Research Day

Faculty of Science

20 September 2007

Tshwane University of Technology
Pretoria
South Africa

PROGRAMME AND ABSTRACTS

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FACULTY OF SCIENCE

RESEARCH DAY PROGRAMME
20 September 2007

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List of Exhibitors

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20	Wirsam Scientific and Precision Equipment	Esther Martyne	(011) 4821060	(011) 7266094	0825746939	esther@wirsam.com
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Research Day

Abstracts

Oral Presentations

In search of scientific evidence to validate the use of Traditional Medicines

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For centuries plants have been utilized for their potential therapeutic substances. Natural products of botanical origin represent almost 60% of all drugs in clinical use. Southern Africa boasts a unique and diverse botanical heritage of almost 24 000 species of which ca. 10% have been studied for their possible therapeutic use. In addition to this unique botanical heritage, South Africa has a cultural diversity with traditional healing being integral to each ethnic group. Indigenous medicinal plant use is well recorded in the readily available local ethnobotanical literature. Despite the well documented ethnobotanical data very little scientific information is available on our indigenous medicinal plants. A concerted and organized effort is required to explore the chemistry and biological activity of medicinal plants with the aim of finding a scientific rationale for the use of the many "Muthi medicines" by the people of South Africa. Some examples (mostly in vitro) will be presented illustrating how gratifying it may be to search for the scientific rationale to validate the use of plants in healing rites. It is imperative that indigenous resources are systematically studied with the ultimate aim of transforming these latent botanical assets into consumer products to the benefit of South Africa and abroad.

Lippia Scaberrima- A Valuable South African Asset

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Lippia scaberrima is one of four indigenous members of the genus Lippia. All are aromatic shrubs which are used by rural communities as remedies for a wide variety of ailments. Quantitative and qualitative analyses of the essential oil from bulk and individual specimens of L. scaberrima were conducted using gas chromatography. Variations in the oil compositions of specimens in the same and in different locations exist. These results opens up possibilities for strain selection, particularly as it is known that the genetic traits of transplanted Lippia spp. are stable. Use of the essential oil in postharvest applications of fruit are currently underway in our research group.

The effects of postharvest drying on trichome structure, as well as on essential oil yield and composition, were investigated. Results indicated that initial drying of the harvested material to minimise moisture content is beneficial, but extended periods of drying leads to a rapid reduction in oil yield. Scanning electron microscopy (SEM) of oil-bearing glands corroborated the chemical changes observed. A combination of different microscopic techniques used to investigate the morphology and chemical contents of the secretory structures revealed that a variety of glands producing secondary metabolites are present on leaf surfaces.

A fast and simple method through which L. scaberrima can be distinguished from the other indigenous species was established by the isolaton of a chemical marker, which was later identified as 4a-hydroxygeniposide using NMR techniques. This compound is closely related to geniposide, a common ingredient of Chinese herbal medicines which has anti-inflammatory properties.

The oil and various extracts were screened for antimicrobial activity using minimum inhibitory concentration and bioautographic methods. The polar methanol extract was found to be the most active, causing significant growth inhibition of Enterococcus faecalis and Pseudomonas aeruginosa. Verbascoside, a medicinal compound, was thought to be responsible for the antimicrobial action. Of the four indigenous species, methanolic extracts of L. javanica exhibited the highest activity against the pathogens. Recent investigations in which we have compared the antioxidant activities of common household teas to those prepared from leaves of Lippia plants have shown that the Lippia teas are comparable in antioxidant potency.
L. javanica teas are more potent than those prepared from the other indigenous species. This can be attributed to the higher levels of verbascoside present in this species.

There is no doubt that the indigenous Lippia species are valuable indigenous plants which should be further exploited.

