfolio it is of best to first measure the risk each asset is exposed too. Different portfolio risk measures has been studied. However, the selection of the appropriate portfolio risk measures continues to be a topic of heated discussion and all the proposed risk measures have drawbacks and limited applications. This was mainly influenced by the complexity in different markets and every market player has its own perception of risk. A risk measure that has received greater acceptance in practice is value at risk (VaR). Unfortunately, VaR has some limitations as it does not capture the potential
loss beyond the confidence level. Another commonly used risk measure as an alternative measure that aims at quantifying the losses that VaR does not capture is conditional value at risk (CVaR). In this study we create a portfolio using two stocks market returns for Computer manufacturing company (IBM) and Microsoft Technical company (MSFT) and measure or estimate the expected losses the portfolio might incur using VaR and CVaR measures. We compared the two risk measures and discuss their strong and weakness features based on the results. All the results and graphs in this study are extracted using a programming language Excel.

**Keywords:** Value at Risk, Conditional Value at Risk, Portfolio Optimization, Stock.

**References**

**Tail–based risk measures and some multivariate dependence structures**

*Andjamba Sem Kamanya*, SM Nuugulu

*Financial Mathematics, Department of Mathematics, University of Namibia*

*Author for correspondence*
email:semkamanya@gmail.com

**Abstract**
In financial mathematics, a risk measure is used to determine the amount of an asset or set of assets to be kept in reserve, were the purpose of this reserves is to make the risks taken by financial institutions acceptable to the regulator. In this paper we are focusing on variance as risk measure by considering the circumstances involved when risk managers or analysts have to deal with risks that exceed a certain threshold or level. Such circumstances are well-known to insurance professionals, for instance in the context of policies involving deductibles and reinsurance contracts. This involves the situation of dealing with events which have a very low probability of happening but of heavy magnitude (tail risks). So we will provide the well-known tail conditional expectation (TCE) risk measure which provides a risk manager with information about the average of the tail of the loss distribution, tail variance risk measure (TV) which estimates the variability along such a tail. We will propose a new premium called tail variance premium (TVP), which answers the demands of the circumstances of dealing with extreme events, considered as risk capital allocation rule or technique which preserve different desirable properties. We will also derive explicit expressions for TV and TVP, and risk capital
decomposition rules based on them, in the general framework of multivariate elliptical distributions.

**Keywords**: Risk Measure, Tail Risk, Risk Capital Allocation, Tail Variance Premium, Elliptical Distributions.

**References**

---

**Effective trading techniques for trading on the foreign exchange and stock market**

**Karihua Pazomundu Tjituri**, **Samuel Nuugulu**

*Department of Mathematics, University of Namibia, Namibia*

*Author for correspondence*
email: karie84@yahoo.com

**Abstract**
The subject of foreign exchange and stock trading has become a hot topic among the developed nations that one might get an impression that it is a new occurrence. Although this phenomenon is popular in the developed world, it is of the author's opinion that a greater proportion of Namibian youth do not know the existence and possibilities of profiting from foreign exchange and stock market. This paper serves to suggest new effective mathematical techniques for trading foreign exchange and stock market. Furthermore, the techniques herein are based on the concept of technical analysis of trends and repeated patterns observed in the foreign exchange and stock market.

**Keywords**: Japanese candlesticks, Fibonacci analysis, moving average, relative Strength index, stochastic oscillator, William R and regression analysis

**References**
Effects of house prices on bank stability and economic growth in Namibia

V. Mbunga*, V. Kandaswamy

Financial Mathematics, Department of Mathematics, University of Namibia

*Author of correspondence
Email: vmbunga@gmail.com

Abstract
This research explores by what means house prices affect bank instability when estimated at different levels of increasing income in Namibia. It is a case that the stability of a bank can react inversely to house price changes from the fundamental values in the situation when the economy is in the growth period/expansion compared to the situation where the economy is decreasing. The threshold estimation method which was introduced by [2] will be used on urban statistical areas in Namibia over the period of 2007-2016, and we have looked attentively at two house price indicators, namely the house price changes and the house price deviations.

Keywords: House price, Bank instability, Economic growth, Threshold model

References

Modelling the diffusion of cadaveric fluids within a porous medium to predict post-mortem

B. Laberloth*, A. Shikongo

Department of Mathematics, University of Namibia
Abstract
A body of a departed soul is known as a cadaver. A cadaver decomposes by the process of autolysis, which is the breaking down of cells or tissue by their own enzymes, and the end product is known as the cadaveric fluid. Since there is no vessel to contain the fluid, it spreads out and stains the immediate environment around the cadaver, the stain is known as the cadaver decomposition island. This model predicts the flow of incompressible fluids within a porous medium and assesses its viability to predict the postmortem from the measurements of the cadaver decomposition island.

References

Building Rent Price index using Case-Shiller Method: Namibia

R. Mouton, V. Kandaswamy
Financial Mathematics, Department of Mathematics, University of Namibia.

Abstract
In this paper, we will look at Case-Shiller (C–P) method to build a rent price index (RPI) in Namibia, on selected regions. In Namibia, currently we are experiencing a strong increase in our housing prices. Renters have the freedom to adjust their rent every 6 or 12 months as they please as there is no law or applicable restrictions prohibiting them. There is currently no price ceiling for housing thus why we are in this predicament as the citizens cannot afford the luxury of housing. In an economic downfall, sellers or renters have a tendency to remain at high prices demands. This method was based on original work done by Karl Chase and Robert Shiller. The C-S has been used in the United States since 1992 on which the full aim of this method remained to measure average change in particular geographic areas. C-S is a composition of family home
price indices in the selected geographical areas. Prices that are monitored for purpose of retrieving indices must be houses that had at least 2 owners. This creates the historical data we need for comparing prices since first ownership. C-S uses a method considered by far to be the most reliable and widely used when calculating indices for house prices- repeat sales technique. According to Investopedia, the Repeat sales method calculates the changes in sale price of the same piece of real estate over a period of time.

**Keywords**: Repeat sales, Housing, HPI Models, Rent price indices.

**References**

---

**Representation of Distributive Lattices**

**Erastus. V*, Mugochi. M**

*Department of Mathematics, University of Namibia, Namibia*

*Author for correspondence*
Email; lilgvictor@gmail.com

**Abstract**
Lattice is a broad topic but, my project is an investigation of ”the representation of the distributive lattices”. We first considered how finite distributive lattices can be represented as a lattice of down sets of join irreducible elements, (Birkhoff’s representation theorem). Then we extended this to infinite cases, and this where topology came in, (Priestley’s representation theorem).

The study went on to show that the Birkhoff’s representation of finite distributive lattices is equivalent to the Priestley’s representation when considered for finite distributive lattices.

**References:**
Interconnectedness of Non-Bank Financial Institutions (NBFIs)
Interconnections, Potential Vulnerabilities and Policy Responses

Elia Namundjebo

Email: enamundjebo@namfisa.com.na
Tel: 061 290 5288

Abstract

Financial Interconnectedness is defined as a linkage of one financial institution to other financial institutions (banks, non-banks, government or companies) in a financial system. The linkages can be through institutions’ market shares, credit exposures, trading links, dependencies between financial agents and other activities. Interconnectedness matters because it serves as a conduit for contagion and systemic risk. The impact of the failure of a large interconnectedness institution can spread across the whole financial system and can cause financial instability. The interconnections between financial institutions has been also highlighted as one of the key factors caused the 2008-09 global financial crisis. However, NAMFISA as a regulatory authority for non-banks in Namibia wants to develop and understand the nature, extent and complexity of the linkages of the non-banking financial institutions (NBFIs) as well as identifying the risks related to financial interconnectedness.

Figure below illustrates how different financial institutions in a financial system are connected to each other.

Interconnectedness is significant for several reasons including funding, investment, diversification, risk sharing or shareholding, and liquidity. It can be a source of or promote systemic stability for NBFIs; but it can also impair systemic stability and be a conduit for
contagion. In this study, we did an investment analysis for the NBFIs and evaluate the macro-linkages of their investments to different markets domestic and cross-border.

References


Optimizing Vessel Maintenance Costs for the Navy

J. Ndiwakulunga
Department of Nautical Science, School of Military science, University of Namibia, Namibia

Email: jndafimana@gmail.com

Abstract
Effective and efficient maintenance planning is essential and important in any organization that is responsible for managing complex assets as well as logistics/procurement. For the Namibian Navy maintenance planning is very vital due to its complexity and the obligations on the Navy’s role to keep its machinery ready and effective as well as to comply with certain International regulations and requirements. Within these, the Navy’s role and responsibilities will be fulfilled with effectiveness. Furthermore, poor planning may reduce the vessels’ availability, which could in turn, be reflected in the service and actions of the Navy. It is against this background then to give attention to the cost of maintenance, most importantly because poor or inadequate planning could prompt into damages that could increase the cost of maintenance.

This research aims to identify various maintenance costs approaches and centers and to develop appropriate strategies of optimizing vessel maintenance costs for the Navy, as well as presenting an appropriate maintenance cost framework. The research is divided into four stages in order to achieve its objectives and to address the research problem.

Firstly the review of the existing literature is done to identify the need for optimization of maintenance costs and to choose the appropriate course of action for maintenance cost approaches. The literature findings indicated that at least maintenance planning, selection of maintenance strategy, labour, shipyard dry-docking and supply chain management/Logistics are the most important factors needed to consider optimization of costs.

Secondly the research evaluates maintenance cost approaches and centers for the Navy by conducting research questionnaires and interviews with Navy personnel involved in the maintenance of vessels. Semi-structured interviews and questionnaires were conducted with three senior officers from the Navy Logistics and twenty two staff members. The results show that: dry docking scheduling, labour and personnel handling, voyage maintenance, as well as general costs are the main factors that have great influence on maintenance costs increase.

Thirdly the research will develop appropriate maintenance cost framework the Navy can use as an optimization strategy for vessel maintenance cost optimization framework. The developed framework was tested to assist managers in other organizations in cost optimization.
The fourth stage concludes the optimized framework by presenting the developed framework for the dry docking scheduling of vessels for routine maintenance, reduction of vessel maintenance costs. This is done by the model which clearly defines maintenance planning, personnel handling, limits of workloads, and cost management strategies.

References:

A concept for the half-life upgrade of NS Elephant

L. Matheus

Department of Nautical Science, School of Military science, University of Namibia, Namibia

Email address: matheuslydia86@gmail.com Cell: +264 816824436.

Abstract
NS Elephant is one of the most important Namibian Navy vessels. During the process of this study, the Namibian Navy had only one support vessel (NS Elephant), which needed to be technically operational in order to perform all the functional roles that support vessels play. Those roles include: working cargo, transferring cargo, pumping and transferring fuel at sea, research and survey, search and rescue operation, and transportation of troops. Wikipedia May 2018 showed that the support vessel was operational and utilized for general duties in the exclusive economic zone. It was also used to train and qualify junior sailors and officers, and participated in training operations with the marines.

The vessel has some shortcomings that hindered it from performing all roles that support vessels perform. NS Elephant cannot offload at sea and it has no scanning machines for incoming and offloaded goods. Moreover, the ventilation system in the crew quarters was designed facing toward crews which is unhealthy and as the vessel can play a vital role when it comes to search and rescue and transportation of troops, the ventilation system needs adjustment. These problem areas led to the concept of a half-life upgrade of NS Elephant. Data collected involved interviews with two engineers from the vessel, chief of naval staff operations, and three
commanders one from old naval base and two from the new naval base Walvisbay. Questionnaires were also distributed to other crew members of the vessel who did not partake in the interview.

This study can play a significant role as it highlights how NS Elephant could be upgraded and the period and cost estimate of the upgrade. This upgrade will thus ensure that NS Elephant is fit to perform all functional roles of a support vessel, hence a concept for the half-life upgrade of NS Elephant.

References
NS Elephant (general cargo)-IMO 9661883, MMSI 659381000, call sign V5TV Registered in Namibia-AIS Marine traffic. Marine traffic.com

Evaluation of Effectiveness of Maintenance Approaches for Marine Auxiliary Machinery at Namibian Navy Headquarters, Elephant Vessel

D.N. Iita
School of Military Science,
Faculty of Science, University of Namibia, Namibia

E-mail address: decemberiita@gmail.com | Cell +264 81 7187 823

Abstract
Shipping is a multifaceted industrial sector with great versatility and characteristics that make it differ from land-based and other industries. This study evaluated the effectiveness of maintenance approaches for marine Auxiliary machinery at the Namibian Navy; Elephant Vessel. Quantitative research design was used to capture the details and adequate information. The study population comprised of staffs of the Namibian Navy who deal with maintenance issues at the Elephant Vessel. 30 respondents were sampled by convenience sampling method. Data were collected using a structured questionnaire and analyzed using Microsoft Office Excel. Results from the study indicated that there were maintenance approaches for marine Auxiliary machinery used at the Namibian Navy. Majority (27.5%) mentioned Condition Based Maintenance. Moreover, Corrective maintenance implemented and evaluated feasible solutions (43%). Reliability Centered Maintenance bridges the gap between different maintenance strategies like corrective, preventive and predictive and eliminate their drawback (92%) were the effectiveness of maintenance approaches. Inconsistent frequency of data collection was due to incorrect implementation of Condition Based Maintenance. Likewise, Time spent collecting lots of data that wasn’t really understood was the results of low confidence in conditional monitoring in Vessel engineers (57%). Financial support for the maintenances (35%) could be a solution to challenges faced by the Namibian Navy in maintenance approaches.
There were maintenance approaches for Marine Auxiliary Machinery used at the Namibian Navy. It was recommended that Namibian Navy needs to develop alternative naval maintenance methodologies in order to achieve future vessel performance requirements, and the is a need for continuous training and education of the naval ship-owners and operators in order to acquire knowledge on monitoring expertise on board.

References

Air space security assessment on the impact of non-coverage areas/airspace by the air defence radar system: a case study of the Namibian Air Force.

A. Kadonga
Department of Aeronautical Science, School of Military Science, University of Namibia, Namibia

Email: ndilimeckie20@gmail.com; Cellphone: +264 813525454

Abstract
The purpose of the study was to assess the impact of the non-coverage airspace by the Namibian Air Force Radar System to the national security. The study was done with a target population of Air Force members. The study used primary data which was gathered by means of self-administered questionnaires issued to respondents and conducted interview. In order to meet the objectives of the study the study has focused on the working experience and general understanding of Air Defence Radar System, the impacts and challenges imposed by non-coverage areas within the Namibian airspace. The study found out that 25% of the Namibian Airspace is covered by the Namibian Air Force Radar System leaving 75% of the airspace uncovered. This may put the National Airspace Security at high risk. Economic or financial constraint was also identified as one of the major cause of non-coverage areas of the Namibian airspace as there are no funds to acquire the required sophisticated equipment. The study also discovered that the insufficiency of personnel and trained staff in the field of Air Defence Radar system humper the process. The study concluded that acquisition of modern Radar systems is highly required in the Namibian Air Force and Air Defence Wing in particular. By acquiring this type of equipment, the Air Force will be able to accomplish its mission as to defend the integrity of the Namibian Airspace. This can only be accomplished by
deploying Radar systems in a group system to provide tight detection which will make the penetration of enemy aircrafts and missiles very difficult.

**Keywords**: Airspace, Defence, Radar, Security, System

**Impact of budget cut on military education operation: A case study of Junior Staff Course, Command and staff College, Karibib**

P.T. Nkandi

*Department of Military History and Military Law, School of Military Science, University of Namibia*

Email: pnkandi4@gmail.com; Tel +264812156917

**Abstract**
The study aimed to investigate the negative impact of budget cut on military education specifically focused on Junior Staff Course (JSC), Command and Staff College, Karibib. The study utilised qualitative methodology by interviewing the total population of 8 respondents who are the directive staff on junior staff course at the college. The result of the study reveals that budget cut has a negative impact on the programme’s objective that aims to equip student officers with scientific knowledge on security matters. The knowledge imparted to student officers is affected due to lack of course materials and therefore it is a security concern. In addition the study revealed that the programme cannot provide adequate necessary learning materials such as study guides, additional reference reading (especially in the college’s library), simulation and war game software for enhancing scientific knowledges and tactical skill that ensure intellectual edge to student officers due to budget cut. The trend has a severely affected Junior Staff Course in such a way that there are incapacitated machinery systems (computers, printers and scanners) that the college is using to produces some of the training materials, such as reference readings (pamphlet). Various computers, scanners and sprinters are not usable as there are no funds to replace inks, cartilages as well as to outsource information and technology (IT) technicians to service and repair these machineries. Furthermore the study found that there was a shortage of fuel and transport allocated to the programme despite the important role they play as means of mobility on the course daily operations including industrial tour visits. The industrials tour visit aims to enlighten student officers on the Namibian’s national interest, as well as industrials goods processing and their contribution to the Namibian economy. Therefore budget cut has affected industrial tour visits in such a way that the student officers they do not visits all important natural resources and industries as there is no enough fuel, drivers and transports well as money for the accommodation. Lack of fund during tour visit forces the JSC management not to visit some of the places in the programme’s agenda. Moreover budget cut has affected the student officer’s researches in terms of broadening of ideas that could be obtained from the places that are not visited. Lack of drivers and transports on the programme can also increases the risk of accidents as the driver can easily get tired and loose concentration due to more trips as student officers and few directive staff that goes on a tour visits cannot fit in one bus. The study
has revealed that due to understaffing, the directive staffs are overwhelmed by increasing workload which was intensified when Namibian Defence Force (NDF) stopped sending its officers abroad for senior officers programme that qualifies a senior officer to become a directive staff. The study has found that lack of expertise within the NDF forces the college to outsource presenters that do not always arrive on time as per course schedule due to delay in travelling and payment arrangements which affect the flow of lessons, as well as the programme’s timetable. Therefore the study concluded that all areas of junior staff programme operation are affected by budget cut, which is a huge compromise on security and military education in Namibia. The study recommends that the NDF management should mobilise funds through political and military persuasion and prioritising funds on the highest military education programme (JSC) in the country. This is because military education is core in providing necessary security skills that ensure peace and prosperity, not only national but regional and as well continental.

Assessing the impact of improper waste disposal on human health and environment in Havana informal settlement

P.S Rehabeam
Department of Military Science, Military History & Military Law, School of Military Science, University of Namibia, Namibia

psrehabeam@gmail.com  Tel: +264 8142 846 19

Abstract
Ethically, the beauty of any environment lies on its good sanitary condition. This is because; when an environment is clean the lives of citizenry are not threatened by illnesses and diseases. However, waste dumps are truly spoiling the environmental conditions in developing countries whereby negative environmental impacts from improper waste disposal can be easily observed everywhere. Namibia is no exception when it comes to improper disposal of waste especially in the informal settlements where cases of Hepatitis E have been reported. The study focused on assessing the impact of improper waste disposal on human health and environment in Havana informal settlement in Windhoek. The impacts of improper waste management on human health as well as the environment were highlighted in this study. Furthermore, the study explored the factors contributing to the effect of improper waste management in the community and also suggested measures that can possibly help to alleviate the problems. A qualitative methodological approach was used in data collection. The study sample comprised of 42 households from the Brendan Simbwaye location in Havana. The study used questionnaires that contained both closed questions that provided ordinal data which can be ranked and open ended questions which allowed freedom of expression as well as interviews which allowed the researcher to discover the in-depth information, views, state of mind and experience of the respondents. The findings revealed that, the process of collecting waste for those who have waste plastic bags was not on a regular base. Furthermore, the study revealed that most of the residents do not have toilets and other proper sanitary facilities and there is a lack of proper waste bins,
waste is disposed of by either, burning, burying, dump in the dumpsites and no refuse removal by municipality, as well as in riverbeds. It was observed that plastic and paper wastes usually dumped in the open are easily blown by wind into the environment which affects the nature of the environment. The study concluded with recommendation that, there should be provision of sufficient skips, provision of proper dustbins, regular collection of waste, and sensitization campaigns to educate the people on how to manage their waste, the health and environmental effects of improper disposal of waste. It is also recommended that researchers and academics should in the future conduct comparative research on improper waste disposal in other parts of Havana.