Emission Profile of Volatile Terpenoids Throughout Fruit Development of Cv. Keitt

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Mango aroma, a sensory characteristic, is mainly determined by the terpenoid composition of the fruit. Metabolic changes undergone during the ripening process lead to changes in the terpenoid composition of the fruit. To date, headspace gas chromatography (GC) using the solid-phase microextraction (SPME) technique, has been used for the analysis of volatiles from fruit at various developmental stages[1,2]. We have developed a method based on headspace adsorption/desorption for the non-disruptive analysis of fruit volatiles. This method has proven to be readily adaptable to direct sampling of fruit in the orchard environment without interfering with the natural metabolic changes occurring within the fruit. Terpenoid profiles were obtained at different stages of ripening for the mango cultivar 'Keitt' throughout the season 2005/6. Sampling took place using a tube packed with Tenax TA® followed by thermal desorption and capillary GC with flame ionisation detection. Some of the terpenoids released by 'Keitt' fruit include Δ^3-carene and -pinene (both monoterpenes) as major components while minor components include the sesquiterpenes -humulene and -caryophyllene. This sampling technique pre-concentrates the terpenoids effectively, and therefore offers a high degree of sensitivity[3]. The terpenoid profile obtained using this simple, rapid and reproducible method is a true reflection of the volatiles emitted by the fruit in its natural state.

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ICP-MS based tracing of lead sources in raw cow's milk

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Exposure to lead is one of the major public health concerns today. In South Africa, there are a wide variety of sources of lead, which include mining, smelter activity, and use of leaded gasoline. Accurate quantification and identification of sources of lead is highly desirable. The isotopic fingerprint of lead has proved to be a reliable tracer of lead origin in biological and environmental samples. Thus, the goal of this study was to determine the concentrations of lead and stable lead isotope ratios and to pinpoint the potential sources of lead contamination in raw cow's milk. Water and fresh milk samples were collected from different dairy farms in South Africa and leaded gasoline purchased from petrol service station in Pretoria. Freeze-dried milk samples were digested in closed vessel microwave digestion system, whereas water samples acidified with ultrapure nitric acid and analysed directly. Tetraalkyllead compounds in the gasoline were converted into water-soluble species and subsequently extracted into dilute nitric acid to minimize carbon build-up on the mass spectrometer interface cones. Lead concentrations and isotope ratios in all samples were measured by ICP-MS. Correlation of isotope ratios and concentrations of lead in milk with that of water and leaded gasoline will be discussed.

Mathematical Models applied to Nature Conservation

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There are real-world concerns that make the study of population dynamics important, not the least of which conservation management of wildlife. In this field, the interaction between species is highly complex and it is generally accepted that these relationships should be disturbed as little as possible. However, this interaction often results in the necessary control of populations and thus population models are important tools for the prediction of such controls.

In recent years, mathematical solutions to wildlife management problems are sought on the platform of computer-interpreted models for interacting species. Various interaction terms of varying order may be introduced to the systems of nonlinear differential equations to determine possible long-term solutions. Phase plane analyses suggest expected outcomes of the different management strategies over time. This allows the wildlife manager (with no mathematical background) to evaluate the options suggested without actually killing the animals, or to investigate the effect of deviations from a chosen program. The models are extremely simple and conservative, considering all the variables that can have an effect on the dynamics of populations, but nevertheless suggest directions for action.

As an example a mathematical model is applied to describe an existing problem in the Ndumo Game Reserve in KwaZulu-Natal, where the over-crowded nyala and impala populations have a detrimental effect on other species and vegetation structures. Officials have been trying to control the nyala and impala numbers with culling over the last two decades, without success. The aim for developing a mathematical model for these competing species is to investigate reasons for the failure to control their numbers, and seek alternative culling programs for effective management, in order prevent extinction of smaller species such as bushbuck and red duiker.

The Development and Sensory Evaluation of Fresh Meat and Offal-containing Sausages

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The lack of adequate access to good quality protein is of primary concern in the Southern African Development Community, where a large proportion of the population suffers from malnutrition. Meat and meat products are excellent sources of high quality protein, but such products are often too expensive for these poorer communities. The objective of this research was to develop acceptable, nutritious meat products using cheaper protein sources, such as culturally-acceptable offal parts and beef trimmings. Four of the 25 formulations of offal-containing fresh sausages were selected, together with a control, for further evaluation. Treatments 1 and 2 contained beef trimmings, beef hearts, intestines and spleen, whereas Treatments 3 and 4 contained beef liver, stomachs and lungs. Spices, rusk and a soy concentrate were also added. The control sample only contained beef trimmings, rusk and spices. Proximate chemical analysis was also done on representative samples.

Thawing and cooking losses were measured for the five treatments. A consumer and a trained sensory panel evaluated the sensory attributes of the cooked sausages. A 12-member trained, black panel helped to develop the standardized score sheet with an 8-point category scale, to evaluate aroma, appearance, texture, flavour and mouth coating. The consumer panel evaluated aroma, flavour and texture. ANOVA was used to test for the panel and product main effect as well as the panel-by-product interaction ($p<0.05$). Principal component analysis was done to determine the smallest number of the latent variables and correlation analysis was done to measure the strength of the linear relationship between variables. All results will be discussed.

Guidelines to Reduce Sexually Transmitted Infections

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Sexually transmitted infections are a major problem in the world today and constitute a major public health concern in South Africa. Annually 11 million new cases of sexually transmitted infections occur in South Africa. Owing to their direct link with the spread of HIV/AIDS, the prevention of sexually transmitted infections is an urgent priority. The purpose of the study was to develop guidelines to reduce the incidence of sexually transmitted infections at Stanza Bopape clinic.

The aims of the study were to:

- determine the incidence rates of sexually transmitted infections at Stanza Bopape clinic;
- determine the knowledge, attitudes and perceptions regarding sexually transmitted infections of clients seeking treatment at Stanza Bopape clinic; and
- develop guidelines to reduce the incidence of sexually transmitted infections at Stanza Bopape clinic.

The research design for the first sub-problem was a cross sectional design, using existing patient data. The second-sub problem used a quantitative survey design, using the clients of the clinic as the population. The data analysis was done with descriptive statistics. Data were gathered from October 2004 to January 2005. The third sub-problem was descriptive in nature. The results indicated that the incidence of male urethral discharge amongst the 21-29 age group was 12.5% and the overall re-infection rate was 10%. In addition, the level of knowledge regarding sexually transmitted infections was low and inconsistent use of condoms was found. Guidelines were developed to reduce the incidence of sexually transmitted infections based on the results of sub problems 1 and 2 as well as national and international literature.

The influence of simulated gastrointestinal conditions on the composition and antimicrobial activity of plant extracts

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In vitro assays often fail to consider the effect of the gastrointestinal environment on the chemical composition and biological activity of natural products intended for oral administration. Crude water and methanol extracts of selected plants (i.e. 'buchu', green tea, thyme, sage and wild camphor) were prepared and exposed to simulated digestive and absorptive conditions and then screened for antimicrobial activity. After exposure to simulated gastric fluid (SGF) and simulated intestinal fluid (SIF), antimicrobial activity was reduced or undetectable in most cases. However, while the 'buchu' crude extracts and SGF products showed no activity against S.aureus and E. faecalis, activity was noted for the corresponding aqueous SIF-exposed extract. This suggests that 'active' compounds may be formed after exposure to SIF. LC-UV-MS was used to detect changes in the chemical composition of the crude extracts and SGF and SIF products pre- and post-exposure and after transport across epithelial cells (Caco-2). Distinct differences were detected on the respective chromatograms. In many cases, the peak area of compounds decreased after exposure to SGF, SIF and Caco-2 cells while the area of other compounds increased. Thus, it can be deduced that the chemical composition and antimicrobial activity was altered after exposure to simulated gastrointestinal dissolution and absorption processes.

Sensory Analysis and Consumer Acceptance of Probiotic Mageu Products

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Mageu is a non-alcoholic fermented maize beverage enjoyed by a large part of the population in Southern Africa. In an earlier part of this study, probiotic mageu products were developed by fermenting maize porridge with probiotic Lactobacillus cultures. The species used could affect the taste of the mageu and make it less acceptable to the consumer. Such products would need to be evaluated for their sensory acceptability. The aim of this study, therefore, was to compare the sensory characteristics and consumer acceptability of maize porridge fermented with a range of probiotic lactobacilli and the traditional mageu starter organism.

A trained sensory panel subjected the products to quantitative descriptive analysis (QDA) and quantified the relevant sensory attributes. The products were also subsequently subjected to consumer acceptance testing. Results included a lexicon of thirteen (13) descriptors for mageu that was developed by the trained panel. Six of the 13 descriptors significantly discriminated between the experimental mageu products. The control product, fermented by Lactobacillus delbrueckii subsp. lactis C09, was most favoured by the panel, while the products fermented by Lb. acidophilus PRO and Lb. rhamnosus LRB, were judged to be most similar to the control. The ANOVA results of consumer acceptance data revealed that the preference for the above products did not differ significantly ($p>0.05$) from the control. In conclusion, the probiotic products fermented by Lb. acidophilus PRO and Lb. rhamnosus LRB, were considered to be the best options to recommend for commercialization of probiotic mageu.