**Keywords**: Health and environmental impact, waste management, Havana informal settlement

**References**


---

**Developing a System Architecture of Computerized Maintenance Management System (CMMS) for Vessel Mechanical & Electromechanical Systems**

**F.N. Nikanor**

*Department of Nautical Science, School of Military science, University of Namibia, Namibia*

Email address: fessycalvin@gmail.com, Cell: +264 81 6989 600

**Abstract**

The Namibian navy is faced high rate of negligence when it comes to maintenance of mechanical and electromechanical machineries. This results in frequent machinery breakdown, very high maintenance costs, and overall decrease in the efficiency of the naval vessels. A computerized maintenance management system (CMMS) is software that is programmed to schedule and record operation and plan maintenance activities associated with the equipment and generate reports. The computerized maintenance employs maintenance practices that are used by many
navies to upkeep their machineries, namely the preventive, condition based, breakdown, predictive, and periodic maintenance practices. This study was undertaken to investigate by focusing on identifying mechanical and electromechanical machineries on the naval vessels, maintenance practices used, and computerized systems for maintenance. Data was collected via semi-structured questionnaires. Upon data analysis, the key findings indicates that work orders, schedules and maintenance reports are manually constructed and stored, thus hindering the tracking process of maintenance plans and schedules. Condition based and breakdown maintenance practices in maintenance of the machinery are often used. In most of the vessels, there is only one machinery condition monitoring display. The architectural system design of the CMMS is designed according to the barrier of the current systems, and maintenance practices used. The system is designed to allow multiple users at the same time based on their credentials to access information in real time at different locations. According to the information fed into the system, it should be able to define the optimal preventive maintenance intervals and plans, define decision limits and monitoring intervals. Furthermore the system should be able to track work orders, schedules, and spare-parts management. Also it should be able to generate and analyse maintenance and failure of equipment reports. Additionally, the system should be able to store maintenance and failure data for future reference. The system is specifically designed for mechanical and electro mechanical machines such as the main engine, steering gear, generators and other auxiliary machinery. On the basis of the above findings, it is recommended that the Namibian navy needs to acquire a software developer for CMMS software of the system architecture designed in this study in order to prolong the life span of the machinery, reduce maintenance costs and minimize human negligence in maintenance of the above mentioned machinery.

References


A perceptive study of the ex-combatant officers on the level of personnel combat readiness in Namibian army of new blood soldiers. A case study of Anti-Air Defence Brigade (AD Bde), Khomas region, Windhoek

J. Amutenya
Department of Military Science, Military History and Military Law, School of Military Science, University of Namibia, Namibia
Abstract

Combat readiness in military forces generally involves tangible and intangible elements of combat power which are aimed to develop a soldier’s capability to perform a given military task successfully. The Namibian Defence Forces have a high number of aging ex-combatant officers and some have already retired. Hence, the study attempted to determine new blood soldiers’ combat readiness while the remaining ex-combatant officers are still active in military duties to ensure maximum personnel combat readiness.

The study therefore identified the criteria used by ex-combatant officers at Anti-Air Defense Brigade to evaluate the level of combat readiness among new blood soldiers of Namibian Army. The study also determined whether new blood soldiers are achieving the level of personnel combat readiness.

The study utilized a qualitative approach through the use of semi-structured interviews to obtain the data. Anti-Air Defence Brigade has the total population of 20 ex-combatant officers, and 12 ex-combatant have participated in the study. The study revealed that ex-combatants evaluate physical and mental fitness to determine the level of combat readiness among new blood soldiers. The other criteria used to determine the new blood soldiers’ combat readiness is the understanding of military goals and objectives. It was also established that some of the new blood soldiers fail to achieve the level of combat readiness because they do not cope with military environment.

The study therefore recommend that the Namibian Defence Force need to implement programs that enhance moral among new blood soldiers during and after recruit training in order to achieve high level of personnel combat readiness. The study also recommend that there is a need to evaluate the usefulness of the criteria used by ex-combatants to assess the level of combat readiness.

Keywords: ex-combatants, personnel combat readiness, new blood soldiers

References


An Exploration of the Impact of Air Traffic Controllers’ Long Shifts: A Case of Grootfontein and Ondangwa Airports, Namibia

K. Ashipala

Department of Aeronautical Science, School of Military Science, University of Namibia, Namibia
Abstract
Working long shifts in a profession such as Air Traffic Controller, which requires maximum concentration and use of cognitive skills, has become a normal phenomenon among the controllers at Grootfontein and Ondangwa airports. The main aim of this study was to explore the impact of Air Traffic Controllers’ long shifts on their job performance, their personal lives or social lives as well as to find out the reasons behind the long working shifts performed by Air Traffic Controllers at Grootfontein and Ondangwa airports. A qualitative research design was used to conduct this study whereby semi-structure interviews methods used as instrument and content analysis was used to analyze the data. The study found out that, precise impact of Air Traffic Controllers’ long shifts on their job performance was not established. This caused by the fact that all controllers had become resilient to their working conditions and they got accustomed to the long shifts. Another fact is that, the two airports’ air traffic is ranging from low to medium on a daily basis. On the other hand, the study revealed that the Air traffic controllers indicated that long shifts have an impact on their personal lives and particularly their relationships. Furthermore, study discovered that the reasons of long working shift have been because of lack of enough qualified air traffic controllers in Namibia. The study hence concluded that long shifts worked by the controllers at Grootfontein and Ondangwa airports were provisions laid down by the Namibian Air Force and Namibia Civil Aviation Authority due to low-medium daily air traffic flow but they did not put into consideration the effect of the accumulation of fatigue and stress resulting from these long shifts on the well being and personal lives of the controllers. The study made recommendations that at least the Ministry of works and transport and the Ministry of Defence should be allocated with a bigger budgets to ensure training of more controllers. The University of Namibia, particularly the School of Military Science, Department of Aeronautical Science, needs to review its curriculum so that it includes specialization such Air Traffic Controller in order to minimize the shortage of controllers in Namibia particularly at those airports under study. The air traffic management of both Grootfontein and Ondangwa should see to it that they review their shift schedules especially during weekends to prevent the impact of long shifts on the controller’s well-being.

Keywords: Air-Traffic, Controller, Shift, Working, Impact

References
Computerised utility facility management at Namibian airports - Eros Airport

Haffeni W. Shiinda
Department of Aeronautical Science, School of Military Science, University of Namibia

Email: hshiinda@gmail.com; Cell: +26481 6185 439

Abstract
This study examines and proposes an effective maintenance method by considering the measures of implementation of the Computerized Maintenance Management System software to systematize maintenance activity in the Namibian air transportation sector. Around the world maintenance is a very important activity in the aviation industry to prolong the life span of landside and airside items at airports. Apart from giving long life span to aircrafts, equipment and airport facilities, Computerized Maintenance Management System reduces the substantial financial losses for repairs and save the production downtime. The study used the expert sampling method. A number of interviews were conducted and a total of 14 questionnaires were distributed to the maintenance management at Eros airport and the Namibian Civil Aviation Authority offices. The results indicated that the practices of ‘maintenance management plan’ and ‘maintenance management team’ play the most significant role in influencing their maintenance efficiency. The results also indicate that ‘Insufficient fund for maintenance job’ and ‘Lack of modern information technology in the maintenance departments’ are the major barriers responsible for the poor maintenance management at Eros Airport. Needless to say this study further provides guidance and references to the maintenance staff to select a suitable Computerized Maintenance Management System that best meets the Eros airport’s individual needs. This system would enable the airport operators to achieve better maintenance efficiency through various strategies and practices.

Keywords: Aviation, Computerized, Maintenance, Management, System

References
Aviation and Airport Articles: Retrieved from
http://www.mintek.com/blog/author/stuart/
Kazunori Ishida. (2014) Airport Energy Efficiency and Management: Safety and Security Management Department Airport Operations Division Narita International Airport Corporation
Fabianus Sindimba (August, 2017) – Eros Airport Maintenance Engineer. Retrieved from: https://mail.google.com/mail/u/0/#inbox/15e3e0e6b11ab943
Investigating the impacts of post-war explosive materials on people: A case study of King Kauluma village, Oshikoto region, Namibia

K.L. Lifumbela

Department of Military Science, Military History & Military Law, School of Military Science, University of Namibia, Namibia

Email address: lkennethy@yahoo.com  Tel: +264 (81) 124 5138

Abstract
Explosive Remnant of war (ERW) materials has been a major issue Worldwide. The war that persisted in Namibia for about 23 years between South West Africa People’s Organization (SWAPO) fighters and the South African apartheid regimes resulted in remnants of numerous war explosive materials in various parts of the country. King Kauluma village is one of the places in Northern Namibia where post-war explosive (PWE) materials are still found to date. Therefore the study considered evaluating the impacts of PWE materials on biodiversity at King Kauluma village in Nehale IyaMpingana Constituency, Oshikoto region. This study was limited to people from the community in King Kauluma village.

The study used interviews and field observations to investigate the impacts of post-war explosive materials on the community members. The study adopted a qualitative research design, in which open ended semi-structured interviews and self-observations were employed to collect data. The study revealed that post-war explosive ordinances have devastating effects on the livelihoods of King Kauluma community as it restricts movements of people due to fear. This brings in a traumatizing situation. The study further found out that there are some community members who lost their lives due to unexploded ordinances that were left in the area. Overall, the key impact of PWE materials in the community is that it increases the level of poverty, due to fear of clearing or extending farm land to increase their crop yield.

The community members face several challenges as they live in the area that is contaminated with PWE materials. Challenges include restricted movements and fear that their children will find surface-lying unexploded ordinances and play with them recklessly. The study therefore recommends that the community should be given the awareness program on the dangers and safety measures on how to deal with un-exploded ordinances. The study further recommends that there is need for relevant authorities to establish a demining program for clearing the remaining unexploded ordinances.

Further research work is recommended to investigate on the impacts of PWE on soil, fauna and flora at King Kauluma village in Oshikoto region.

References
Perceptions of lecturers and students in the faculty of science at the University of Namibia towards the role of the Namibian Defense Force (NDF)

F. N. Lukas
Department of Military Science, Military History & Military Law, School of Military Science, University of Namibia, Namibia

ferdinantngh@gmail.com Tel: +264 816583779

Abstract
Understanding of the civilians’ perceptions towards their defense force is an issue of concern to every state. All over the world civilians have diverse perceptions toward their military forces. Normally people’ perceptions are linked to their attitudes which may eventually affect the security of their countries. The study assessed the perceptions of Science (civilians) students and lecturers towards the Namibian Defense force in terms of its contribution to the national development. The study had also looked at the possible causes of the Science students and lecturers’ perceptions towards the role of NDF. The study was conducted at the University of Namibia, and it only concentrated on science students and lecturers, specifically from two Departments (Physics Department and Mathematics Department). In addition, Namibian civilian students and lecturers from above mentioned departments were the only key informants for the study. The study used a questionnaire as research instrument. Additionally, the study used non-probability sampling method through purposive method for data collection.

The study revealed that some Namibian civilian students and lecturers perceived that NDF contributed to the national development in terms of Job provision, ensuring safety within the society as well as sponsoring students’ studies at tertiary institutions. However, majority of the participants do not know what NDF has contributed to the national development. By searching for the connection between Namibian civilians and NDF, it became an evident that poor perceptions among civilians towards the role of NDF were direct result of huge gap existing between the Namibian Defense Force and civilians. The study had also found that most of the Namibian civilians do not know the mission and vision of the NDF. Furthermore, most of the Namibian civilians have never experience NDF employees serving the society that could stimulate civilians’ perceptions towards the force.

The results reveal that most of the Namibian civilians have poor perceptions towards the role of NDF, mostly on its contribution to the national development. Poor perceptions among civilian (students and lecturers) towards NDF show that the country’s future security is questionable.

Key words: Namibian Defense Force, civilians, perceptions, lecturers and students, causes and national development.

References

INVESTIGATION ON THE CAUSES OF ACCIDENTS AND INCIDENTS OF LIGHT AIRCRAFT: NAMIBIA CASE STUDY

LUKAS IMMANUEL M
School of Military Science, Department of Aeronautical, University of Namibia, Namibia

Email: mwashindangelukas@gmail.com | Tel: +264-813871353

Abstract
The purpose of this study was to investigate the causes of accidents and incidents of light aircraft in Namibia, whereby Khomas region was randomly picked and was the region that was investigated. The study investigated various factors that contributed to the accidents and incidents of light aircraft. The case study employed Questionnaires and semi-structured interviews as an instrument that used to collect data from respondents. However, data were analyzed and the results were presented by means of graphs, tables, figures and general statements. The factors observed are human, environment and mechanic, where Human factors contributed the most followed by Environmental factors and mechanical factors respectively. The study discovered that high rate of accidents and incidents of light aircraft occurred because Aviation Company failed to implement and enforce procedures, practices, supervision and regulation within their organization. The study recommends that training programmes shall be initiated to ensure the effectiveness knowledge gained and self-confidence of pilots. Furthermore Airline training and operational procedures must be updated to improve the reliability of pilot as an information processor. The study concluded that in order to ensure air traffic safety, knowledge and awareness should be gained from previous aircraft accident investigations carried out by Namibia directorate of aircraft incidents and accidents investigation (DAAI) with the aim of ensuring that accidents in similar circumstances will not occurred. Fully implementation of the above recommendations and adhering of pilots to the rules and procedures of flight, then aviation industry will be accidents free.

Keywords: light aircraft, accidents and incidents, contributing factors.
An assessment on the effectiveness of airport screening system: a case study of Ondangwa airport

L. H Monima
School of Military Science, Department of Aeronautical Science, University of Namibia

Email: hitotelwa01@gmail.com; Tel: +264-812600049

Abstract
Airport security measures serve to protect the travelling public, crew and aircraft. Airports and aircrafts become targets of the terrorists. Thus the study on the effectiveness of airport screening system at Ondangwa airport was conducted. The main objective of the study was to assess the effectiveness of the screening system installed at Ondangwa airport. The data was collected by means of questionnaires and participant observation.
The study found that all security personnel working directly at the check-point had been trained in the basic aviation security course, and few respondents have completed a course of cargo and mail security course and screener certification. The researcher found that all personnel are fully trained on aviation security and the walk through detector only detects metals. It was observed that some flat metals may not be detected by the X-ray at the security check point but if the security personnel got suspicious of a that particular parcel they usually double the tray and re-screened the parcel again. The respondents also revealed that during power outage they had to search the passenger’s manual with the help of hand-held metal detector device.
The researcher discovered that the respondents’ welfare was not taken care of due to their expoal to radiation during the screening of the passengers and their belongings. They had been working with the X-ray for more than a year but they had never taken for check-up or issued with the device to measure how much radiation they exposed to during their shift. It was observed that security personnel during their shift want only work at the point where there is less exposure of radiation. This had an effect on the performance of their duty as they may not want to be exposed to radiation for a long time, and may compromise the screening procedures and safety of passengers, crew and aircraft.
Finally, the airport security system procedures are good and in place, but training is required more often so that personnel are updated with the new technologies in aviation sector. Training played vital roles on the personnel capability at the security check-point at the airport and this will enable them to be equipped with knowledge of all airport security screening equipment’s for passengers and their belongings. They will gain a better understanding of the process for each screening device which will drastically improve the overall quality of the screening. It’s
recommended that the personnel need to be issued with Dosimeter device to count the radiation they exposed too and taken for check-up once the count reach 1milliSievert and a regular (annually) check-up should be done to all security personnel working with X-ray screening scanner.

Keywords: Security, effectiveness, technologies, capabilities

Assessing the impacts of weather on aircraft’s accidents and incidents in the Namibian airspace

H.M Mughongora
Department of Aeronautical Science, University of Namibia, Namibia
School of Military Science, University of Namibia

Email address: hillariusmm@gmail.com , Cell: +264 813171923

Abstract
The purpose of this study was to assess the impacts of weather conditions on aircraft’s accidents and incidents in the Namibian airspace. This study was necessitated due to continued occurrence of aircraft’s accidents and incidents in Namibia. According to the report on aircraft accident/incident from the Directorate of Aircraft Accident/Incident Investigation (2012), there continues to be occurrences in aircraft accidents and incidents, even though there has been a slight decline over the years. The study focused on identifying the main weather factors impacting accidents and incidents in the Namibian airspace, determined the effects of bad weather and used these findings to devise mitigation measures so as to keep the Namibian airspace up to standard with the International Civil Aviation Organization (ICAO). Data was collected using semi-structured questionnaires and face to face interviews administered to Aircraft Accidents Investigation personnel from the Directorate of Aircraft Accidents/Incidents Investigation in the Ministry of Works and Transport. Collected data was analysed both quantitatively through descriptive statistics and qualitatively through themes. The study revealed that, although weather is not the major cause of aircraft’s accidents/incidents in the Namibian airspace, it does contribute to the occurrences with turbulence (65%), poor visibility (52%) and wind (20%) being the major weather factors leading to these incidences. These could be due to the lack of communication between pilots and air traffic controllers (ATC) on weather and pilot’s adherence to recent weather updates as well as inadequate manoeuvring trainings during flight. The study findings reveals that bad weather is a significant factor to aircraft’s accidents/incidents in the Namibian airspace, thus a lot needs to be done in order to maintain a safe operational airspace in order to significantly reduce or eliminate the occurrence of aircraft’s accidents/incidents. With the study affirmation that, most aircraft accidents and incidents are a result of pilots’ errors and bad weather conditions, the study therefore recommends, the uptake of new technologies, proper training, including accurate weather forecasting and communication
and up to date aircraft maintenance. This will ultimately ensure adherence to new rules and regulations and indefinitely reduce these unfortunate occurrences.

Key words: accidents, incidents, weather factors, impact, occurrences

References

A comparative study between Grootfontein Airbase and Windhoek Hosea Kutako International Airport on the effectiveness of ATC communication equipment

S.N. Ndokosho
School of Military Science, Department of Aeronautical Science, University of Namibia

Email: sakeusndokosho@yahoo.com, Cell: +26481 4159039

Abstract
The purpose of this study was to compare the effectiveness of ATC communication equipment between Grootfontein airport and Windhoek Hosea Kutako International airport. The study employed a case study design with the population of interest being the air traffic controllers and technicians at above mentioned airports. Questionnaires were used to collect data from the respondents. Data were however analysed both quantitatively through descriptive statistics and qualitatively through themes. The results were presented by use of tables and general statements derived from themes. The study found out that International airport is equipped with ATC communication equipment such as radio, recorder, central processing unit system and ATC RADAR while Grootfontein airport is in shortage of equipment such as ATC RADAR. The study concluded that both airports are using exactly same ATC communication equipment and each equipment has its own backup in case one fails. Grootfontein airport needs to be provided with ATC RADAR which is very important in detecting the range, angle and velocity of the objects in the atmosphere. On the other hand, Windhoek International airport needs to be equipped and stands at the standard of international as per ICAO standard. It came in when compared to other international airports from different countries specifically, developed countries.
Furthermore, all equipment from both airports are not manufactured in Namibia so Namibia needs machines and qualified people to manufacture its own ATC communication equipment and stop buying from other country which is very cost. Should all the factors mentioned above be put into considerations, the effectiveness of the ATC communication equipment and standard of airports may be realised.

References

Assessing the Effectiveness of Human Factors in Quality Aircraft Maintenance:
A Case Study of the Namibian Air Force

E. Nghifilenya
Department of Aeronautical Science, School of Military Science, University of Namibia

Email address: elvisdenzell@gmail.com | Cell: +264 81 386 7781

Abstract
The study sought to assess the effectiveness of human factors in quality aircraft maintenance to aircraft maintenance technicians in the Namibian Air Force. Therefore, without proper human factors training in aircraft maintenance, aircraft technicians will not gain adequate skills, awareness and knowledge of how to apply human factors in an effective way. Furthermore, the Namibian Air Force is being faced by human factors problems that reduce the effectiveness in aircraft maintenance practices that may lead to some aircraft incidents and accidents.