A decrease in heart period variability as an indicator of ischaemic heart disease

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Introduction: Autonomic dysfunction is characterisitic of chronic heart failure. Changes in heart period variability (HPV) is an indication of autonomic dysfunction. This study focused on HPV and arterial blood pressure as indications of myocardial ischaemia during an electrocardiographic (ECG) stress test.

Methods: Blood pressure and heart rate were recorded on three groups of subjects: a healthy group, a group on blood pressure medication, and an ischaemic group on blood pressure medication. The measurements were done before, during and after a stress ECG. The heart period data was analysed with respect to the total power of the frequency components.

Results: Both groups on blood pressure medication showed a decrease in heart period variability when compared to the healthy group. Comparing the groups on blood pressure medication, there was a decrease in heart period variability in the group diagnosed with ischaemic heart disease. Arterial diastolic pressure increased with exercise in both groups on blood pressure medication but not in the healthy group.

Conclusion:
Patients with ischaemic heart disease could further be monitored using heart period variaiblty as an indicator of ischaemic heart disease.

Tilt table testing as a clinical instrument

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Introduction: Tilt table testing can be used to determine the reactivity of the baroreceptor reflex (BR). BR is responsible for maintaining blood pressure during change of posture, e.g. from supine to upright position. This test can be used to identify neural damage to this reflex, or in people in which this reflex compensates inadequately for postural changes.

Methodology: Finometer recordings (FR) were continually performed on ten healthy male students while in a supine followed by an upright position. FR involve arterial blood pressure, cardiac output, and heart period variability measurements.

Results: Subjects responded to the change in posture by increasing their arterial blood pressure by 7.5 % and heart rate by 36% in order to maintain cardiac output at a constant value. Subjects also showed a decrease in the variation of the heart period with the change in posture.

Conclusion: The baroreceptor response maintains cardiac output by a reflex increase in heart rate and blood pressure. Tilt table testing provides a measure of the baroreceptor response to a change in posture. Future tests will be aimed at determining a quantifiable marker of this reflex in various disease states.

Using an OBE Approach to overcome first-year University students' alternative conceptions in interference and diffraction of light

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Many researchers have reported the incidence and prevalence of alternative conceptions concerning many concepts and principles in science. It is also reported that many of these alternative conceptions are remarkably resistant to extinction. This study sought to investigate whether or not an outcomes-based education (OBE) instructional approach could help alleviate or overcome these alternative conceptions amongst first-year University students. A conceptual framework, based on the constructivist view of learning, was developed. This conceptual framework also paid attention to the criticisms and limitations commonly cited around the OBE approach to teaching and learning. A pre-test was administered to identify possible pre-existing alternative conceptions held by the students in the research sample; followed by an instructional intervention, either OBE based or traditional lecture based. Both interventions calculated to redress the identified alternative conceptions. These interventions were then followed by a post-test to ascertain the effectiveness of the interventions. Both quantitative and qualitative data were collected. From the quantitative data, the findings showed highly statistically significant gains between the pre- and post-test scores of the research sample. The qualitative data showed that most of the pre-existing alternative conceptions appeared to have been overcome by the intervention. However, a few notable pre-existing alternative conceptions persisted beyond the post-test. No statistically significant difference was found between the OBE intervention and the traditional lecture intervention. Implications of the findings for both classroom practice and further research are presented.

Physiological adaptations in untrained African and Caucasian males, following eccentrically induced muscle damage.

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Background: Eccentrically biased exercise (downhill running, DHR) elicits muscle trauma. With post-exercise healing, a potential adaptation may be an increase in stiffness of the muscular-tendon system (MTS), which may enhance elastic recoil potential of the muscle. Such a response may facilitate a decrease in the metabolic cost of running economy (RE), and may facilitate changes in associated metabolic variables. Anecdotal evidence suggests that Africans and Caucasians may respond differently to exercise induced muscle damage.