Relevant data were collected by questionnaires. Moreover, the study adopted both qualitative and quantitative research design and a case study approach was employed to acquire information and draw conclusions. Upon the analysis of data, the study found out that majority of aircraft technicians did not receive human factor training within their organization and there is no such program in place in the Namibian Air Force. The study also found that there were many factors affecting human performance and causing human factors problems in aircraft maintenance in the Namibian Air Force.

On the basis of findings for this study, the researcher recommends that the Namibian Air Force management implements human factors program and offers continuous in-service training for human factors lessons to all aircraft technicians. Furthermore, the study suggested that all aircraft technicians must be considered equally in terms of promotion and get equal payments according
to their qualifications. Lastly, the study also recommended that all aircraft technician must be controlled and tested on alcohol and drugs prior to duties. Therefore, it was concluded that if all these factors have being maintained and considered, human factors in aircraft maintenance will be more effective in the Namibian Air Force at technical departments.

**Keywords:** human factors, maintenance, technicians, effectiveness, aircraft, Namibian Air Force

**References**

**An investigation of the economic impact of outsourcing Namibian Defence Force (NDF) fleet maintenance to civilian contractors: A Case Study of Composite Depot, Khomas Region**

**O Indongo**

*Department of Military Science, Military History and Military Law, School of Military Science, University of Namibia, Namibia*

Email address: indongofaithoiva@gmail.com Tel: +264 (81) 388 6967

**Abstract**
Outsourcing fleet maintenance is essential to effective and efficient force generation and sustainment in order to provide vital support to the Namibian Defence Force (NDF) and joint forces across the strategic, operational, and tactical levels of wars. Therefore the main objective of the study is to investigate the impacts of outsourcing NDF fleet maintenance to civilian contractors. Specific objectives include identifying reasons for outsourcing NDF fleet maintenance to civilian contractors, to identity procedures and methods used for outsourcing fleet maintenance, to determine the challenges associated with outsourcing and to propose an economic framework for outsourcing NDF fleet maintenance to civilian contractors.

The study adopted descriptive research design as a qualitative approach. Primary data were collected through questionnaire, interview as well as field observation. Purposive sampling technique was used for 7 interviewees and systematic random sampling technique for 40 respondents in open and closed ended questionnaires. In addition, secondary data, such as
vehicle accident reports, log books, journals, articles and research papers were used. The researcher also presents the results by using descriptive statistics such as mean, standard deviation, charts, tables and other related statistical data presentation techniques. The major findings of the study indicates that, lack of maintenance workshops in the organization, lack of skills among employees and non-existence of sophisticated equipment and machineries for repairing and fixing vehicles are the main reasons why the organization outsources fleet maintenance to civilian contractors. It also discovered that lack of parts also contributed as to why the organization outsources the function of fleet maintenance to other outside workshops.

The major challenges that hinder the outsourcing NDF fleet maintenance to civilian contractors are corruption, lack of educated transport managers and inflation. Poor budget allocation, disclosure of confidential information and promotion of employees are also challenges of outsourcing. Therefore, the study recommends that the Ministry of Defence should construct more workshops facilities to cater NDF fleet at large and training of employees on mechanical related courses to be able to maintain fleet in the base.

**Keywords**: Outsourcing, Maintenance workshops, Budget allocation and Fleet maintenance

**References**


**An investigation on the effectiveness of security screening system and aircraft inspection at Namibian aerodromes used as ports of entry and exit: a case study of Hosea Kutako International Airport**

**P.K. Shimweefeleni**

*Department of Aeronautical Science, School Of Military Science, University Of Namibia*

Email: skpandeni@gmail.com, Cell: +264816412194

**Abstract**
This paper examines the aviation security challenges and reactions faced by Namibian airports serving international civil aviation and being used as ports of entry and exit. The conclusion and recommendations solely rely on the case study research conducted at Hosea Kutako International Airport as the main airport in Namibia which caters for most of the international flights. The focus was mainly on the screening, airport security personnel; aircraft security inspection by the security authority; infrastructure; surveillance; security plans and communications; and specialty operations. The main objective of this paper was to investigate the effectiveness of the airport security screening system and aircraft security inspection mechanisms employed at Hosea Kutako International Airport. The airport handles over 814,810 air passengers and about 17,514 aircrafts annually; just as airport security threats increase with the increase of airport users across the world. To protect civil aviation against acts of unlawful interference for the safety of all passengers, airplanes, property and general public, potential threats to airport security must be prevented through a sufficient high level of security.

To gather these data, the researcher conducted open ended and semi-structured interviews, questionnaires and on-site observations. The study reveals that Hosea Kutako is not adequately equipped with qualified personnel, the departments at the forefront of airport security and national security are very understaffed; and the current screening equipment are not reliable. The study also confirms that airport architectural and infrastructure design requirement of Hosea Kutako International Airport necessary for implementation of airport security measures are of low standard and an urgent improvement is needed. In addition, it was also found out that there is lack of training and exposure on the airport personnel responsible for security. There is also lack of funding and probable complacency from the airport authority to improve the security levels. Notably, Hosea Kutako International Airport overall security system is not adequately prepared to combat new and arising airport security threats currently experienced in other part of the world therefore the current security issues should be addressed urgently.

**Keywords**: Aviation, Airport, Safety, Security, Screening, Inspection, Threats

**References**


**Health & family challenges faced by soldiers after the liberation struggle of Namibia: A Case Study of 261battalion Army base**

**P. Shimuningeni**

*Department of Military Science, Military History & Military Law, School of Military Science, University of Namibia*
Abstract
It has been twenty-seven years after Namibia got independence. Maintaining freedom within Namibian borders comes with a sacrifice. Numerous service men and women sacrifice their comfortable lives. They left their families, put their lives on the line, and endanger their health to be catapulted over and inboard into a war zone where survival and safety wave their minds constantly. The descriptive study aimed to assess the health and family challenges faced by soldiers after the liberation struggle of Namibia, to identify their welfare after exile, determine the influence it had on them, and to recommend possible solutions for challenges faced by soldiers after liberation struggle at 261 Battalion and in the Namibian Defense Force as whole. The escalation in reports on earlier deaths of war veterans after retirement, Gender Based Violence (GBV), Dismissals and suicides, pain and sickness, health and family problems in Namibian liberation struggle veterans invited this study. Twenty one men and women members of liberation struggle from the 261 battalion who were selected through non-probability and a snowball sampling made up the study. They answered the questionnaires which were analyzed and findings were drawn from them. The study found out that ninety nine percent of participants faced numerous health and family challenges after the liberation struggle. Poor vision and hearing, injuries, mental health, pain and diseases, separation from families and isolations, poverty, poor diet, poor performance and financial problems, and stress are the challenges they faced and some still facing just to mention a few. This study concluded that, many liberation struggle veterans faced and some are still facing health and family challenges that impact and influence their work performances, family relationships, their welfare and daily lives. Therefore the study recommends that the Namibian government and Ministry of Defense force take these study findings as state of emergency by offering necessary free treatments and assistance for the health and family challenges faced by the liberation struggle veterans.

Keywords: Namibian Liberation struggle, Veterans, Health and family challenges, War

References

Namibian National Security Assessment on Unmanned Airports/Airstrips closer to the Namibian Territorial Borders

S.S. Nangolo
Department of Aeronautical Science, School of Military Science, University of Namibia, Namibia
Abstract
The study sought to investigate the impact of the usage of unmanned airports/airstrips closer to the Namibian territorial borders on the national security. The study revealed that, the unmanned airports/airstrips closer to the Namibian territorial borders are fully functional and most of them are in use despite the absence of security personnel to ensure the safe usage and security certified operations on these airports/airstrips. The study was conducted in various communities living in close proximity to these unmanned airports/airstrips, so as to assess public views towards the usage and existence of unmanned airports/airstrips in their areas, as far as national security is concerned. The study was conducted using questionnaires and semi-structured interviews as research instruments as well as the researcher’s personal observations. Furthermore, the study used non-probability method through purposive method for data collection. The study found out that both participants from communities, Namibian Police and the Ministry of Defense echoed similar views of concern as far as national security is concerned towards the usage of unmanned airports/airstrips in the country. The study noted that, aircrafts using these unmanned airports/airstrips are not subjected to any form of security measures such as searching or screening of passengers and their luggage upon landing or before departing, in order to establish their backgrounds and what is consigned in their cargo. Furthermore, the study have found out that some of these unmanned airports/airstrips are not fenced off, but they are just open and this can be a grave danger to the community especially children and animals that may be roaming around at unsafe distance from the aircraft landing or taking off. Therefore, the study recommends these airports/airstrips to be fenced off in order to prevent people and animals’ uncontrolled access on these airports/airstrips as this would be dangerous to their lives. These unmanned airports/airstrips pose a great danger to be used for drug smuggling, human trafficking, smuggling of ivories as well as terrorists may also enter the country through these facilities. Therefore, the study recommends for the state to put up some control measures regarding the usage of unmanned airports/airstrips closer to the borders, such as deployment of security/safety officers at these airports/airstrips in order to ensure the safety rules and regulations are enforced as far as the national security is concerned. Community policing of civilian populace, living in close proximity with unmanned airports/airstrips can also be taken as a watchdog tool for the state.

Keywords: Security, Safety, Terrorists, Borders, Airports, Screening

References
An assessment of rainfall variability impacts on rural households’ food security: Onkila village-Omusati region

Z. T. Sheefeni
Department of Military Science, Military History and Military Law, School of Military Science, University of Namibia, Namibia

Email address: zzeztu@gmail.com; Tel: +264 (81) 252 4925

Abstract
Food security and climate change are recognized as factors that constitute significant threats to Namibia’s national security. Rainfall variability is one of the drawbacks of climate change to the Namibian rural communities due to high dependence on activities that are sensitive to rain. Onkila village in Omusati Region is one of the areas prone to rainfall variability and the livelihoods of residents depend on rain-fed farming, which has emphasized the need to assess the impacts of rainfall variability on rural households’ food security. The study assessed climate change awareness among rural community members; and the impacts of rainfall variability on food security. The study also focused on assessing the strategies utilized by the community members to overcome the impacts of rainfall variability on food security.

The study has adopted a qualitative approach, whereby focus group discussions and key informant interviews were used to obtain data. From the village’s overall population of 36 households, 21 household heads have participated in the study as well as two key informants from the constituency council’s office and Ministry of Agriculture. The study found that the community is aware of climate change, however there is no formal knowledge, which may perhaps have affected the community’s means of adapting the impacts of rainfall variability. The study has also found that rainfall variability in the area is associated with frequent droughts which negatively impacts the community’s means of food production as low rainfall meant reduced crop yields. Additionally, another major impact of rainfall variability revealed is the increment of food (Omahangu) prices.

The community has used several strategies such as the growth of drought-resistant crops species and dependence on low-priced food to lessen the impacts of rainfall variability on food availability. Other strategies utilized by the community include applying for new farming land in areas that are less vulnerable to rainfall variability, early ploughing and youth emigration in search for jobs to support their families. The major challenges that hinder the community’s ability to adapt the rainfall variability include the infertile land, lack of money as well as the lack of appropriate weather information. Therefore, the study recommends educating rural residents and improving the appropriation of weather and climate information in order to increase awareness and resilience to climate change impacts.

Keywords: climate change, rainfall variability, awareness, food security, adaptation strategies.

References
The Effectiveness of Voluntary Reporting Systems in Namibia:  
A Case Study of Eros Airport

T.T. Shilikunye  
Department of Aeronautical Science, School of Military Science, University of Namibia, Namibia

Email: sterturjanus@yahoo.com; Cell: +26481 375 7115

Abstract
The study examined the effectiveness of Voluntary Reporting Systems implemented at Eros Airport based aircraft operators and air service providers. There is a need to have an existence of VORSY in order to facilitate collection of information on actual or potential safety deficiencies that may not be captured by the mandatory incident reporting system. However, these services are often under-utilized because of their reluctance in admitting personal errors to an employer or to the Regulatory Authority, and limited knowledge about them. As a consequence, they may fail to collect information on actual or potential safety deficiencies thus not contributing to the identification and implementation of safety improvement measures.

The study collected both primary and secondary data. Primary data was collected using questionnaire which had both open and close-ended questions. A case study was employed to acquire information and draw conclusions. Upon the data analysis, the study found out that there were different organizations at Eros airport that participated in the study which are not limited to Air Namibia, Government Air Transport Service, Namibia Aviation Training Academy and Nampol Air Wing. All these organizations showed their level of satisfaction whereby the majority of respondents were satisfied to a small extent and large extent. Respondents further indicated that company representative compile VORSY and VORSY reports are submitted to VORSY administrators or directly to concerned directors/sections.

On the basis of findings of this study, there is a need for aircraft operators and air service providers at Eros Airport and elsewhere to continue facilitating the collection of information on actual or potential safety deficiencies thus contributing to the identification and implementation of safety improvement measures in aviation.

Since the level of satisfaction on the use of VORSY was to a small extent, there is a need to make use of VOSRY to a large extent so that the reporting person, without any legal or
administrative requirement do so, submit a voluntary incident report. This can be achieved by offering incentives to report. For example, enforcement action may be waived for reported unintentional violations. There is a need to ensure complete confidentiality of the system and strict anonymity of the reporter. Anonymous reports need to accepted on a request that reporter give his identity to enable later contact if any part of the report needs clarification.

**Keywords**: Reporting System, Aircraft Operator, Air Service Provider, Mandatory, Voluntary

**References**

---

**Impact analysis on the advancement of aviation technology on navigation systems**

**S. N Leonard**

*Department of Aeronautical Science, School of Military Science, University of Namibia*

Email: simonleonard73@gmail.com; Cell: +26481 4248 202

**Abstract**
This research investigated the impact of aviation technology on navigation systems. The main aim was to establish the impact resulted by changing the aviation technology on navigation systems in Namibia. As technology advances, new systems and concepts will continue to emerge, offering potential improvements in terms of safety, efficiency and/or economy of international flights. Air Navigation has witnessed some important improvements in recent years, with the states and operators having pioneered the adoption of advanced avionics and satellite-based procedures which included the addition of the Wide Area Multilateration system as well as the Performance-based Navigation. Research questionnaires were disseminated to relevant authorities at Eros airport, and the interviews were then also conducted at the respondents’ willingness to participate in the study. The results showed that the impacts were more beneficial to the navigation systems as compared with the challenges faced, even though some challenges are still visible due to their nature. The findings showed that situational awareness of flight crew can improve significantly from advanced aviation technology, as well as the provision of the basis for regulatory framework that address today’s and tomorrow’s navigation requirements. In spite of the benefits, some of the challenges faced with technology advancement include the need for investment in new infrastructure and technology, adjustment of training programs as well as sending people for training. From the findings, it is recommended that the Namibian
Civil Aviation Authority establish programs to recruit and train the next generation of aviation professionals, in order to create solutions to challenges for Air Traffic Services and Defense, and Namibian Air Navigation Service Providers.

**Keywords**: Aviation, Technology, Navigation

**References**

---

**An analysis on the Effectiveness in Search and Rescue services: A comparative study on fire, search and rescue fire brigade of Grootfontein airbase and Eros airport fire brigade**

**T.H. Joseph**

*Department of Aeronautical, School of Military Science, University of Namibia*

Email: jhmutenya@yahoo.com , Cell: +264 81 356 7315

**Abstract**
The objective of this study was to analyse the Airports fire brigade and fire section in Namibia with specific emphasis on the effectiveness in search and rescue services. Grootfontein airbase fire section and Eros airport fire brigade were purposively selected for a comparative study between the military and civilian run airport fire brigade. Grootfontein airbase is a Military airport under the Ministry of defence that accommodate both military and civil traffic, whereas Eros airport is a civil operated airport run by Namibia Airport Company under the Ministry of works and transport. As per International Civil Aviation Organisation requirements annex 12 states that all airports are required to establish an effective fire fighting unit that provides search and rescue services as part of safety standards set by International Civil Aviation Organisation, failure to establish such department the airport may face downgrading. It is for this reason that the study compare and make analysis on the question of how effective Grootfontein airbase and Eros airport fire brigade. A case study using closed and open ended questionnaires and face to face interviews was employed to gather information on this study. Both qualitative and quantitative method was employed for this study. The findings revealed that, both Grootfontein airbase and Eros airport fire, search and rescue department have 100% qualified personnel as all members went through Airport Rescue Fire Fighter and fire fighter levels. However, when it comes to the effectiveness in search and rescue services the study shows that Eros airport fire brigade is more effective in providing search and rescue services compared to Grootfontein airbase fire unit. This is due to the fact that Eros airport fire brigade uses modern fire fighting
equipments as they have three modern fire tender vehicles, modern personal protective fire fighting equipments, an ambulance and every member at Eros airport is equipped with a two way radio for quick transfer of information. In comparison to Grootfontein airbase that are still using one old fire fighting vehicle and outdated personal protective fire fighting equipment despite having qualified individuals. It was revealed that this has a direct negative effect on their daily activities. From the findings, it’s clear that more is needed to be done at Grootfontein airbase fire section in terms of enhancing effectiveness in search and rescue if the airport is to realise the International Civil Aviation Organisation standards and requirements especially that civil traffic is also accommodated at Grootfontein airport. The study recommends that all the standards and requirements as set in International Civil Aviation Organisation annex 12 and 14 shall be met by each airport accommodating civil traffics. Further, the study identified various challenges encountered by the two airports and possible alternative solutions were provided. The finding where interpreted and analysed in a way that it provide inference of the subject being researched and the conclusions are drawn based on the findings.

**Keywords**: Search, Rescue, Downgrading, Effectiveness, Standards

**References**

DEPARTMENT OF PHYSICS

Estimation of the Lifetime cancer risks due to Gamma radioactivity in the soils of Oshakati, Namibia

A.L Robert*, E.E. Taapopi, S.A. Shimboyo, J.A. Oyedele and M.N Nambinga
Department of Physics, University of Namibia, Windhoek, Namibia

*Author for correspondence
Email: robbieanna02@gmail.com; Tel: +264-81-7728632

Abstract
Natural radioactive materials are found throughout nature. Gamma radiation emitted from natural sources (background radiation) is largely due to primordial radionuclides, mainly $^{232}$Th and $^{238}$U series, and their decay products, as well as $^{40}$K, which exist at trace levels in the earth’s crust. Their concentrations in soil, sands, and rocks depend on the local geology of each region in the world [1,2]. The concentration of these primordial radionuclides could be high in some areas, and exposure to these levels could possibly be harmful to people. For this reason, many countries measure the concentrations of these radionuclides in the soils and estimate the radiological hazards attributable to them [2,5].

This study is an estimation of the hereditary cancer risk, cancer fatality risk per annum, lifetime cancer risk and the lifetime hereditary cancer risk due to the soils of the town of Oshakati in the northern part of Namibia. The radiological fatality cancer risks and severe hereditable effects due to exposure of naturally occurring radioactive materials (NORMs) are assessed using the International Commission on Radiological Protection (ICRP) recommended risk assessment technique and the use of appropriate nominal probability coefficients for stochastic effects [1,3,4,5]. The mean annual effective dose values for soil samples collected from 10 different areas in the town (10 samples per area) was used to determine these parameters. These values were obtained from a publication that was published in an international journal by researchers from the Physics department of the University of Namibia [2] and from the nominal coefficients provided by International Commission on Radiological Protection (ICRP) [1,3,4]. The results from this study will be presented at the conference.