Aim: To determine differences in physiological variables before and after a bout of downhill running in untrained African (n=10) and Caucasian (n=9) males.
Methods: RE, lactate, respiratory exchange ratio (RER), and heart rate (HR) were measured at 2 steady state speeds (9km/h and 11km/h) before and at 2, 4, and 6 weeks after a bout of downhill running (-13.5%, 60 minutes). Data was analyzed using a repeated measures ANOVA (2 groups x 4 times), with $p < .05$.

Results: There were no significant group differences in any dependent variables prior to exercise. There was a significant group effect after DHR, with RE ($p=0.05$), lactate ($p=0.01$), and RER ($p=0.01$) being lower for the Africans compared to the Caucasians, while HR was lower for the Caucasians ($p=0.01$). There was also a significant time effect, with lactate ($p=0.05$), RER ($p=0.01$), and HR ($p=0.05$) being lower for both groups, after the DHR, compared to baseline.

Discussion:
It is proposed that Africans may adapt differently compared to Caucasians to exercise induced muscle damage. It is tenable that the reduced metabolic cost of running seen in Africans may be related to "healing" and a concomitant increase in elastic recoil energy in the MTS. It is also reasonable to deduce that one bout of exercise-induced muscle damage results in a positive adaptation in a variety of related physiological variables.

Datura Poisoning in a Horse confirmed by Urine Analysis for Tropane Alkaloids

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Datura spp are common annual weeds on disturbed soil in South Africa. Datura poisoning has been described in horses after ingestion of dried plant material (seeds, leaves, stems) in baled hay. Affected horses commonly show colic symptoms due to decreased gut motility leading to atony and impaction of the large intestines. The essential toxins contained in the plant are atropine and scopolamine.
Two horses from one herd have been presented at the Onderstepoort Veterinary Hospital with colic symptoms. The one horse was unresponsive to treatment and had to be euthanized. The other one was less seriously affected; additionally to the colic the mare exhibited marked mydriasis persisting for several days after recovery. Datura ferox and D. stramonium were found in the tef hay previously fed to the horses. Scopolamine was the main tropane alkaloid extracted from the plant material, confirming that this was most probably a case of Datura ferox intoxication. Urinary samples of the surviving horse have been taken for three consecutive days. Atropine and scopolamine were extracted and detected using enzymatic hydrolysis followed by liquid-liquid extraction and liquid chromatography tandem mass spectrometry (LC/MS/MS). This is the first time Datura poisoning could be confirmed by urine analysis for tropane alkaloids.

Key Words: Datura ferox, colic in horses, tropane alcaloids

Developing a quality control protocol for cancer bush (Sutherlandia frutescens)

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Sutherlandia frutescens is has a long history of ethnomedicinal use. Despite the extensive traditional and current use, few studies have been undertaken to determine the extent of phytochemical variation which clearly impacts on quality control of herbal formulations. One hundred plant samples were collected from natural populations and cultivation farms. To assess the extent of phytochemical variation, the samples were analysed using near infrared spectroscopy (NIRS), liquid chromatography coupled to mass spectroscopy (LC-MS) and thin layer chromatography (TLC). The influence of chemical variation on antimicrobial activity was also explored using the minimum inhibitory concentration (MIC) method. Negligible within population variation was noted. NIRS may be a valuable tool to ensure authenticity and to rapidly quantify compounds perceived to be responsible for the therapeutic benefits of cancer bush. TLC methods have been developed and could be used in quality assessment of raw materials. Variation in amino acid concentrations were noted for various plant parts and recommendations will be made to producers to optimize harvesting protocols.

Physicochemical characterisation of maize tassel adsorbent, Part I: Surface texture, thermal stability and microstructure

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In this study various physicochemical parameters have been evaluated for maize tassel, a novel adsorbent. The Brunauer-Emmett-Teller (BET) isotherm was used to model experimentally obtained N2-adsorption data (up to p/po= 0.30); the results indicate that the powdered material is mesoporous with specific surface area (SBET), total pore volume (VP up to p/po= 0.98) and average pore width values of 2.517 m2/g, 0.0045 cm3/g and 71.96, respectively, for the 150-300 µm fraction. Particle size distributions were obtained by applying the Fraunhofer diffraction pattern analysis (FDPA) algorithm to the laser diffraction patterns obtained experimentally. The material exhibited stability to thermal decomposition up to about 230 °C, as evidenced by the results obtained from simultaneous thermogravimetry-differential thermal (TG-DTA) analysis and differential scanning calorimetry (DSC). High-resolution scanning electron microscopy (HRSEM) revealed a microstructure showing predominantly flattish rod like particles.

Computer –aided Instruction for first year chemistry students: An Intervention at Tshwane University of Technology (TUT)

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Past imbalances in the education system continue to perpetuate poorly resourced schools and inadequately skilled teachers, particularly in the fields of mathematics and science. This means that poorly prepared students enter the university and consequently achieve low pass rates for the subject Chemistry 1.

The conceptual understanding of 32 Foundation Chemistry students was tested using the Journal of Chemical Education (JCE) Chemical Concepts inventory to identify problem areas. The Foundation Chemistry groups complete a six-month programme prior to entering the mainstream Chemistry 1 course.

A computer based intervention using graphics, animation and self-test questions was developed in order to address the student's difficulties. This presentation was deliberately planned to incorporate computer generated graphics and allow selected internet links in order to motivate students and facilitate continuous self-assessment. TUT is a University of Technology and as such a computer based approach is desirable in order to expose students to computer technology. The intervention was first peer assessed by the chemistry lecturers at TUT and then implemented during the second half of July to the experimental group of Foundation Chemistry students who passed the course to continue with Chemistry 1. This group was re-assessed both in terms of student's conceptual understanding as well as their attitudes towards computer-aided study in order to determine the effectiveness of the intervention. A completely random selection of students from a different group of Chemistry 1 students was presented with the intervention after modification based on peer assessment of the results from the first group and after further assessment and evaluation the model will be incorporated as part of the Chemistry 1 course from January 2008. The results of student's feedback and improvements in conceptual understanding are discussed.

Phosphate and Nitrate Removal by Wastewater Protozoa

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Up to date, the involvement of protozoa in the removal of excess biological nitrogen and phosphate is not yet clearly defined. The current study aimed at isolating protozoa from wastewater, screening their nutrient removal ability and ascertaining the optimum pH and temperature for nutrient removal as well as their influence on chemical oxygen demand (COD) and dissolved oxygen (DO) of wastewater. Several nutrient/carbon sources were also tested to determine the best supplement in the mixed liquor that will enhance nutrient removal.

Of a total of 10 protozoa isolated and screened, 5 showed significant nutrient removal efficiency of more than 70 % at the end of 96 h. There was a drastic reduction of over 90 % in DO of the mixed liquor inoculated with the isolates. The optimum pH and temperature ranges for nutrient removal by the respective isolates were found to be 8-9 and 25 o C - 30 o C respectively. In the presence of Na acetate, glucose and sucrose as nutrient/carbon sources in the mixed liquor, nutrient removal ranged from 40 – 68 % for Phosphate and from 27 – 82 % for nitrate. This study has been able to show that, certain wastewater protozoa isolates have the ability to remove phosphorus and nitrate from wastewater in a shake flask environment. The study has still shown the effect of protozoa isolates on other physico-chemical properties of wastewater and the optimum conditions for nutrient uptake.

Use of the upper second premolar for age determination of the African lion (Panthera leo) in Sub-Saharan Africa, for purposes of remote monitoring.

Conservation agencies in Africa struggle to monitor their wildlife populations due to limited resources such as scientific support and financial constraints. The hunting industry within Africa is a large and lucrative business, yet the ability to monitor this form of utilization and ensure its sustainability is lacking. This research shows how it is possible to develop a remote monitoring center, which can use taxidermies as a source indicator for what is happening within the various hunting areas. By determining the age of death for an individual African lion (Panthera leo), one is able to analyze harvesting trends over time. These trends will act as an indicator as to the sustainability of the hunt. This research developed an aging technique using the upper second premolar of the lion. Morphological, histological and radiographic tooth characteristics were examined and the rate of pulp closure as well as cementum line count proved the best two techniques to use. Two hundred and forty five teeth collected from across sub-Saharan Africa were aged and trends for Tanzania and South Africa over the last two decades were depicted. The conservation implications are encouraging as now one has a method of ensuring that not only are hunts sustainable, but that non-sustainable harvesting is curtailed.