References
Structural, magnetic and optical studies of $\text{Mg}_{0.2}\text{Fe}_x\text{Cr}_{0.8}\text{O}_3$ nano oxides

Mbela Kalengay$^1$, TN Nsio$^2$

$^1$Department of Mathematics, Sciences and Sports Education, University of Namibia

$^2$Department of Integrated Environmental Sciences, Faculty of Agriculture and Natural Resources, University of Namibia

*Author for correspondence
Email address: kalengaym@gmail.com Tel: +264812689575

Abstract
In recent years, nanomaterials have been the subject of active development and research around the world, due to exceptional characteristics resulted from nanoscale size, such as an improved catalysis and adsorption properties as well as high reactivity. Studies have shown that nanomaterials can effectively be used to remove various pollutants in water and subsequently have been successfully applied in water and wastewater treatment. In this paper, we present the structure, magnetic and optical properties of $\text{Mg}_{0.2}\text{Fe}_x\text{Cr}_{0.8}\text{O}_3$ nanosized alloys with $0.3 \leq x \leq 0.9$. The samples were synthesized at low reaction temperature of about 100 °C by using the hydrothermal method in a pressure reactor, allowing to produce samples with particle sizes in the range between 32.8 and 55.6 nm. The structures and magnetic properties of the synthesized samples were investigated on the as-prepared samples annealed at 600 °C. The evolutions of the properties as a function of composition were investigated by XRD, TEM, Mössbauer spectroscopy, magnetization and susceptibility measurements. The optical band gaps calculated through UV-visible spectroscopy are found to be varying with doping concentrations of Fe and Cr. The results also show the presence of weak ferromagnetic (FM) clusters. The nanoparticle oxides have been found to exhibit exchange bias effects which appear to be sensitive to particle sizes [1]. The interpretation of ZFC and FC magnetization results suggest evidence of spin freezing and this behaviour at low temperature appears to be associated with increased magnetic hardness. The variation of crystallite size with energy band gap of the nanostructures has also been investigated.
Fig.1 TEM micrographs for Mg$_{0.2}$Fe$_x$Cr$_{1.8-x}$O$_3$ samples.

References

An empirical relation for dielectric breakdown in vegetation fires

K.M. Mphale*, K. E. Maabong, D. Letsholathebe and S. Chimidza
Physics Department, University of Botswana, P/Bag 0022. Gaborone, Botswana.

* Author for correspondence.
E-mail address: mphalekm@mopipi.ub.bw. Telephone: +267 355 2142.

Abstract
The compulsion to provide reliable electric power for sustenance of socio-economic development is vital for most of Southern African states. The demand for the resource in the region is anticipated to be around 1061 TW h by the year 2040 [1]. However, there is a deleterious effect of fire-induced power disruption which has observed in many tropical and Mediterranean countries and it is likely to hamper the supply reliability of the resource. The
mechanism through which the disruptions occurs is currently a subject of current research in electric power distribution, e.g. in [2,3]. It has been observed that streamer initiated conduction channel provide a means of high voltage electric power flashover [4]. The main purpose of this study is to determine the empirical expression for breakdown electric field strength of vegetation fires. The breakdown field was measured from vegetation fuel (*Peltophorum Africanum*) flames at different combustion temperatures. The experimental data is needed for validation of simulation schemes which are necessary for evaluation of power grid systems reliability under extreme wildfire weather conditions. In this study, *Peltophorum Africanum* fuels were ignited in a cylindrically shaped steel burner (*Figure 1*) which was fitted with a Type-K thermocouple to measure flame temperature. The fuels consisted of dried fine twig (≤ 0.8 mm Ø) and limb wood (≥10 mm Ø) litter. Two copper pinned-electrodes supported by retort stands were mounted to the burner and energized to a high voltage. This generated a strong electric field sufficient to initiate dielectric breakdown in the flames. The evaluated empirical relation for breakdown electric field strength (*E_{crit}*) was of the form; \( E_{br} = \frac{40}{T_{fl}} \text{kV/cm} \).

References

*Figure 1.* Experimental set up for measurement of breakdown electric field strength for vegetation fires
Type Ia supernova equivalent widths and applications to host galaxy dust reddening

E. Kasai

Department of Physics, University of Namibia

Author for correspondence
Email address: ekasai@unam.na | Tel: +264 61 206 3027

Abstract
I present preliminary measurements of equivalent widths of type Ia supernova spectra and discuss their applications to host galaxy reddening. While such studies have been conducted within the local Universe (i.e. at low redshifts, \( z < 0.1 \)) by some authors, this has not been done extensively at intermediate and high redshifts (\( z > 0.1 \)). Our understanding of whether or not the conclusions drawn at \( z < 0.1 \) also hold at \( z > 0.1 \) is therefore limited. It is for this reason that our type Ia supernova data sample for this study - part of which was taken with the Southern African Large Telescope and the rest from the literature - is from within the redshift range \( 0.1 < z < 0.3 \) (which we refer to herein as intermediate redshifts). Our preliminary measurements of equivalent widths of two spectral features show no change in values compared to the same measurements obtained at low redshifts, i.e. we see no redshift evolution. As a result, there is currently no evidence that the dust reddening law in galaxies, as derived from Type Ia supernova spectral studies, evolves significantly with redshift, at least out to \( z = 0.3 \), something that can be better checked with more data.

References
ASSESSMENT OF RADON-222 IN THE SOIL OF ROSSING URANIUM MINE, ARANDIS, NAMIBIA

H. Angula*, E.E. Taapopi, S.A. Shimboyo, J.A. Oyedele and M.N Namibinga

*Department of Physics, University of Namibia, Windhoek, Namibia

*Author for correspondence
Email: helvynelago12@yahoo.com ; Tel: +264-81-7843157

Abstract

In nature there are many unstable atoms or nuclides. The radiation coming from these naturally occurring unstable nuclides is known as natural background radiation. The radiation coming from these naturally occurring unstable nuclides is known as natural background radiation. Soil, rocks, water and air contain unstable nuclides that are a source of natural background radiation [1,2,3]. The magnitude of these exposures depends on geographical location and on some human activities, such as mining [1,2]. There has been increasing interest in many countries to estimate the possible health problems that inhabitants of an area are exposed to due to the levels of natural radionuclides such as Uranium-238, Thorium-232 and their progenies and radioactive Potassium-40. Radon is a gas that has three natural isotopes, namely action (219Rn) emitted from the 235U decay series, thoron (220Rn) emitted from the 232Th decay series and radon (222Rn) which is emitted from the 238U decay series. The production of 220Rn and 222Rn in terrestrial materials is based on the activity concentrations of 228Ra and 226Ra present and these are predominantly alpha emitters. Radon is the most significant element of human irradiation by natural sources through inhalation of its short-lived products of 210Pb and 210Po [1,3,4].

The radiation hazard due to the radon concentration and exhalation rate from the soil of Rossing Uranium Mine, Arandis, Namibia has been evaluated. The activity concentration of 238U (which was in secular equilibrium with 226Ra) in thirty soil samples collected from three different areas, with ten soil samples per area of the mine, has been used to calculate the radon concentration and radon exhalation rate from these soil samples. These values were obtained from a publication that was published in a reputable international journal by researchers from the Physics department of the University of Namibia [3]. This was done in order to access the concentration of Radon-222 at the mine. The estimated Radon-222 concentrations with their corresponding exhalation rate were calculated using well established relations [1, 3,4]. The activity concentration of Radon-222 in the soil matrix was calculated from the activity concentration of Ra-226 in the soil samples. The results from this study will be presented at the conference.

References


---

**DESIGN OF A GRID CONNECTED PHOTOVOLTAIC SYSTEM FOR INSTITUTIONAL USE**

I. L Shawapala  
*University of Namibia, Department of Physics*

*Author and correspondence*  
Email address: isacice1920@gmail.com | Tel: +264812026930

**Abstract**

A 25.2 kW grid connected PV system was designed to meet the university daily energy demand and its annual energy output for the first year was estimated to be about 9.2 MWh, with a potential to meet the University of Namibia, Windhoek campus’s daily demand, was designed. A Photovoltaic power system is one that uses light energy from the sun by converting it into electricity, which might or might not, be connected to the national grid. Like most countries in the world, Namibia uses electrical energy to meet domestic, commercial and industrial energy requirements in many areas. Electrical energy is a major part of the total energy used in the country annually. Energy can only be used if there is someone producing it, yet the Namibian current existing electricity power station such as the Ruacana Hydro Power, Van Eck and Paratus Oil Stations, Ombepo Wind Farm and some other source of energy generation cannot meet the required demand of energy in Namibia. Namibia imports more than 60% of its electricity needs from neighbouring countries. Namibia need to use other alternatives, such as PV solar systems, to produce electricity locally.

Factors affecting the energy yield of a PV system, such as amount of solar radiation, and long-term weather data for a site, which allows estimation of the variability of the climate and the amount of solar radiation were considered. An incoming solar radiation intensity of 6.27kWh/m²day was measured using a Pyranometer installed at house rooftop in Otjomuise, Windhoek. The data was used to determine the size of photovoltaic generator required to produce electricity to meet the energy demand of the University of Namibia, Windhoek campus. The site assessed for the installation of a grid connected PV system at UNAM was the rooftop of the Y- Block, with an area of 792 ± 0.025 m².

The PV solar system’s economic analysis was also done. The total cost of the system was estimated at N$ 1.3 million (using SunPower prices of 2018). The payback time was estimated to
be 4 years. Financial analysis done on the system projected future cost savings to be N$6.8 million. The project will save about 20.8 tons of CO₂ annually as estimated.

It will be necessary to know the impact a 25.2kWp or higher capacity grid-connected solar PV system will have on the university’s energy bill cuts. It is therefore recommended that a studies be carried out to address this issue. It is also best for many (if not all) other institutions to install PV systems, whether stand-alone or grid-connected to cut their bill costs, and at the same time, that is the most efficient way to turn Namibia into energy independent country so more studies are highly recommended.

References

A review of progress in raising the efficiency of organic photovoltaic cells

S. Iiyambo (200821067)*, and Z. Chiguvare
Department of Physics, University of Namibia

*Author for correspondence
Email address: miiyambo69@gmail.com | Cell: +264818109938

Abstract
Organic polymers are associated with advantages over conventional semiconductors and they can be used in organic photovoltaic (OPV) cells. OPV technology, which involves the direct conversion of solar radiation into electricity using organic solar cells, plays a significant role as an energy generating candidate for many applications in the commercial sector as well as for domestic energy needs. The technology of OPV has advanced during the past decades due to further scientific developments, and its future looks promising. The OPV cell is environmental friendly in the provision of energy which is clean, affordable, and reliable. The power conversion efficiencies (PCE) of this technology experienced an immediate increase in the last few years, and prompted an attraction from both scientific and economic interest. This research aims to revise the scientific advancements which have been achieved, in theory and practice, to increase the PCE of organic photovoltaic cells. It also looks at the concept, structure, synthesis, working principle, and limitations of OPV cells. The research project was achieved by studying organic solar cell knowledge of the past, present and predicted future.
A study of the dwarf planet Pluto through stellar occultation observations

J.N. Nuulimba¹*, E. K. Kasai²

¹Astrophysics Section, Department of Physics, University of Namibia
²Department of Physics, University of Namibia

*Author for correspondence
Email address: juliananuulimba@gmail.com | Tel: + 264 81 376 3964

Abstract
In this mini thesis, we present the techniques employed in studying the nature of planets in the solar system, which includes information about their sizes and atmospheres. One of the ways in which this is performed is through what is called a “stellar occultation”, in which light from a distant star is obscured by a foreground planet in our solar system. We specifically focus on the case of stellar occultations by the dwarf planet “Pluto” and present the method of measuring parameters such as its mass and radius using the occultation observations. We discuss in detail the process of deriving what is called a “light curve” from the occultation data, from which we compute all parameters of interest. The dataset we use in this exercise is for the occultation event which occurred on the 12th of June 2006, in which Pluto occulted the star P384.2. The event was successfully observed in Southern Australia at five sites, which are (1) Black Springs, (2) Hobart, (3) Mount Stromlo, (4) Siding Spring and (5) Stockport. For our work, we only make use of the Siding Spring dataset in deriving the light curve and determining all our parameters of interest, including Pluto’s mass and radius.

References

SOLAR RESOURCE DATA - ITS ANALYSIS AND USE FOR MODELLING ENERGY OUTPUT OF PV SYSTEM IN WINDHOEK, NAMIBIA

A.M. Joao, C.S.S.Pena, and P.Dobreva
Renewable Energy, Department of Physics, University of Namibia
Abstract
In the past 200 years energy systems based on coal, oil, natural gas and other fossil fuels have greatly promoted the development of human society. The need for such resources induces political and economic disputes of a number of nations and regions, and even conflict and war. As pointed out in [2] ‘‘In today’s 21st century, there is no problem as important as a sustainable energy supply, especially for the benefit of solar energy development that has been highly concerned by all mankind.’’ Namibia receives large amounts of solar radiation which makes it an ideal location for solar power plants, like photovoltaic (PV) plants. The output of a PV plant is strongly affected by climatic factors like solar radiation, ambient temperature and others. Accurate predictions of the energy output of PV plants is essential for increased reliance on sustainable energy supplies. In most cases, predictions are based on long-term climatic data obtained from satellites, which has high uncertainty.

The aim of this project was to use ground based climate measurements for comparison with the long-term satellite climatic data and for prediction of a PV plant’s output. Measurements of Global Horizontal Irradiance, Direct Normal Irradiance, Ambient temperature, wind speed and others at minute intervals were obtained from the SAURAN network station in Windhoek for the period 1st of September 2016 to the 31st of October 2017. These were used to construct a one-year climate file of hourly values for Global Horizontal Irradiance, Direct Normal Irradiance, Ambient temperature and wind speed.

The constructed climate file was used for modelling, with a suitable modelling software, of the energy output of a Photovoltaic system in Windhoek. Statistical tests were then used to compare the Global Horizontal Irradiance for each month of the ground based measurement with the long term satellite data in order to identify if there were any significant deviations from the long term values. Statistical tests were also used to compare the output energy of the PV system obtained with ground based measured data to that obtained with long-term satellite data. The results underlined the importance of using ground-based measurement solar resource data to obtain realistic expectation for the energy output of PV systems.

A STUDY OF DETERMINING THE PROPERTIES OF ASTEROIDS FROM OCCULTATION MEASUREMENTS

Kankondi S.E

Astrophysics Section, Department of Physics, University of Namibia

Author for correspondence
Email address: kuopio.s.k@gmail.com | Tel: +264 814856981
Abstract
An occultation is when any foreground object passes in front of any background object, such as our moon can occult a star, Jupiter can occult Uranus, etc. Occultations also vary in the amount of luminosity that is blocked by the occulting body thus are time and position dependent. This study will specify on the Centaur (10199) Chariklo which was discovered in 1997 by the Spacewatch program at the Kitt Peak National Observatory, Arizona, United States. Centaurs are objects which have been pulled inwards from the Edgeworth Kuiper Belt by Neptune by gravitational scattering. The core objective of this study is to determine the properties of the Chariklo main body as well the two ring structure surrounding the centaur. The photometric data taken at the Cuno Hoffmeister Observatory (CHMO) on 2016 October 1 of the Chariklo occultation will be used. Studying centaur occultations is important because they provide us with unique ways to determine features such as the connection between asteroid rings and planetary rings. Understanding the ring parameters (width, orientation, orbital radius, optical depth, etc.) and the mechanics of the particles inside the rings C1R and C2R of Chariklo would guide further research on the understanding of bigger ring structures such as the giant planetary rings. Predicting the stellar occultations by centaur Chariklo and its two rings C1R and C2R is a strenuous task as the main centaur body subtends roughly 25 milliarcsec (25 mas) as seen from Earth while the rings have a span of about 80 mas. Chariklo has a known radius of (119 ± 5) km, estimated from thermal measurements and it is the largest Centaur object known to date. Chariklo occultations it is estimated that the C1R and C2R have orbital radii of approximately 391 km of the inner ring and 405 km of the outer ring and widths of 7 km and 3 km, respectively. The 2016 occultation was predicted on the new Gaia DR1 catalogue released in September 2016. The J2000 DR1 star position had a right ascension position of $\alpha = 18^h 16^m 20^s.0789$ and $\delta = -33^o 01' 10'' .760$ which was the declination position held during the moment of occultation. The photometric data taken by the Cuno Hoffmeister Memorial Observatory (CHMO) still needs to be fully analysed, compared to the data from the other observatories and presented in the upcoming presentations.

Design construction and testing of a solar cooker appropriate for Namibian climate

Antonio S Miguel
Renewable energy Section, Department of physics, University of Namibia

email address: antoniosmig@gmail.com
Phone: (+264) 812350514

Abstract
With the increase in demand for firewood and a very low or no supply of electricity in the rural settlements of Namibia as well as the ever increasing electricity tariffs around the cities such as Windhoek, the population needs low costing but effective technologies to meet their cooking
energy needs. This project designed and constructed a box solar cooker using physics principles, as an alternative way of preparing meals abstaining from the frequent use of electricity and firewood. Considering that Namibia has a desert climate the design opted towards achieving a maximum heat accumulation inside a solar box cooker. Instruments such as multimeters, thermocouples and digital thermometer were used in the testing of the constructed solar box. The selection of this instruments was based on availability. Different calculation were carried out involving the average temperature recorded in the solar box, and the average heat accumulation by the solar box has been estimated. Temperatures in excess of 110°C were measured inside the box against an outside temperature around 30°C, confirming that the box can be used for any cooking needs, around the boiling temperature of water.

**Keywords**: Solar cooker, solar box and solar device

**References**


**RADIOLOGICAL CANCER RISK ASSESSMENT OF NATURAL RADIOACTIVITY OF WINDHOEK, NAMIBIA**

V. Nakafingo *, E.E. Taapopi, S.A. Shimboyo and J.A. Oyedele

*Department of Physics, University of Namibia, Windhoek, Namibia*

*Author for correspondence*

Email: eggscellent4@yahoo.com ; Tell: +264-81-4888426

**Abstract**

The $^{235}$U, $^{232}$Th series and natural $^{40}$K are the main source of natural radioactivity in soil and have long half-lives up to $10^{10}$ years. Therefore, their presence in soils and rocks is simply
considered as permanent [1]. The terrestrial radioactivity arises mainly from the primordial radionuclides whose half-lives comparable to the age of the earth and their concentrations in soil depend primarily on the geographical conditions and geological formations[2]. The concentrations and distribution of natural radionuclides ($^{235}$U, $^{232}$Th series and natural $^{40}$K) in soils from Windhoek city, Namibia was investigated with an aim of determining the radioactivity concentration of the natural radionuclides materials (NORMs) and critically assess natural radioactivity levels and the annual effective dose in order to know the radiological cancer risks. 160 soil samples were collected from 16 sites of Windhoek. The average activity concentrations were determined by use of gamma spectrometry method with a high purity germanium (HPGe) detector and found to vary from 15.0±1.3 to 37.8±2.1 Bqkg$^{-1}$ for $^{235}$U, 17.5±2.7 to 62.1±3.3 Bqkg$^{-1}$ for $^{232}$Th and 168.9±15.0 to 784.9±30.1 Bqkg$^{-1}$ for $^{40}$K. The absorbed dose and the mean effective dose for the city were calculated from the above concentrations. In comparison with the internationally approved values, the mean effective dose value of 0.07±0.01 mSy$^{-1}$ obtained is below the limit of 1mSy$^{-1}$ recommended for the public exposure control by the International Commission on Radiological Protection (ICRP), hence this area should be considered Low Background Radiation Area (LBRA). Radiological hazard assessments arising from the natural radionuclides are further to be carried out by determining the Fatality cancer risk and the Hereditary effects risk.

References

An Assessment and Interpretation of Aeromagnetic data over the Tsaobis area, Erongo region, Namibia

Natalia .R. Rengura
Department of Physics, University of Namibia

*Author for correspondence
Email: nataliashelly09@gmail.com; Tel: +264-81-7906261

Abstract
The main aim of a geophysical study is to examine subsurface structures, highlighting more detailed features that are hard to obtain from surface mapping. Tsaobis is an area located in the south of Omaruru and East of Swakopmund in Namibia. The area was mapped by the Geological Survey of Namibia (GSN); however some structural lineaments are covered by young Kalahari sediments. This study provides an interpretation of the high resolution aeromagnetic data acquired from the GSN, with the purpose to delineate the subsurface geologic structures for the area. The result is a map consisting of an integration of the geology and the geophysics showing faults and magnetic lineaments.
REVIEW OF OBSERVATIONAL EVIDENCE OF THE ACCELERATED EXPANSION OF THE UNIVERSE USING SUPERNOVA DATA

N.S. Simasiku¹*, E. K. Kasai²

¹Astrophysics Section, Department of Physics, University of Namibia
²Department of Physics, University of Namibia

*Author for correspondence
Email address: santysimasiku@gmail.com | Tel: + 264 81 733 2017

Abstract
In this mini thesis, we present the observational evidence of the accelerated expansions of the Universe, as proved in 1998 by two teams of supernova cosmologists, using observations of low-redshift and high-redshift Type Ia supernovae. The data set used for the project is the Union 2 data set, which comprises 580 Type Ia supernovae compiled by several authors. Using this data set, we fit for three cosmological parameters using the Metropolis Hastings algorithm of the Markov Chain Monte Carlo technique. The three parameters are the relative matter density $\Omega_m$, the relative dark energy density $\Omega_\Lambda$, and the Hubble constant $H_0$. In deriving the three parameters, the Lambda-CDM model, which is our current best theoretical description and understanding of how the Universe works, is fitted to the supernova data. This type of study is crucial to our efforts of advancing the frontiers of Science by constantly improving our understanding of our place in the Universe and continuously expanding our knowledge of its dynamics. In the process of doing all this work, a number of computational, numerical and data analysis skills are acquired and presented in this mini thesis along with the main results.

References
ESTIMATION OF THE RADON CONCENTRATION AND EXHALATION RATE IN THE SOIL OF WINDHOEK, NAMIBIA

S.K Nandjedhi*, E.E. Taapopi, S.A. Shimboyo, J.A. Oyedele and M.N Nambinga
Department of Physics, University of Namibia, Windhoek, Namibia

*Author for correspondence
Email address: mangokie08138@gmail.com  Tel: +264-813821854

Abstract
Naturally occurring radioactive materials (NORMs) are one of the harmful terrestrial materials found on Earth. They are classified through their radioactive decay chains which are Thorium series, Uranium series and Actinium series [1, 3]. The Uranium series is also called the “Radon series” which is a source of isotope Radon-222 having a half-life of 3.82 days. Radon-222 is a colorless, odorless gas and is a daughter isotope of Radium-226 an alpha emitter found in natural soil. The mobility of Radon is very divergent as it can transport though soil, liquid and in air which is why the radioactive Radon-222 can easily accumulate in houses and unventilated places. The alpha particles released by Radon can be ingested by humans causing catastrophic cell DNA manipulations which leads to cell damage and that can cause cancer [3, 4]. The mean activity concentration of $^{238}$U (which was in secular equilibrium with $^{226}$Ra) in for the 16 geographical areas has been used to estimate the radon concentration and radon exhalation rate from the soil samples of these areas. These values were obtained from a publication that was published in a reputable international journal by a researcher from the Physics department of the University of Namibia [2]. The methods used to estimate the objectives of this research comply with the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) techniques under secular equilibrium consideration of the samples [1,3,4].

The concentration of Radon-222 in the soils of Windhoek ranges from $15.2 \pm 2.2$ to $27.2 \pm 2.0$ kBq.m$^{-3}$ at locations Northern industrial and Ludwigsdorp respectively, while the exhalation rate of Radon-222 from the soils of Windhoek ranges between $0.0078 \pm 0.0019$ and $0.0139 \pm 0.0010$ Bq.m$^{-2}$.s$^{-1}$ at locations Northern industrial and Ludwigsdorp respectively. The results obtained shows proportionality to the Uranium-238 values used, which makes the UNSCEAR techniques fit. Both the concentration and exhalation rate around Windhoek are within the critical levels of 78 kBq.m$^{-3}$ and 0.033 Bq.m$^{-2}$.s$^{-1}$ recommended by the UNSCEAR. The activity concentration of Rn in soil in the absence of transportation, and the exhalation rate were calculated and they compare well with the world average values suggested by United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR, 2000).

References:
The study of the origin of diffuse x-ray emissions from globular clusters

R. Evans, M. Backes, T. Simon *
Department of Physics, University of Namibia

*Author for correspondence
email: tuwi9617@gmail.com; Tel: +264-81-6224766

Abstract
For a number of globular clusters, diffuse X-ray emissions have been detected; however the origin of these diffuse X-ray emissions is unclear [1]. This study will explore the origin of diffuse X-ray emissions from globular clusters by analyzing data from Omega centauri and Terzan 5. In this project we obtained multi-waveband observations of the above mentioned globular clusters with known X-ray emission. On the night of 13 June 2018, we obtained data of Omega Centauri in the $g$, $r$, $i$ and $z$ filter pass-bands, and on the night of 07 September 2018 we obtained in the $g$, $r$, $i$ and $z$ filter pass-bands of Terzan 5. These filters pass-bands span the visible and near-infrared part of the spectrum. We obtained the spectral energy distribution of these two globular clusters in this part of the spectrum. The data analysis is an ongoing process and full results of the analysis will be presented hopefully at the conference in November 2018.

References

DETERMINATION OF SOLAR WATER HEATING CONTRIBUTION IN REDUCING ENERGY CONSUMPTION IN WINDHOEK

F N N. Lotto *, N. Kwarikunda
Department of Physics, University of Namibia

*Author for correspondence email
foibetuwilika@gmail.com; Tel: +264-81-3205823
Abstract
Solar energy is increasingly gaining prominence as an alternative source of energy in Namibia due to the favourable climatic conditions. One of the applications of solar energy is the direct conversion of solar radiation into heat, which can be used for various applications such as cooking and water heating. This paper discusses the thermal performance of solar water heating systems in Namibia using measured data and through modelling.

The thermal performance of solar water heaters installed in Otjomuise, Windhoek, was investigated using data that was recorded over a period of nine months (January 2017-September 2017), at one-minute interval to determine their performance under the prevailing climatic conditions. The results show, on average, a collector efficiency and a solar fraction of ~80 %, indicating that solar water heaters can meet on average, 80% of the energy needed for water heating in a typical homestead in Namibia. The performance of the collector was also modelled using MATLAB software. The results obtained from modelling were validated using the measured data.
Is contraceptive use a significant predictor of pregnancy among sexually active teenagers in Namibia?

L. Amutenya and L. Pazvakawambwa
Population Studies, Department of Population Studies and Statistics
University of Namibia

Email address: loideamutenya@yahoo.com | Cell: +264 (81) 6463136

Abstract
There is a worldwide concern on early child bearing, and although countless measures are taken to alleviate this concern, in developing countries like Namibia, teenage pregnancy is still on the rise. Teen mothers often face several difficulties arising from the families and societies where they are brought up, in addition to that teenage mothers are more likely to experience severe complications during delivery which will result in higher morbidity and mortality for both themselves and their children. This study aims to establish factors influencing pregnancy among sexually active teenagers in Namibia, specifically aiming to establish patterns and trends amongst teenagers using 1992 to 2013 NDHS, to investigate whether contraceptive use affects teenage pregnancy and to which extent it affects teenage pregnancy. Data was obtained from the NDHS from 1992 to 2013 from all 13 regions and the study participants were identified as female teenagers in the age group 10-19 who had already given birth to their first child. Analysis entails survival models, using Cox proportional hazard regression, which were conducted to compare time-to-first birth of the respondents either by place of residence or and whether or not they use contraceptives, furthermore to assess the effects of the explanatory variables to survival time. Overall trends revealed that teenage pregnancy has increased since 1992 to 2013, with a highest increment from 2006 to 2013. In addition to that results also discovered that there were significant differentials in the probability of teenage pregnancy, teenagers from a rural areas were less likely to use contraceptives and more at risk of falling pregnant. Teenagers who had primary or no education were more likely to fall pregnant than their counterparts that had gone to higher educational institutions. Though contraceptives are available, teenagers still do not use them, effort needs to be concentrated on motivating teenagers to use contraceptives, and for them to be well informed on their sexual reproductive rights, this will improve their sexual and contraceptive future choices. In order to reduce these high rates teenage pregnancy, there is a need for deeper understanding as to why teenagers do not use contraceptives.

Keywords: Teenage pregnancy, (NDHS), Survival analysis, Namibia
Disabilities in Namibia: A Statistical Analysis on the Access to Learning and Economic Opportunities of People living with Disabilities

L. Beukes and I. Shipanga

Department of Statistics and Population Studies, University Of Namibia

Email Address: ishipanga@unam.na

Abstract

Background During the year 2011 disability affected the lives of 108,992 people in Namibia according to the Disability report (NSA, 2016), these disabilities included seven well known disability types amongst which were mentally disabled, visually disabled and loss of limbs. This made up 4.7% of the entire population of Namibia. As a developing country Namibia has made provisions for people living with disabilities such as the disability grant that came into existence in 1992 as well as the disability act (1997) which aimed to create equal opportunities for individuals that have disabilities and for them to assume more complete responsibilities as members of society.

Objectives The main aim of this study was to determine whether disability status has a bearing on the ability to engage in learning and economic activities focusing on determining the demographic, social and economic profile of people living with disabilities in Namibia as well as the prevalence for the number of disabilities an individual is affected by and to establish whether there is association between the number of disabilities an individual is affected by and educational attainment as well as employment status.

Method Data from the Namibia Intercensal Demographic Survey (n=108992) was used to analyse the data using cross tabulations to determine how the number of disabilities are distributed throughout the country as well as how they are distributed with socio-demographic determinants. This included region, sex, age, area, employment status, educational attainment, type of disability and number of disabilities. A Binary logistic regression analysis was used to determine how these socio-demographic variables influenced difficulty in engaging in economic activities which is dichotomous (1=Yes, 2=No) as well as difficulty in engaging in learning activities which is also dichotomous. Chi-Square tests of association were done to determine whether there is association between the number of disabilities and educational attainment and number of disabilities and employment status.

Results Overall it is established that most persons living with disabilities are situated in rural areas, with a higher percentage living in the Ohangwena region of Namibia (16.1%). Showing that there are more females with disabilities since the Namibian Population is mostly made up of females, but a higher percentage of males are affected by three different types of disabilities. Regarding employment status, as the number of disabilities increase the number of people living with disabilities that are employed decreases having higher percentages of people being employees, and employed without pay as Subsistence Communal farmers. The model showed that the odds of having difficulty in engaging in economic activities is 0.940 times greater for males then females and the odds of having difficulty in engaging in learning activities is 0.961 times greater for males then for females. Results also show that the odds of having difficulty in
engaging in economic activities is 2.979 times greater and 0.719 times when affected by three
types of disabilities then one type of disability and two types of disabilities respectively.
The odds of having difficulty in engaging in learning activities are 6.985 and 2.342 times greater
when affected by three types of disabilities the one of two types of disabilities respectively. Tests
of association indicated that there is association between the number of disabilities an individual
has and employment status as well as educational attainment but it indicates a weak association.

Conclusion

More still needs to be done to ensure that people living with disabilities have access
to learning facilities as well as the ability to engage in economic activities. Securing these vital
characteristics can ensure that people living with disabilities are participating as active members
of the society. Therefore creating an environment for people to engage in learning activities on
home grounds by proving knowledge to the parents/guardians of individuals living with
disabilities can ensure that individuals who do not have the ability to access educational facilities
attain some form of educational knowledge.

References

health and retirement study”, The Journal of Human Resources 5(4)
http://uis.unesco.org

AN ANALYSIS OF INFLATION RATES IN NAMIBIA: 2008-2017

P.N Haufiku and K. Mutorwa
Department of Statistics and Population Studies, University of Namibia

*Email address: Haufikupn@yahoo.com Cell: +264 814417223

Abstract

Inflation is the persistent increase in the level of consumer prices or persistent decline in the
purchasing power of money (Webster 2000). Inflation is one of the major economic challenges
facing most countries in the world especially African countries with Namibia not being an
exception, inflation affects a lot of people especially those who are living on a fixed income, as
they cannot buy as much as they could previously. This study used ARIMA models to
exclusively focus on forecasting Namibia’s monthly inflation for the year 2018 using monthly
inflation rates from 2013 to 2017. The study also used annual data of exchange rate, consumer
price index (CPI), gross domestic product, government expenditure and revenue from 2008 to
2017 to determine whether or not the explanatory variables are significant determinants of
inflation in Namibia. The study revealed that, for the the last 5 years, Inflation rates in Namibia
have varied between 2.90% in April 2015, the lowest, and 8.20% in January 2017, the highest.
Inflation was lowest in 2015 across all months. . Inflation rate is expected to be 5.51% in 2018
The multiple regression models were used to explain the significance of the explanatory variables. The results showed that exchange rates, consumer price index (CPI), gross domestic product, government expenditure and revenue do not significantly affect inflation, these variables accounted for 78.1 percent variation of inflation rates in Namibia and an adjusted variation of 50.7 percent annually for the past 10 years.

REFERENCES

THE STUDY OF STUDENT'S PERCEPTIONS ON CAMPUS SAFETY AND SECURITY AT THE UNIVERSITY OF NAMIBIA MAIN CAMPUS

R.V. Kauraisa and L. Kazembe
Department of Statistics and Population Studies

Email address: kauraisar@yahoo.com | Cell: +26481 4181904

Abstract
The primary of this study was to explore the students’ perception on campus safety and the use of campus safety services. This study included the perception of 80 students at the University of Namibia main campus registered during the 2018 academic year. The study investigated the impact of demographic variables, which are, gender, age, year level, study mode, accommodation and crime victimization history on campus on the overall perception of the students. The information on the perceptions of the students was collected using a Likert scales of 1 to 5, multiple choice questions, open ended and free response comments. The questions was grouped in demographic information, sense of community, campus safety campus environment and overall perceptions. The study was carried out using an analysis with SPSS 25, Microsoft excel. A descriptive statistics was firstly carried out to determine how the students have perceived the safety and security on campus with regard to the different areas and times when they are on campus. Most students perceived the campus as “Not safe” as shown in table 1 below. A Bivariate regression model was then carried out between the students who were victimized with crime on campus and the overall perception of the students on the safety issue on campus.
References
5. Carrico, Brian Andrew, (2016)” The effects of students perception of campus safety and security on student enrollment”.

Access to Health Care in Malawi: An Examination of Delays among Caregivers of Children Suffering From Diarrhoea

S.E. Kazembe and I. Shipanga
Department of Statistics and Population Studies University of Namibia

Email address: sozok45@gmail.com
[Tel: +264816113625]

Abstract
Children’s health is very important and crucial to their survival during infancy. When a child is unwell the decision to seek, access healthcare depends of the caretakers. Children who are less
than 5 years of age are unique and different from adults since they can hardly express themselves about their health condition. Being in the vulnerable stage of their life (need more care), one expects the caregivers to react promptly and seek help to restore the health of the child, since well-being of a child depends on their decisions. There are three different kinds of delay that may affect the wellbeing of children. These are delay in making decision or seek healthcare, delay in reaching health facility and where to go and delay in receiving adequate care at the health facility (Waiswa, et al, 2014). These hindrances are associated with the caregiver’s social and economic situation. The main aim of this study is to investigate the delay in access to health care among caregivers of the under-five children with diarrhea in Malawi. This study used secondary data from the Malawi Demographic Health Survey of 2015-16. That focused on caregivers of children who are suffering from diarrhea. The data analysis that was conducted was the descriptive statistics of both the dependent and independent variables and then conducted chi-square test of association of the socio-demographic factors of the caregiver and child and associated delay. It also did some bivariate analysis and model the multivariable logistic regression. Of a sample of 19967 children, 2297 (11.5%) reportedly had diarrhea. Forty eight percentage of children with diarrhea were taken to a health facility. Caregiver's education of secondary or higher (OR 0.657; 95% CI, 0.487-0.886), rich (OR 0.719; 95% CI, 0.604-0.857) wealth index and married (OR 0.476; 95%CI, 0.279-0.811) marital status decreased the odds of being delay in seeking treatment. Caregiver’s geographical location in Central region (OR 1.720; 95%CI, 1.387-2.133) increased the odds of being delay in seeking treatment. There was a strong age bias; a child aged 3 to 4 years old had higher odds of experiencing a ‘delay’ in seeking treatment, compared with a child aged 1-2 years old (OR 0.794; 95% CI, 0.673–0.939). Those in the poorest living conditions were less likely to seek treatment, because they had to work in order to find living to sustain the family. A similar study in India found also the same results. Caregivers who had only primary education found had less knowledge of the disease hence why they were delay. Similar study in Malawi on Malaria found that caregivers of Central region were most likely to be delay in seeking healthcare because they has low NGO’s programmers for children. The findings enhance our understanding of the factors that influence treatment-seeking behaviour of the caregivers in cases of childhood diarrhoea. Most of the factors that negatively affect decision to seek treatment are addressable by creating community awareness and health systems strengthening. The government and policy makers should enhance programmes that carter for the reduction in the delay to seek advice or treatment experienced by caregivers.

**Key words**: delay, healthcare, caregiver, seeking, advice.

**References**

United nations (2000), Millennium Development Goals (MDGs)

Abstract
Corruption has become a very big concern in every country, especially in most developing countries such as Ghana, Kenya, Swaziland, Republic of Congo and Namibia just to mention a few. Due to the high level of corruption practices, most countries have resorted to setting up anti-corruption commissions or agencies in their respective countries. In Namibia, the Anti-Corruption Commission (ACC) plays a very important role in the fight against corruption since its inception under the anti-corruption act, 2003, (act No. 8 of 2003). Their initiatives in Namibia are there to ensure that the people entrusted with authority do not abuse their authorities and they put the interests of the public before their own to combat corruption. To date, a lot of countries worldwide, including African countries are currently suffering from different forms of corruption ranging from bribery, embezzlement, abuse of discretion, favoritism, nepotism, theft and fraud. People resort to practicing corruption due to several reasons such as poverty, poor salary/income pay, greed, lack of accountability and transparency, poor leadership and moral decay, etc. With a population of approximately 2.3 million people, Namibia is not excluded from such corruption practice. This begs the question, are the anti-corruption initiatives that are in place in Namibia and other African countries effective in combating corruption and in national building? For this reason, this research study focused on the evaluation of the relationship between the anti-corruption commission’s initiatives in Namibia and the Human Development Index (HDI) of the republic of Namibia. The study used secondary data from the ACC of Namibia and the United Development Program (UNDP) reports. The ACC initiatives data were extracted from their annual reports of 2006 to 2015, while the HDI data and its components were extracted from the UNDP Namibia annual reports for the period of 10 years (2006-2015). All data analyses were conducted using the Statistical Package for Social Sciences (SPSS) version 25. A two-tailed Karl Pearson correlation tests were performed to test for significant relationship between the anti-corruption initiatives (public awareness campaigns on dangers and evils of corruption, radio/TV interviews or shows, number of cases investigated by ACC, and cases referred to prosecutor-general) and HDI (education, health and Gross National Income (GNI) per capital) in Namibia. At a 20% significance level, it was revealed that HDI (Education) had a positive relationship with public awareness campaigns on the dangers and evils of corruption (p-value=0.170), but a negative relationship with number of cases investigated by ACC (p-value=0.110). However, HDI (Health) had a negative relationship with number of cases investigated by ACC (p-value=0.143), but a positive relationship with public awareness campaigns on the dangers and evils of corruption (p-value=0.072). Likewise, the overall HDI had a positive relationship with public awareness campaigns on the dangers and evils of corruption (p-value=0.099), but a negative relationship with number of cases investigated by ACC (p-value=0.135). On the other hand, HDI (GNI) had no relationship with any of the ACC initiatives. Furthermore, multiple regression analysis embedded with forward selection was performed to explore the relationship between the dependent variables (HDI) and the independent variables (ACC initiatives). Results from these regression analyses showed that Radio/TV interviews or shows=20 (p-value=0.032) had an effect on HDI (Education), Public awareness campaigns on the dangers and evils of corruption=18 (p-value=0.049), Radio/TV interviews or shows=8 (p-value=0.004), and Number of cases investigated by ACC=488 (p-value=0.013) had an effect on HDI (Health), while public awareness campaigns on the dangers and evils of corruption=13 (p-value=0.002), public
awareness campaigns on the dangers and evils of corruption=32 (p-value=0.0.008) and public awareness campaigns on the dangers and evils of corruption=39 (p-value=0.001) had an effect on HDI (GNI), at a 5% significance level. Based on the findings of this research study, the following recommendations were made: the government and the anti-corruption commission need to take serious action to work towards the improvement of the current implemented anti-corruption initiatives if we want to win the fight against corruption, The ACC should ask for assistance and financial aids from other countries in improving the anti-corruption initiatives, and Further studies can be done to evaluate the relationship between corruption and HDI from 2006-2018 to evaluate how corruption affects the HDI and sustainable development in Namibia.

A statistical analysis of poaching incidences in Namibia

M.M.T Mumbango* and O. Oyedele
Department of Statistics and Population Studies, University of Namibia, Namibia

Email: mtjino8@gmail.com; Tel: +264 85 3648795

Abstract
Poaching is not something new in world, especially in Africa and in Namibia. There appeared to be some misunderstanding with differentiating between poaching and sustainable hunting. Sustainable hunting is the well-controlled use of wildlife based on scientific principles and sound knowledge (NACSO, 2016), while poaching is the act of catching and killing of an animal without permission, on someone else’s property, to get valuable parts from them (Cambridge, 2018). It can be as a result of trophy hunting, for medicinal or traditional purposes. What has been evident is that most of the animals being poached are considered endangered species and indigenous to their environmental habitats. In Namibia, the populations of rhinos, elephants and pangolins are greatly affected by the illegal hunt and capturing of them. Figure 1 below shows a bar chart of the reported parts taken/poached items taken from the poached animal for the period of January 2017 to June 2018. One can tell that the elephant tusks were the most commonly ceased poached item from poaching offenders in Namibia, while meat products were the least, with twenty-three tusk being the most, than carcass and horn with both six cases.
Poaching is not only a wildlife crime but also an economic crime that robs the country and its people of much needed income. The global annual market value of illegal wildlife trade ranges between US$5 billion (N$66 billion) and US$23 billion (N$300 billion) and ranks amongst crimes such as trafficking of humans, drugs and weapons in terms of profitability (Baldus, 2004). In addition, illegal hunting and poaching or trafficking of wildlife animals or products only cheats the nation and future generations of their natural heritage. Moreover, the Namibian government took several measures to deal with the ever increasing activities of poaching. Two of such measures were the amendment of the punishment provisions (under the Nature Conservation Ordinance 4 of 1975) by increasing the penalties for illegal hunting of rhino or elephant from a maximum fine of N$200,000 to N$25 million and a proposed imprisonment from 20 to 25 years which can also be executed together with the maximum fine. However, despite all these measures, the number of poaching incidence in Namibia is still high and daily occurrence of poaching is just a daily norm in the country. For this reason, this study aimed at examining the poaching incidences reported in Namibia for possible contributing poaching factors, which can be used for future purposes as a prevention tool to save many animals’ lives. The data used in this study was secondary data for the period of 2013-2018, obtained from drafted publications of the Ministry of Environment and Tourism. Only rhinos and elephants poaching incidences were focused on, in this study because information on other poached animals were not available during the duration of this study. All data analyses were conducted using the Statistical Package for Social Sciences (SPSS) version 25. Pearson Chi-square tests for association were conducted to test for possible associations between poaching incidences and geographical variables (such as Location, Poached Animal and Nationality). At a 5% level of significance, it was revealed that there were a significant association between animal poached and parts taken (p-value=0.000), and between animal poached and geographical location (p-value=0.000). To explore the contributing factors of poaching incidences in Namibia, a Poisson regression method was used. Here, the independent variables for this model were poached animal, parts taken and geographical location, while the dependent variable was the recorded number of poaching incidence. Results from the Poisson regression revealed that only type of animal poached and parts taken were significant contributors to the poaching incident rate in Namibia. It is therefore recommended that the government invest more in the security of our wildlife animals especially those at the brink of local extinction, at all the country’s national
parks. Resort and lodge owners who host endangered species at their farms, are urged to recruit game guards and have regular random patrols of their land and maintenance of the farms fencing. The contributing factors to the increase in poaching activities need to be identified and be tackled, only than can we see a decrease in poaching cases in Namibia.

References

The use of internet and social media and its effect on academic work of undergraduate students at University of Namibia (UNAM), Windhoek

S Mutilifa and N Indongo*
Department of Statistics and Population Studies, University of Namibia

Email: dmutilifa@gmail.com Cell: +264 81 677 0725

Abstract
Africa is the third continent with the most internet users in the world with a 10.9% usage. For the past ten-year internet has been an important instrument for facilitating academic activities among student in tertiary institution in Namibia. Davis et al (as cited in Mingle J. & Adams M, 2015) said through the internet, a number of web technologies emerged and one technology that is making waves with regard to information sharing and communication is the social media network which has been a tremendous growth in the use of the internet. The main objective of this study is to investigate the effect of social media on academic work of undergraduate students at the University of Namibia main campus specifically the study aims to ascertain what students mainly use social media for; ascertain how the use of social media affect the academic work of students; identify the most favourite social network among students and to make appropriate recommendations on appropriate usage of social media among students. A data collection tool was developed and administered on face to face to eligible respondents. The analysis is based on primary data collected. The method of analysis is mainly quantitative and analysis was performed in SPSS. Descriptive statistics were computed, relationship between variables of interest were examined through cross tabulation and significance tested using chi-square test. Logistic regression was used to predict the probability of effect of social media on academic work of students. Results were presented in odds ratio. Overall results show that most students mainly use social media for entertainment and educational purposes such as downloading/receiving videos and pictures containing educational information adding that some
get to share old examination papers for revision. The most popular social network was WhatsApp followed by Instagram with a majority of male students who indicated that they use social media to make friends. Majority of respondents confirmed that social media has a positive effect on their academic work. Furthermore, results from the logistic regression indicated that the probability of social media negatively effecting the academic work of students who live off campus is (4.076) times higher than those who live on campus. In addition, the probability of social media negatively effecting the academic work of students who said their grades will improve if they stop using social media is (4.108) times higher than those who said their grades will not improve. In conclusion although social media should be used with caution as it might take up much of the study time for students it emerged from the results that it’s a useful reference tool for academic work.

It is therefore recommended to get the perception of staff on how the use of social media effect the academic work of undergraduates.

References

A COMPARISON OF ADULT MORTALITY BETWEEN KAVANGO EAST AND KUNENE REGION USING SURVIVAL ANALYSIS

K. Y. Mutjavikua and L. Kazembe*
Department of Statistics and Population Studies, University of Namibia

*Author for Correspondence
Email address: lkazembe@unam.na | Tel: +264612064515

Abstract
Adult mortality is one the mortality that is rarely studied, with most studies focusing on either infant or maternal mortality. As such measures are put in place to improve maternal and infant but adult mortality is neglected, yet adults are the most economically active section of the population, whose health will affect the economy and the household in one way or the other. The main goal of this study is to analyze factors associated with adult mortality in Namibia. Particular emphasis is place by comparing the adult mortality between two regions, with high and low mortality rates: the Kavango East and Kunene region. At the same time we examine contrasts in the main causes of death between these two regions. Data used for the study came from the Namibia Inter-censal Demographic Survey (NIDS) 2016. NIDS used a cross-sectional study design. Adult mortality was measured as age at death (in complete years). Cause of death, sex, region, and place of residence were used as independent variables. Descriptive statistics, Kaplan-Meier survival curves and Cox regression model was used for analysis. The study found
that the main contributing risks factors of adult mortality were pregnancy related deaths, accidents, suicide, natural death and other unspecified causes for both Kavango East and Kunene region. Furthermore, the variables cause of death, regions of interest, and sex, were found to be significant at 5%, the log rank test results from the Kaplan-Meier survival curve were used to consider significance. Contributing factors due to pregnancy related deaths and suicide should be explored further by looking at health care facilities as well as socio-cultural factors that increase the risk of adult morality.

**Keywords**: adult mortality, Kaplan-Meier survival curves, Cox proportional model, Namibia, Kunene region, Kavango East Region

---

**Determinants of under 5 year’s Nutritional Status in Namibia**

L.T Ndadi and I. Kamwi  
Department of Statistics and Population Studies, University of Namibia

Email address: lineekelandadi@gmail.com  cell: +264813575799

**Abstract**

According to (Ashis, 2017) Poor nutrition among under-five children remains one of the major public health problems in many parts of the world. It is identified as the major cause of death, with an estimate of 45% of all deaths among children aged 0-59 months of age. Child malnutrition remains common all over the world; it is most dominant in developing countries. For example, the prevalence of chronic malnutrition was about 39.9% in Africa, and the prevalence rate of underweight was 26.6% in South-East Asia.  
(Das et al, 2007) stated that poor nutrition is associated with increased morbidity, growth faltering, developmental retardation and significant mortality. A number of studies have also demonstrated a relationship between growth status, school performance and intellectual achievement. It leads to poor performance in schools and it also affects them psychologically and mentally.

In Namibia few studies have focused the factor that influences poor nutritional status in children under the age of 5 years. The aim of this study is to investigate factors associated with poor nutrition in children under the age of 5 years in Namibia.

**Methods**: Data from the Namibian Demographic and Health Survey (NDHS) was used of 2013. the data was analyzed and cleaned using spss version 2.0. Descriptive statistics were calculated for continuous variables. Cross tabulations were carried out for the dependent variable against the independent and binary logistic regression was carried out to further investigate the relationship between poor nutritional statuses with the independent variables.

**Results**: A total of 4078 respondents in the study. Children between 24-35 months had the highest prevalence which shows 56.7 percent children without poor nutrition and 43.3% with poor nutrition out of the total 4078. People with secondary education had the highest percentage 63.5% compared to higher with 4.9%. Female headed household had the highest percentage
51.1% compared to male 48.9%. We had the highest children with poor nutrition in rural 51.8 compared to urban 58.2. Only duration of breastfeeding and type of place of residence were found to be significant from the crosstab analysis. Further Analysis from the binary logistic regression indicated that marital status (P-value=0.022) & Type of place of residence (0.001) are the only significant variables. The negative coefficients (-0.06,-0.063 & -0.272) indicates that the event becomes less likely as the predictor increases. Odds ratio greater than 1(1.015 and 1.063) indicate that the event is more likely to occur as the predictor increases. Less than 1 indicate the event is less likely to occur as the predictor increases.

Conclusion The findings of this study indicated that poor nutritional status is associated with duration of breast feeding and place or type of residence out of the possible 5 dependent variables in our study. These factors should be taken into consideration by our government and private sector when it come formulation of new strategies and policies to reduce poor nutritional status in children under the age of five so that we may also prevent possible deaths due to poor nutrition.

References

Estimation of Prevalence ratio of Anaemia in Namibia: A comparison of selected Logistic Regression models

M. N. Ndaifanua
Department of Statistics and Population Studies, University of Namibia

Email address: ndaifanuam@gmail.com | Tel: +264 81 778 5026

Abstract
Anaemia has become a great concern globally and has impacted negatively on the economies of developing nation. The prevalence rate can be used to compare the level of Anaemia burden at a particular time in two or more communities or areas. The data was obtained from NHDS of 2013. The sample was a stratified sample selected in two stages (urban and rural area), were selected with a stratified probability proportion to size selection from the sampling frame. Stratification was achieved by separating every region into urban and rural areas, and the study population consists of all children below the age of 5 years from the 13 region with a total of 2283.
Children were classified as anaemic if their haemoglobin level is below 11.0 g/dl and as severely anaemic if their haemoglobin level is below 7.0 g/dl. Selected logistic regression models were used to develop a predictive model on estimating the prevalence of anaemia based on predictor variables. When the models were adjusted by either conditional or marginal method there was a slightly difference in the prevalence but a huge difference in the confidence intervals, the conditional produced wider confidence interval. The results of the study show that the predictor variables such as wealth index, Region and mother’s educational level are statically significant. Poorest children and children whose mothers only have primary education were found to be at risk of contracting anaemia. Overall, the results suggest that binomial regression model is a better model to estimate prevalence ratio compared to Poisson regression model.

References
NDHs (2013)

The association of factors which influence infant mortality rate in Namibia: analysis of Namibian Demographic and Health Survey of 2013

F. Petrus
Department of Population Studies and Statistics, University of Namibia

*Petrus Filippus
petrusfilipus@yahoo.com, 0813969791

Abstract
Infant mortality rate (IMR) is defined as the number of deaths of infants under age 1 per 1,000 live births in a given year. Globally, approximately 10 million infants die each year, and more
than 90% of these infant deaths occur in the developing countries (WHO, 2017). In Namibia, infant mortality rate has declined by 19 percent over the past 20 years (UNDP, 2013). Infant mortality rate is considered a sensitive indicator of the living standard and socio-economic conditions of a country. It remains a huge challenge for the Namibian Government due to the high infant mortality rate to achieve the Sustainable Development Goals (SDGs). This paper examined and identified the important determinants of infant mortality in Namibia. This study used Logistic regression analysis in order to evaluate the independent effect of each variable on infant mortality. The results from the logistic regression model indicated that maternal age, number of household members and birth order number were significantly associated with infant mortality in Namibia. Infant in the 5+/24 months birth order/preceding birth interval were found to be 0.53 times more likely to die than those in 2-4/24 months birth order/preceding birth interval category. Households with more than 7 members have a 0.54 higher chance of reporting infant deaths when comparing to those with fewer household members. Appropriate policies and measures that aim at educating and empowering women are recommended in order to reduce the overall infant mortality rate. Given changes in facilities and awareness levels daily, there is need to carry out a similar study using current data set so as to identify population segments that require strengthened programs. In addition, current data set is needed to evaluate the government intervention.

References
3. United Nations Development Programme (2013) “Namibian Demographic and Health Survey (NDHS)” Namibia: Ministry of Health and Social Services

**A statistical analysis of the determinants of fruit and vegetable consumption in Namibia**

*Helaria F N Shaningwa and N M Nickanor*

*Department of statistics and population studies, University of Namibia*

Email address: shaningwah03@gmail.com |Tel: +264812250584

**Abstract**

Jaime P C., & Monteiro C A., (2003) stated that, according to estimates by the World Health Organization (WHO), inadequate consumption of fruits and vegetables is one of the five main factors in the global burden of disease. Also, fruits and vegetables are important foods in the composition of a healthy diet, since they have low energy density and are sources of micronutrients, fiber, and other components with functional properties. In spite of the enormous benefits of fruits and vegetables, Layade A.A., Adeoye I.B. (June 2014) declared that,
consumption of fruits and vegetables in Africa is low compared to the recommended daily intake and estimates of fruit and vegetables in sub-Saharan Africa ranges from 70 to 312 g per person per day, far below the World Health Organization (WHO) minimum recommendation of 400g per person per day or 146kg per person per. The study was therefore carried out to assess the prevalence of inadequate fruit and vegetable consumption in Namibia, to examine its association with sociodemographic determinants. According to the Pearson’s Chi-Square p-value there is sufficient evidence at 5% level of significance to conclude that, there is an association between individual’s regions, age in 5-year groups, educational attainment, type of place of residence, wealth index, respondent’s occupation grouped, respondent currently working and the frequency of reading newspaper of magazine and the number of days eating fruits and vegetables in a week. The generalized Poisson log linear model shows that, individuals living in female headed households and those living in urban areas consume more fruits and vegetables correlated to the ones living in male headed households and those living in rural areas. Furthermore, respondents that were not currently working and do not read newspaper/magazine or read newspaper/magazine less than once a week take in less fruits and vegetables compared to the ones that were currently working and read newspaper/magazine at least once a week. What is more, binary logistic regression revealed that, people that living in urban areas consume more fruits and vegetables as to the ones living in rural areas, yet individuals that are graded as poorest, poorer, middle income, richer, not working, professionals, work at clerical, sales, services departments, agricultural employee/self-employed, skilled manual, unskilled manual, were not currently working, do not/ read newspaper/magazine less than once a week consume less fruits correlated to those ones living in rural areas, richest, work in other jobs, respondent that were currently working and those that read newspaper/magazine at least once a week. We conclude that initiatives to promote fruit and vegetable consumption are necessary for the country as a whole, but special attention should be given to older individuals (45-49), households headed by males, rural communities and lower income individuals.

References


Lilie Shikomba and Peter Iiyambo  
Department of Statistics and Population Studies, University of Namibia

Email Address: shikombalillie@gmail.com Cell: 0813219716

Page | 250
Abstract
Cohabitation refers to partners who live together essentially as a married couple, but they do not have a legal marriage certificate. Culturally especially in Africa, parents would usually only allow their children to move out of the house once they are married, but recently that practice has been ignored by some. Thus, it may lead to cohabitation among the unmarried partners. Problems arise not usually considered by the individual cohabiters, these problems arise in the areas of child custody, insurance, personal property, and wills which might have compounded in late marriages where the rights and expectations of children of former marriages and collateral heirs are involved. Partners choosing to cohabit should consider the outcomes of cohabitation prior to or early in the development of their relationship to avoid overwhelming legal complications. Children raised in cohabitation family setting may not receive the same social and institutional supports that the children in married parent families receive (McLanahan, 2015). The findings of this study would help the policy makers come up with the appropriate policies in respect of addressing social and economic problems that are associated with cohabitation in Namibia. In addition, the findings can also be of interest to other researchers. In this study, we examined the trends of cohabitation in Namibia using the 1992, 2000, 2006 and 2013 Namibian Demographic and Health Survey (NDHS) data. Furthermore, we use a Binary Logistic Regression model to determine whether there is a significant relationship between cohabitation and independent variables, namely age, level of education, occupation and the region of origin. The results show that the proportions of cohabiting couples increased between 1992 (13.9%) and 2013 (32.1%). In addition, there is a significant association between cohabitation and age, level of education and region origin. The results suggest that couples who are age 25-29 are 22.5% more likely to cohabit compared to other age categories. The odds of an individual cohabitating is more likely to be 1.673 times for an individual in northeast compared to an individual in the northwest for the year 1992, in 2000 the odds for an individual cohabitating is more likely to be 2.671 for an individual in Omuasati Region compared to an individual in Caprivi region. In addition, for 2006 and 2013 the odds of an individual cohabitating is less likely to be 0.751 and 0.812 in Omuasati Region compared to an individual in Caprivi Region. The overall percentage of cohabitating individuals based on highest education level were 18.1%, 37.4%, 42.6% and 1.9% in 1992, 2000, 2006 and 2013 respectively.

References
A TIME SERIES ANALYSIS AND FORECASTING OF TUBERCULOSIS INCIDENCES IN ERONGO REGION: 2003 - 2017

P.M Shikongo and W. Tjipueja

Department of Statistics & Population Studies, University of Namibia

Email address: paulinashikongo77.ps@gmail.com  | Tel: +264813404136

Abstract

Background: Tuberculosis (TB) remains a major public health problem and a global burden, in spite of the progress made in the fight against TB, it continues to be a fatal infectious disease in the world. In Namibia, it still remains a national burden, the WHO estimates that about 30 percent of TB patients in Namibia go undiagnosed, untreated or unreported (Tiemersma, 2011). According to (Barnard, 2014) Erongo region was ranked the third worst affected region in Namibia, where approximately 1 000 patients are receiving treatment. This national statistic indicates the need for extensive monitoring and predicting tuberculosis incidences in an effort to make the control of tuberculosis more effective. Objectives: The main objective of this study is to fit a suitable model and forecast the TB cases in Erongo Region and the secondary objectives are to determine if there is any seasonal variation, trend or autocorrelation (internal structure) in TB cases in the Erongo region between period 2003 - 2017. To scope the emerging issues of TB control and elimination TB in Erongo estimate the future trends of all forms of TB. Understand the underlying forces and structure produced by the observed data. Understand the development and pattern of TB, a significant concern in the adaption of preventative measures. Methods: Tb incidence cases data for Erongo region for the time period 2003 – 2017 were extracted from MoHSS database. Poisson modelling was used to test the significant of the response variables, the Box-Jenkins approach specifically the ARIMA model, is typically applied to predict the incidence of infectious diseases. This method takes into account changing trends, seasonality changes and random disturbances in time series. Exponential Smoothing methods also play a significant role in time series forecasting and are especially effective for short term forecasting. The Mann-Kendal test tested for the existence of a monotonic trend. Results: In this study, based on the Erongo Tuberculosis data from the year 2003 – 2017 we established a Simple Seasonal, Simple Exponential Smoothing and a single ARIMA (0,1,1) model, which can be used to successfully forecast TB cases in Erongo region. Comparative analysis has demonstrated that the Simple Seasonal model performs reasonably well and is our best fit model. To the best of our knowledge, this is the first study to establish TB cases for Erongo region. Based on the results of this study Simple Exponential Smoothing is suggested to give surveillance by providing estimates on tuberculosis incidence in Erongo region. Both the ACF and PACF plots are uncorrelated showing significant peaks that suggests seasonality. The Ljung-Box test which yielded p-values above 0.05, which is an indication that model has adequately captured the correlation in the time series. The residuals are uncorrelated and therefore, white noise. Forecast errors are normally distributed. Poisson modelling found that age group, sex, facility level and marital status are statistically significant and BMI is not significant. Regression coefficient is equal to zero. The Mann-Kendall test yielded a p-value < 0.05, suggesting that a monotonic trend exists when we take into account seasonality. Conclusion: A seasonal pattern, a rising and a declining trend with variable amplitude of fluctuations were observed in the incidences of TB.
The models discovered that the forecasts suggest that Erongo region will continue to be faced with high TB incidence in the coming years. Hence, strengthening health extension programs, continuous follow-up, supervision of treatment adherence and defaulters tracing should be strengthened to improve and reduce TB burden in the region. The increments of TB cases in summer clearly show that temperature has a direct relationship with the increasing rate of infection, which is shown by the seasonality of the disease in the study area.

References

Factors Influencing Medical Health Insurance Coverage in Namibia

**J. Shivute*** and **L. Pazvakawambwa**

*Department of Statistics and Population Studies, University of Namibia*

*Corresponding Author: jshivute77@gmail.com|Cell: +264 817197638*

**Abstract**
The health of the worker is a measure of their competency and capacity for productive work in relation to the total number of persons maintained by a nation stated Kamil (2016). Brockmeyer & Stiftung (2012) found that most of the products provided by private medical aid funds are too expensive for most of the population, especially for low income workers in the formal/informal economy. The purpose of this study is to establish the prevalence of health insurance coverage in Namibia and to identify factors influencing health insurance. This study used quantitative design and the data was obtained from the (NDHS) 2013 targeting men and women. Binary logistic regression method was used to establish the determinants of health insurance coverage. The prevalence of Health insurance coverage in Namibia was 18%. Nine percent are covered by an employer, 5% are covered by social security and 4% by private/commercially purchased insurance. Chi-square tests of association show that the “Rich” have a higher chance of being covered compared to the “Poor”. Those with no formal educational have the lowest coverage compared to those with a higher education level. Females had a lower chance of being covered compared to their male counterparts. The 15-19 age group had the lowest chance of being covered by a health insurance with the age group 45-49 having the highest chance of being covered. Khomas region have the highest chance of being covered by a health insurance compared to the Otjozonjupa region. Men and women from Caprivi, Erongo, Hardap, Ohangwena, Oshana, Omusati, Kavango and Kunene were less likely to be covered by health insurance compared to those residing in the Otjozondjupa (RC) region. Additionally, those residing in an urban area have the highest chance of being covered compared to those who reside...
in a rural area. There is still a need to emphasize on the importance of health insurance coverage throughout an individual’s life in Namibia.

References

An investigation of demographic factors of alcohol consumption in Namibia

F.N. Shuuya and W. Tjipueja
Department of Statistics and Population Studies, University of Namibia

Email address: Shuuya.fillemon@gmail.com  Cell: +264813781765

Abstract
Little research has been conducted on alcohol use in Namibia. Alcoholism is a chronic disease, progressive and often fatal; it is a primary disorder and not a symptom of other diseases or emotional problems (Torr J. & Etl, 2004). The main objective is to investigate demographic factors of alcohol consumption in Namibia specifically the study aims to determine the association between alcohol consumption and each of the demographic factors to assess the knowledge, attitude and practices of alcohol consumption in Namibia, so that it can be used for decision making by future researchers as a preparation for a change in the uncertainties that are expected in the future.

This study used secondary data, namely, the alcohol consumption of household individuals from the Namibia Demographic and Health Survey (NDHS) FOR 2013. A qualitative descriptive study was conducted from all 13 regions in Namibia. The sample size consisted of 1249 respondents of household individuals aged between 15 years old and 49 years old. Stratified sampling technique was used to select sample size and collected data was analyzed using the SPSS version 22.

Pearson chi-square test was performed to focus on the relationship of the dependent variable (alcohol consumption) and the independent variables (age, gender, occupation, educational level, marital status and religion). All significance tests were done at 5%. The prevalence of participants drinking was 47.5%; in addition, 53.6% of the participants were aged between 35 years old and 39 years old, while 74.4% participants that are employed consumed alcohol. According to my findings on alcohol consumption and marital status is 2792 on degrees of freedom of 3 and (p-value=0.0425<0.05), therefore the null hypothesis is rejected whereby marital status seems to be related to alcohol consumption. Alcohol consumption and age (p-value=0.046<0.05), followed by religion (p-value 0.000<0.05), followed by occupation (p-value=0.003<0.05) and then gender (p-value=0.000<0.05). This independent variables are all related to alcohol consumption. Educational level the highest group of alcohol consumption was
56% in higher educational level, while the lowest group of alcohol consumption was 45.5% in secondary level. However, with Educational level (p-value=0.127>0.05) shows that there is no relationship which means it does not affect the amount of alcohol they consume.

We conclude that the prevalence of alcohol consumption is high among this cohort of Namibian men. Due to the high prevalence of alcohol consumption among men in Namibia, attention should be paid by occupation, educational and public health agencies for making efforts collectively to reduce alcohol availability.

**Keywords:** Alcohol consumption; occupation; educational level; marital status; gender

**References**

**AN ANALYSIS ON THE DEMOGRAPHIC FACTORS THAT INFLUENCE PROSTATE CANCER SCREENING IN NAMIBIA: EVIDENCE FROM 2013 NDHS**

R. Shuuya and K. Mutorwa
Department of Statistics and Population, University of Namibia

Email address: shuuyareginald1@gmail.com | Cell: 0817602050

**Abstract**
Ramon and Denis (2007) stated that Prostate cancer is the most frequent non-skin cancer in men, including Namibian men. It is, however, the most common cancer in men, causing only 8.9% of cancer deaths in men with the lifetime risk (0–74 years) of developing it of 5.9%. The main aim of this study is to investigate the socio-demographic factors (age group, educational level, wealth index, region and type of place of residence) that influence prostate cancer screening in Namibia. The study also assessed the association between prostate cancers screening and socio-demographic variables. Then the study determined whether or not prostate cancers screening differs with respect to socio-demographic variables. A quantitative cross-sectional research design was used, using the Namibia Demographic Health Survey (NDHS) for 2013. Descriptive statistics (frequencies, percentages and cross tabulation) to describe the study sample, and a multivariable logistic regression model was used to determine which factors had influence on prostate screening. In a sample of 4481 men from the NDHS dataset, only 26.1% have been tested for prostate cancer. The educational level, age group and wealth status are the factors found to have an association between prostate cancer screening and socio-demographic variables in Namibia. While in the multivariable logistic regression analysis educational level, age group and wealth status remained the important predictors of prostate cancer screening. This study observed that most Namibian men are not aware of, and they have no knowledge and information of prostate cancer screening and most (73.86%) have never been tested for prostate
cancer. Hence, the study suggests that the Namibian government and policy makers should redirect efforts and funds to improve education and cancer awareness in the country. Since the study was limited to those who went for screening, future research should focus on the result of screening, if the results are positive or negative.

**Keywords:** prostate cancer, screening

**References**

---

**A statistical analysis of highly voluminous data: a special case of Principal Component Analysis**

P. Stephanus¹*, O. Oyedele², and D. Ntirampeba¹

¹ Department of Mathematics and Statistics, Namibia University of Science and Technology
² Department of Statistics and Population Studies, University of Namibia

*Author for Correspondence
Email address: pstephanus@gmail.com | Tel: +264 81 200 0008

**Abstract**

**Background:** In multivariate analysis, one deals with a single dataset involving large numbers of variables, which means large dimensions. In such situation, one encounters problems when it comes to viewing the data graphically and investigating the relationships between these variables. Principal Components Analysis (PCA) is one method used to reduce the high dimensionality of the big data to few(er) dimensions that are easier for humans to comprehend and visualize. The number of few(er) dimensions is not really distinctive. Several authors have proposed different methods. Most of them suggested using the total number of large eigenvalues/variance values in the data as the number of few(er) dimensions. However, with big data, if the large eigenvalues/variance method was to be used, the number of few(er) dimensions can easily be the same as the total number of dimensions in the big data, which means the big data have not been reduced by PCA. This is because big data often have very large number of variables having large variance value. Hence, this study developed a new method for determining the number of components to use when dealing with big data.

**Methods:** Consider a centered matrix $X_c(n \times p)$, the new method termed RMSEP method is defined as

$$
\text{RMSEP value} = \sqrt{\frac{\sum_{i=1}^{n} \sum_{j=1}^{p} (x_{cij} - \hat{x}_{cij})^2}{n} \cdot \frac{n}{p}}
$$

where $x_{cij}$ is the $(i,j)^{th}$ element of $X_c$ and $\hat{x}_{cij}$ is the PCA-approximated $(i,j)^{th}$ element. The RMSEP method is then embedded into PCA and the RMSEP value per PCA analysis is...
determined, which makes it a total of \( p \) RMSEP values corresponding to different \( r \)-values. The \( r \)-value with the minimum RMSEP value is recorded suggests the number of components (i.e., reduced dimensions) to use in the final PCA analysis. This method rely heavily on minimizing the error between the data \( \mathbf{X}_c \) and its PCA-approximation \( \hat{\mathbf{X}}_c \), rather than on the number of large variances. The RMSEP method was applied to large data of reservoirs water levels in Namibia, with 8736 samples and 112 variables.

**Results:** After applying the RMSEP method on the reservoirs water levels data, the minimum RMSEP value obtained was 269.0394 when \( r = 3 \), while the maximum RMSEP value was 742.2538 when \( r = 112 \). Thus, from this analysis, the suggested number of components to use in the final PCA model for this data is \( r = 3 \). Furthermore, the study showed that the RMSEP method suggested fewer components when compared to other traditional methods that depends on large variances. The Kaiser criterion, Scree test and Proportion of variance accounted suggested number of components to retain could be \( r = 30 \), \( r = 7 \) and \( r = 26 \) respectively.

**Conclusion:** Although the commonly used eigenvalues methods have reduced large dimensions of water levels data, they still suggest large dimensions as compared to the dimensions obtained by the RMSEP method. Only three (3) components were suggested by the RMSEP method.

**Keywords:** Big Data, Principal Components Analysis, Singular Value Decomposition, Root Mean Squared Error of Prediction.

---

**SPACE-TIME MODELLING OF UNEMPLOYMENT IN NAMIBIA**

Fransina Amutenya  
*MASTER OF SCIENCE (IN APPLIED STATISTICS & DEMOGRAPHY)*

**Abstract**

The government of Namibia has taken and continues to take note of recent developments in the country relating to high unemployment, and its impact on the population. It had initiated various programmes all geared towards the Millennium Development Goal number one (MDG1) of eradicating poverty and extreme hunger. Despite this effort, such programmes are usually to get under way very slowly and often fail to accomplish the aims due to the time lag that results until those remedial actions actually become effective.

This research seeks to assess regional variations in the number of unemployed persons in the 14 regions of Namibia over time through the application of a Fully Bayesian spatial smoothing approach with temporal trends. The study follows a quantitative cross-sectional research design and the analysis was based on the Namibia Labour Force Survey data of 2012, 2013, and 2014 complemented with regional population sizes of 2014.

The response variable for this study was the number of unemployed persons in a particular region during the three respective LFS periods. The covariates of interest considered were the time component representing the three respective LFS periods, education measuring the regional average level of education for unemployed persons, age measuring the regional average age of the unemployed persons as well as the density which represent the regional number of persons per kilometre square.
Results indicate that on average, the risks of unemployment lies in females of the age-group 20-24 who are never married. Also, educational level explains positively the status of employment. Furthermore, rural areas have an increasing risk of unemployment compared to urban areas, whereby on average individuals stay up to 2 or more years without employment.

**Keywords:** Unemployment, Bayesian analysis, Space-time, Labour Force, Relative Risk

---

**MAPPING THE HIV/AIDS EPIDEMIC IN NAMIBIA USING BAYESIAN SPATIAL MODELLING**

**Job Shikongo**  
*MSc Biostatistics*

**Abstract**  
Background: In order to develop an effective prevention response, a deeper understanding of the dynamics of the HIV epidemic is required. Maps are often used to spot out areas of a country with the most disease occurrences in order to plan for a proper intervention and targeted distribution of aid to most affected areas. They are indeed regarded as useful tools for geographical targeted interventions, monitoring and evaluation of disease burden. The main objective of this study is to develop a spatial model of HIV/AIDS epidemic in Namibia using the Bayesian spatial modelling techniques in order to map HIV/AIDS prevalence and identify socio-economic demographic characteristics and sexual behavior that are associated with HIV/AIDS prevalence.

Methods: This study follows a cross-sectional study design, using secondary data, obtained from the 2013 Namibia Demographic Health Survey database. This study used secondary data and adopted the sampling method, namely two-stage stratified cluster sampling method, which was used to obtain the sample. The sample was based on respondents aged between 15-49 and 50-64 both women and men that tested HIV positive. Spatial regression models were fitted in BayesX 3.0.2 to adjust for spatial random effects and non-random effects. The Moran’s I (Moran, 1947) and Geary’s c (Geary, 1954) statistics were both developed to test the null hypothesis of zero autocorrelation with interval or ratio data.

Results: The global Moran's statistic was 0.12 (p-value=0.0028) with a variance of 0.00215. Thus, this implies that values in neighboring regions tend to cluster. After adjusting for spatial random effects and non-random effects, results confirmed significant spatial effects with posterior mean lying between 0.00233 and 0.08 and some socio-economic factors were significant in explaining the spatial clustering towards the regions in the northern Part of Namibia except Kunene region.

Conclusion: It is expected that the findings of this research will be a ready tool in the hands of policy makers in the formulation of policy and design of programs to combat the epidemic in the country. Access to data on HIV/AIDS are highly restricted in the country and this hampers more in-depth modelling of the epidemic. Interventions should initially target Zambezi and Omusati region because they recorded a high HIV positive incidence rate of 21.4 and 19.01 per 1000 population respectively and subsequently spread out across other regions.
A statistical analysis of factors influencing teenage pregnancy in Namibia

Ruusa Nghikongwa
Masters in Applied Statistics and Demography

Abstract
According to a 2014 World Health Organization (WHO) fact sheet on adolescent pregnancy, it is estimated that about 21 million 15-19 year old girls in developing countries become pregnant every year and 11% of all births worldwide are to girls aged 15-19 years old. The average global birth rate among 15 to 19 years is 49 per 1000 girls and country rates range from 1 to 299 births per 1000 girls with the highest rates in sub-Saharan Africa. The 2013 Namibia Demographic and Health Survey (NDHS) indicates that 19% of women aged 15-19 have begun childbearing where it represents a 4% increase in teenage pregnancies in Namibia since the 2006/07 NDHS which was at 15%.

This study aims to identify factors associated with teenage pregnancy in Namibia. Specifically to examine the trend of teenage pregnancy in Namibia, to assess the influence of socio-demographic and behavioural factors on teenage pregnancy and to propose recommendations to strengthen teenage pregnancy prevention strategies. The study is based on a quantitative and cross-sectional design approach, where the target population is adolescent teenagers in the age group 15-19 and the main source of data will be the 1992, 2000, 2006 and 2013 NDHS. Data analysis included the construction of a frequency table for variables of interest to constitute the background characteristics profile of the teenagers and bivariate analysis using cross tabulations and chi-square tests. Spatial analysis is used to establish the trends and percentage changes for Teenage Pregnancy for the period 1992 – 2013 as well as for the common contraceptives used by the teenagers across the regions. The Cox Proportional Hazard model is applied to the outcome variable age at first birth where the cox model gives an expression for the hazard at time t for an individual with a given specification of a set of independent variables denoted by x_i to predict individuals’ hazard. The Kaplan-Meier method is developed for scenarios where survival time is measured on a continuous scale whereby only intervals containing an event contribute to the estimate, to compute the survival distributions compare between groups.

The overall trend of Teenage Pregnancy (TP) shows that there was a slight decrease from 1992 – 2000 and started to slowly and rapidly increase from 2000 – 2013. Bivariate analysis of TP with categorical variables shows that across the years, the significant factors are education, religion, wealth index, marital status, employment status and teenagers that chew tobacco. The highest prevalence of contraceptive methods used is the condom across the 1992 – 2013 period followed by the use of the injection and the lowest being the pill. The overall median survival age to first birth is 17 years. The significant factors affecting age at first birth are teenagers from the year 2013 (HR=3.88, 95% CI: 2.99-5.02), rural area (HR=1.23, 95% CI: 0.10-1.52), no religion (HR=0.58, 95% CI: 0.31-1.06), one child born (HR=0.20, 95% CI: 0.04-1.14) and age at first birth of 11-13 years (HR=2.04, 95% CI: 0.89-4.69). This study concludes that the median age at first birth is 17 years where young teenagers engage into early sexual activity thus leading to early pregnancy.
A Quantile Regression Analysis on Factors Influencing Blood Pressure Levels in Namibia

Hilarius Shilomboleni

Abstract
Developing countries including Namibia are experiencing a rapid increase in non-communicable diseases, which is hindering the progress of worldwide population health. High blood pressure extremely contribute as a risk factor to these chronic diseases: diabetes, cardiovascular disease, cancer, and chronic respiratory diseases. Blood pressure is estimated to instigate round about 60 percent of deaths around the world, of which 80 percent occur in developing countries. The aim of the study was to examine how factors such as behavioral, socio-demographic, socio-economic status influence blood pressure measurements of adults age 35-64 in the country, using Quantile Regression. Descriptive and multivariate analyses were explored to obtain the appropriate results using 2013 Namibia Demographic and Health Survey.

The results show that the basic characteristics of the participants, Age, BMI, and DBP were all significantly higher in females than those in males (P < 0.05), however FPG and SBP were higher in males than females (P < 0.05). The demographics were significantly different between genders. Furthermore, Age was positively associated with both systolic and diastolic blood pressure, likewise BMI showed significantly positive associations with systolic/diastolic blood pressure across the entire conditional blood pressure distribution. Adults resident in rural areas were negatively associated with high systolic/diastolic blood pressure, whereas weekly adult smokers and unemployed were positively associated with systolic blood pressure through four last quantiles (10th, 50th, 90th and 95th). Age and BMI showed substantial trends along the quantile axis. This study concluded that practically all selected common factors influencing blood measurement presented positively associated with systolic and diastolic blood measurements. This indicates that there is a need to enforce operational structures that will contribute to advancement of the adults’ behavioral, socio-demographic and socio-economic status in the country. The finding of this study has potential to assist government, policy makers and other collaborative organizations on resource allocation to improve adults’ blood pressure measurements.

Validation of the survey tool for measuring Food Insecurity for the HCP project for Windhoek City: An Item Response Theory (IRT) Approach

Vonai Charamba1*, Ndeyapo Nickanor2, Lawrence N. Kazembe2, Jonathan Crush3

1Department of Animal Science, University of Namibia, Windhoek, Namibia
2Department of Statistics and Population Studies, University of Namibia, Windhoek, Namibia
3BSIA, Wilfred Laurier University, Waterloo, Ontario, Canada

*Author for correspondence
vcharamba@unam.na, charambavonai@gmail.com Tel: +264 61 406 4093
Abstract
Following the controversy of the applicability of the Household Food Security Assessment Score (HFIAS) and Household Dietary Diversity score (HDDS) as measures of food insecurity in urban set-ups in the Global South as it was primarily designed for measurement in rural communities, (Haysom and Tawodzera 2018) where food insecurity was theorized (Crush and Frayne 2010), the study validated the use of the HFIAS and the HDDS in determining food insecurity (access) levels for urban households in Windhoek. Secondary data analysis was done on cross-sectional survey data collected from 890 households randomly selected from suburbs in Windhoek by applying the Rasch models and the area under the curve (AUC) of the receiver operating curve (ROC) analysis for the HDDS binary responses and Partial Credit Model for the polytomous response HFIAS as the validation of the summand based measures is dependent on them meeting the assumptions of the item response theory Rasch Models (Deitchler et al 2010, Abuelhaj 2007). The Principal Components Analysis and Mokken analysis to determine the dimensionality and monotonicity. The ROC, sensitivity and specificity values indicated the HDDS to be effective in separate households according to their dietary quality and quantity while the PCM results justified the use of the summand based HFIAS and the Household Food Insecurity Access Prevalence (HFIAP) food insecurity categories as none of the desired underlying assumptions was grossly violated, thereby making the two measures valid in measuring food insecurity statuses of Windhoek urban households.

Keywords: Food insecurity measurements, internal validation, external validity, urban households food insecurity, Windhoek

MODELLING RISK FACTORS FOR PSYCHOTIC CONDITIONS AND DEPRESSION AMONG ADULTS IN NAMIBIA

ADOLF PANDULENI HAUFIKU
Department of Statistics and Population studies

phaufiku@gmail.com

Abstract
Mental health problems are a global growing health concern. Mental disorder is categorized into anxiety, depression, schizophrenia and alcohol and drug dependency. Depression is ranked by the WHO as the single largest contributor to global disability and suicide. Most reports produced concentrated on descriptive statistics but no statistical models were fitted to establish risk factors for mental health in Namibia. This study aimed to identify socio-economic factors for psychotic disorders and depression among adults in Namibia. Out of the 14234 from 2013 NDHS, participants there was 9906 women aged 15 – 49 and 4328 men aged 15 – 64. Logistic regression was used to establish factors that contribute to psychotic disorders. Factor analysis (Principal axis factoring) was used to construct an index for depression and grouped the single factor into tertiles. Then multinominal logistic regression was used to establish factors influencing depression. Logistic regression results shows that regions, place of residence, level of education,
marital status and sex are significantly influence the risk of psychotic disorders in men and women. Multinomial logistic regression results indicated significant differentials in the likelihood of both mild and severe depression due to region, smoking status, marital status and sex of participants at 5% level of significance. There is a need for more mental health facilities to be rolled out to all regions and to step up mental health educational campaigns in Namibia. Marital relationships should be promoted in the society. Smoking should continue to be discouraged.

Modelling factors affecting the Severity of Injury from Motor Vehicle Traffic Crashes in Namibia

Maano N. Shimanda
Department of Statistics and Population Studies, University of Namibia

Email address: mshimanda@gmail.com | Tel: +264816762257

Abstract
Motor Vehicle Traffic Crashes (MVTC) are one leading causes of death and disability in the world, especially in developing countries. Despite having a well-developed road network, MVTC are the third highest cause of death in Namibia with 23.9 per 100 000 MVTC fatality rate. This study was conducted in Namibia to model factors affecting the severity of injuries from MVTC to inform plans to develop/enhance preventative measures to improve road safety. Study aim was to examine human (e.g. driver actions, age, gender), accidents (e.g. crash type), environment (e.g. weather, road surface, visibility and road signs), vehicles (e.g. vehicle types and number of vehicles) and temporal factors (e.g. day of week and time). A quantitative cross-sectional study, based on data from the National Road Safety Council (NRSC) was conducted. The study population was all MVTC in Namibia occurred from January 2009 to December 2016 (n= 21 976), with cases being MVTC that resulted in either fatal, serious and slight injuries. Bivariate analysis to ascertain risk ratios was undertaken and all the factors that showed a significant association with fatal/serious/slight were further assessed via ordered probit and multinomial logistic regression analysis. Approval for the study to use the said datasets was secured from the NRSC Namibia and research permission approval has been granted from the Centre for Postgraduate Studies of the University of Namibia (UNAM). Factors found to be associated with fatal/serious MVTC compare to slight injuries on multinomial logit analysis were; driver approaching angle/travelling straight (RR= 1.091), morning peak (RR= 1.521), light delivery vehicles (LCD) (RR=1.292), accidents involving a single vehicle (RR= 1.173). Other factors such as avoiding objects, age, gender, weather and buses/minibus were not found to have any association with fatal/serious injuries MVTC in this study. This study concluded that human attitudes contributes more to injury severities while LCDs were mostly involved in MVTCs. Hence, study recommend more advocacy campaigns targeting drivers focusing more on speeding and travelling times.

Keywords: Motor Vehicle Traffic Crashes, Injury severity, factors, multinomial logit, Namibia
A spatiotemporal analysis of survival among TB and HIV co-infected patients in Erongo Region, Namibia

A I Shipanga
Department of Statistics and Population Studies

Abstract
Namibia is among the Sub-Saharan African countries with highly burden of TB and HIV co-infection in the world, the interaction between TB and HIV/AIDS makes the diagnosis and management of the co-infection difficult. The purpose of this study is to identify risk factors, assess spatial and space-time clusters mortality among TB and HIV in Erongo Region. A retrospective cohort study from 2003 to 2017 was carried out using data consisting of 3145 subjects from all the 16 health facility providing ART and TB management in Erongo Region. Descriptive statistics, Univariate and Multivariate analysis were performed using R, STATA v14.2 and BayesX was used for spatial and spatiotemporal analysis. Global Moran’s I and LISA statistics were used to help analyse the spatial distribution and clusters of the disease across settings. About 53.2% of the patients were alive at the end of the study, 13.5% defaulted treatment, 1.3% stopped treatment, 17.2% were transferred out to other treatment and 14.8% of the total experienced event of interest (death), during the period. Only marital status and sex were not associated with death in the univariate analysis with a p-value of 0.3032 and 0.0677 respectively.
Mortality was higher in Usakos district as compare to the other 3 health district in the region. Mortality worsen with increasing WHO clinical stage. In multivariate analysis, function variable violated the PH assumptions with a p-value of 0.0125. Global moran’s I show that the EAs tend clusters, 0.1733 (p-value=0.0001) and the presence of hot spots in Erongo Region. The study revealed risk factors and spatial distribution of TB and HIV mortality in the region over the years. The detection of space-time clustering was useful in identifying higher risk areas. From this study it is recommended that there is a need to have targeted intervention among these areas to ensure that Namibia strives to attain its NDP5 which is intended to reduce mortality of TB among HIV patients. This information can be used by the region for planning purposes, allocation of resources and even dissemination of TB and HIV information.

A Hurdle Regression Model for Exploring the Factors Affecting the Pass Rate of Grade 10 Learners in Khomas Region

Rapikama Mumbuu
Department of Statistics and Population Studies

Abstract
Modelling semi-continuous data with the presence of excess zero has become a common phenomenon in real life situations. Common models such as linear models cannot handle zero-
inflated data. This study analyses factors which influences learners’ pass rate by exploring
generalized linear models (Poisson regression, Negative Binomial, Hurdle models and Zero
inflated models). The data was analysed using the MASS, pscl, and AER R-packages and SPSS.
Descriptive statistics were used to analyse socio-demographic variables. Six GLM models were
fitted and the hurdle models performed better based on the lowest AIC values.
The results showed that the age, points obtained by the learner, location and the type of school
have significant differential in pass rate with p-values less than 0.05 in the truncated Hurdle
Poisson and truncated Hurdle Negative Binomial. The two models also have shown that the sex
is insignificant in determining the pass rate as the p-values were above 0.05. A learner who is
attending school in low density area has a reduced chance of passing than a learner in a rural
area. The results further revealed that the learner at the state school has a higher chance of
passing than a learner at the private school. However the number of private school that wrote the
grade 10 examination in 2016 was only 8% of the total number of schools and this might has
contributed to the low percentage in the chances of passing at the private schools, because one
expect the private schools to outperform state schools given the privileges they have such as
selecting the best performing learners from the previous grades and a better infrastructure in
terms of classroom space and teaching materials.

In order to improve the pass rate of learners in densely populated areas, an emphasis should be
put on building more schools in these areas so that classrooms are not overcrowded. Over age
learners should also be given extra assistance such as extra classes and extra motivation from the
life skills teachers.

A COPULA APPROACH TO SAMPLE SELECTION MODELING OF
TREATMENT ADHERENCE AND VIRAL SUPPRESSION AMONG HIV
PATIENTS ON ANTIRETROVIRAL THERAPY IN NAMIBIA

Jason Nakaluudhe
Department of Statistics and Population Studies

Abstract
Namibia has a generalized human immunodeficiency virus (HIV) epidemic, with HIV mainly
being transmitted through heterosexual transmission. Although the number of people receiving
ART has increased, the achievement of the 90-90-90 strategy on testing, treatment and
suppression has not been evaluated. Moreover, examining factors associated with treatment
adherence and viral suppression will assist in designing appropriate interventions. However,
modelling treatment adherence and viral suppression may result in biased estimates if sample
selection is ignored. We fit a joint distributional model of ART treatment adherence and viral
suppression, to adjust for sample selection bias among HIV patients on ART in Namibia,
examine for the presence of tail dependence in sample selection bias, and investigate the factors
associated with viral suppression, viral load and ART adherence.
The study used two datasets; HIV data of patients, aged above 16 years, on antiretroviral therapy
in Erongo region and the selected health facilities in Windhoek, Namibia. A Heckman-type
selection analysis using copula were used on the two outcomes: ART adherence with viral suppression and ART adherence with viral load. The families of copulas i.e. Normal, Frank, FGM, AMH, Student-t and the 0, 90, 180 and 270 degrees rotated versions of Joe, Gumbel and Clayton, to capture dependence in the outcomes, were modelled and selected based on the lowest AIC and BIC. The results show a strong negative correlation between adherence to ART treatment and viral load suppression. The results also show the dependence structure between ART adherence and viral load margins. Further results show that current body weight in ART treatment vary statistically significant between viral loads. Antiretroviral therapy adherence with viral suppression and ART adherence with viral loads exhibit positive dependence structures, even though some demographic and clinical characteristics were not associated with ART adherence, viral suppression and viral load. Similar studies in the future need to consider socio-economic factors in addition to those considered in this study.

**Keywords:** HIV; Antiretroviral Therapy; ART adherence; viral suppression; viral load; Heckman-type selection; joint bivariate copulae

---

**Modelling progression of HIV/AIDS disease stages using homogenous semi-Markov processes: Cohort study, Namibia**

**Simon Kashihalwaa and Lilian Pazvakawambwa**

*University of Namibia, Department of Statistics and Population studies*

**Abstract**

**Background:** The progression of HIV infection to AIDS and then to death can be considered a stochastic process. Disease progression can be broken down into a finite number of intermediate states, based on CD4 counts. The five states of the Markov process of HIV/AIDS progression are commonly defined as: S1: CD4 count > 500 cells/microliter; S2: 350 < CD4 count ≤ 500 cells/microliter; S3: 200 < CD4 count ≤ 350 cells/microliter; S4: CD4 count ≤ 200 cells/microliter; and D: Death.

**Objectives:** The objective of this study was to model the progression of HIV/AIDS disease of patients under ART follow-up in Namibia using homogenous semi-Markov processes, using the data obtained from MoHSS.

**Methods:** A retrospective study design was used to obtain data on 11028 patients who initiated treatment from 2008-2012 and were followed till 2017. The semi-Markov model was employed to estimate the transition probabilities, transition intensity rate and sojourn time. Time Homogeneous model was fitted to assess effectiveness of ART by comparing the forward transition and reverse transitions.

**Results:** The sample comprised 32.1% male and 67.9% female patients. The probabilities of transiting from good states to worse states increased with time. Sojourn times for states 1, 2, 3 and 4 were 22, 8, 10 and 15 months respectively. The conditional probability of staying in same state given number of month decreases with increasing time. The intensity indicates that the rate of transiting from good states to worst states is decreasing.
Conclusions: HIV can progress to AIDS without delay if there is no intervention. Early ART initiation is crucial to reduce the probabilities of transiting from good states to worse states.

An application of survival analysis on the prevalence and risk factors of breast cancer in Namibia

Alexandrina Petrus
Department of Statistics and Population Studies

Abstract
The study was aimed at examining the prevalence and trends for breast cancer patients, regardless of patient’s sex, as well as exploring the risk factors associated with breast cancer in Namibia. Secondary data obtained from the Cancer Association of Namibia for the periods of 2013 to 2016 was used. An increasing occurrence trend of breast cancer diagnosis was observed in 2014 with 16% compared to 2013, while in 2015 there was a decreasing trend of 7%. However 2016 showed a decreased trend with 35% compared to 2015. Survival analysis techniques (Kaplan-Meier to construct the survival curves, Log-Rank Test to determine differences in survival between groups and Cox Proportional Hazards to investigate the association between the survival time of the patients and their demographic characteristics) were used to estimate the survival rate of the breast cancer patients. The demographic characteristics considered were the patient’s age, marital status, occupation, first pregnancy, tobacco use, alcohol consumption, ethnicity, sex and place of residence. Results revealed that Khomas region had the highest percentage of reported breast cancers cases, with the most age group detected with breast cancer being the 41-50 and 51-60. Moreover, Ovambo, Whites and Damaras ethnic group were the utmost diagnosed with breast cancer. From the survival analysis, it was observed that the breast cancer survival time was influenced by age and ethnicity. It was further revealed that the age groups 41-50 and 61-70 were significantly associated with the development of breast cancer. Hence this study recommended that a greater focus along the breast cancer care pathway, with emphases on improving access to early diagnosis at early age.

Food Security and Quality Of Life in Windhoek Informal Settlements: A Structural Equation Modelling Approach

T.W. Shinyemba*, N. Nickanor, L. Kazembe
Department of Statistics and Population Studies, University of Namibia, Namibia

tshinyemba@unam.na; Tel: +264 61 206 3397; nnickanor@unam.na; Tel: +264 61 206 3934; lkazembe@unam.na; Tel: +264 61 206 4515
Abstract
Namibia is experiencing an increase in its population living in urban areas due to rapid urbanisation, with the biggest growth rate experienced in Windhoek, where about 16% of the total population live. With rapid population growth, Windhoek faces a number of challenges including the development of informal settlements, which manifest compromised well-being. The objective of the study is to investigate the relationship between food security and quality of life in Windhoek informal settlements, since going without food does have an impact on people’s well-being. We used Structural Equation Modelling (SEM) approach on secondary data obtained from a quantitative cross-sectional study in informal settlements of Windhoek, Namibia. The study measured food security using HFIAS indicators, and the WHOQOL-BREFEQ-5D instruments were used to measure quality of life. Multivariate statistical analysis using Exploratory Factor Analysis (EFA), Principal Component Analysis (PCA), and Confirmatory Factor Analysis (CFA) methods were applied to reduce dimensionality in the data and link food security to quality of life.

The results confirm that food insecurity was a significant predictor of quality of life outcomes in Windhoek informal settlements. The study further revealed that lack of access to food affect social well-being, environmental well-being and physical well-being in a negative way. Similarly, the study found that pain/discomfort, anxiety/depression, self-care, and usual activities were positively associated with food insecurity.

Keywords: Food Insecurity, Quality of life, Informal settlements, Windhoek, Structural Equation Modelling.
In vivo antimicrobial and toxicity of a halogenated monoterpene from a Namibian Plocamium species of marine algae on Escherichia coli O157:H7 and Pseudomonas aeruginosa inoculated into balb C mice

Anthony Ishola¹*, Michael Knott¹ and Jane Misihairabgwi²
¹Department of Pharmaceutical Chemistry, School of Pharmacy, University of Namibia.
Private Bag 13301, Windhoek, Namibia.
²Department of Biochemistry and Microbiology, School of Medicine, University of Namibia. Private Bag 13301, Windhoek, Namibia.

*Author for correspondence: Email: aishola@unam.na, Tel: +264-61-206 5037.

Abstract
The purpose of this research was to investigate the dose-response relationship and to determine the acute and sub-acute toxicity parameters of the red marine algae Plocamium species in balb C mice using in vivo techniques
Eighteen mice of average weights between 19.2 - 21.9 mg were infected with Escherichia coli and Pseudomonas aeruginosa by intravenous injection and sub cutaneous methods respectively. After incubation and disease development, group of mice were subjected to various treatments which included gentamycin, ampicillin injection and injection with different concentrations of Plocamium extract over a period of five days. A group was not treated and was used as a negative control. The E. coli O157:H7 and P. aeruginosa loads in faeces of test mice was quantified daily in each animal for the duration of treatment.
Miller-Tainter method was used to determine the acute (LD⁵₀) toxicity of Plocamium extract.
Sub-acute toxicity measurements, 12 balb C mice were randomly divided into groups. The test animals were treated with 119 mg/kg, 178 mg/kg and 355 mg/kg concentrations of Plocamium extract daily by intra-gastric gavage for 28 days and observed daily to detect any signs of toxicity. Biochemical parameters were determined between day₀ and day₂⁸.
The LD₅₀ was calculated to be 3556 mg/kg.
Plocamium extract of 355 mg/Kg reduced E. coli to zero on the fifth day. P. aeruginosa were not inhibited by any concentrations of the marine algal extract. Biochemical results showed very high levels of alanine transaminase and aspartate transaminase in serum.
The development of liver lesion is an indication of liver injury which is a sign of the toxicity of Plocamium extract even at low concentrations.

Keywords: LD₅₀, Biochemical, dose response, hepatotoxicity, lesion
Polymorphism of the KAP1.1 Gene in the Swakara sheep of Namibia

N.F. Nyoni, T.O. Itenge* and M.N.T. Shipandeni
Department of Animal Science, Faculty of Agriculture & Natural Resources, University of Namibia, Namibia

*Author for correspondence
Email address: tamushendje@unam.na | Tel: +264 61 2063180

Abstract
Keratins are structural intermediate filamentous proteins that constitute about 90% of the total wool fiber in sheep. Swakara sheep are profoundly kept for pelt production in Namibia, and variation at the KAP1.1 gene could potentially be developed into a genetic marker associated with pelt quality traits. The main objective of the study was to determine genetic variation in the KAP1.1 gene of Swakara sheep. Blood samples were collected from 168 Swakara sheep randomly selected from four farms; Neudamm, Kalahari, Tsumis and Gellap-Ost located in three regions; Khomas, Hardap and Karas of Namibia. Genomic DNA was extracted using Inqaba biotech-kit protocol. Polymerase chain reaction-Agarose gel electrophoresis method was used in identifying genetic variation in the KAP1.1 gene. Data were analyzed using Chi-square test at 5% level of significance. Three alleles; A, B and C were observed at the KAP1.1 gene with genotype frequencies of 0.13, 0.57 and 0.3, respectively. Mostly the B allele frequency was highly distributed in comparison to the A and C alleles. It was observed that there was a significant difference in allele frequency distribution amongst the four farms under study. The predominant allele B across all farms could be attributed to the adaption of the Swakara sheep to the different locations.

Key words: Genetic variation, Pelt, Keratin.

References