Key words: hunting; sustainability; taxidermies; cementum lines; pulp cavity

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Alterations in salivary cortisol and A-amylase characterise the stress response to downhill running

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Background: The physiological events underlying the response to "stress" include activation of the hypothalamic pituitary adrenal (HPA) axis and/or the activation of the sympathoadrenal (SA) system. Examination of both the relative and temporal activation of the HPA axis and SA system is key to understanding adaptive and mal-adaptive responses to stress.

Aim: The present study aimed to characterise the HPA axis and SA response to a bout of downhill running.

Method: Eleven untrained males performed a 60 min bout of downhill running (-13.5% gradient), at a speed eliciting 75% of their $\dot{V}O_2$peak on a level grade. Saliva samples were collected before, immediately after (IPE), and every hour for 12 h and every 24 h for 6 d. Salivary cortisol and -amylase levels were measured as markers of the HPA and SA response respectively. Data were analyzed using a repeated measures ANOVA (12 h period: 1 X 14; 24 h intervals 1 X 6, $p \leq 0.05$).

Results: There was a significant ($p < 0.05$) time effect, with salivary cortisol levels lower from 2-12h, -amylase levels higher from IPE-2h, compared to baseline.

Conclusion:
The stress response to 60 min of downhill running is characterised by the dominance of the SA system over the HPA axis for the first 12 h after exercise. Surprisingly, cortisol levels were not elevated and followed the normal diurnal rhythm observed during rest. The finding that -amylase level was significantly increased and reacted more rapidly than cortisol, suggests that it may be a better index of the acute response to stress.

Research Day

Abstracts

Poster Presentations

POSTER SESSION

POSTER NR	PRESENTING AUTHORS	POSTER TITLE
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P2	EA Shikanga	Isolation of Bioactive Polar Compounds from Lippia Scaberrima
P3	A Makgekgene	Use of Ruminally Protected Sunflower Oilcake Meal in Sheep Diets
P4	NW Kwezi	Hplc Analysis of Protecting Group Migration in Myo-inositol
P5	N Makala	The quality of the Mpofu Training Centre borehole water and the use of the conventional methods to improve the water quality.
P6	PNS Motha	Isolation of Iridoid Glycosides from Indigenous Lippia Species
P7	BP Chokwe	Synthesis of 2-pinanol From Waste Stream of Pulp Processing
P8	W du Plooy	A Comparative Study of the Terpenoid Profiles of Four South African Mango Cultivars
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P11	M Majuru	Evaluation of slurry preparations for multi-element determinations in coal by ICP-OES

ICP-MS based tracing of lead sources in raw cow's milk

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Exposure to lead is one of the major public health concerns today. In South Africa, there are a wide variety of sources of lead, which include mining, smelter activity, and use of leaded gasoline. Accurate quantification and identification of sources of lead is highly desirable. The isotopic fingerprint of lead has proved to be a reliable tracer of lead origin in biological and environmental samples. Thus, the goal of this study was to determine the concentrations of lead and stable lead isotope ratios and to pinpoint the potential sources of lead contamination in raw cow's milk. Water and fresh milk samples were collected from different dairy farms in South Africa and leaded gasoline purchased from petrol service station in Pretoria. Freeze-dried milk samples were digested in closed vessel microwave digestion system, whereas water samples acidified with ultrapure nitric acid and analysed directly. Tetraalkyllead compounds in the gasoline were converted into water-soluble species and subsequently extracted into dilute nitric acid to minimize carbon build-up on the mass spectrometer interface cones. Lead concentrations and isotope ratios in all samples were measured by ICP-MS. Correlation of isotope ratios and concentrations of lead in milk with that of water and leaded gasoline will be discussed.

Isolation of Bioactive Polar Compounds from Lippia Scaberrima

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Lippia scaberrima Sond. is one of the five Lippia species indigenous to South Africa. The plant is used as a remedy for many ailments, including coughs, colds, fever and bronchitis1, and is sold as a general health tea (Mosukujane tea). Most medicinally used Lippia spp. are prepared as infusions which contain water-soluble secondary metabolites. However, literature on non-volatile constituents of Lippia is scarce and fragmented. Only a limited number of flavonoids and iridoids have been identified in Lippia spp. world-wide2.

Ground aerial parts of the plant were defatted using petroleum ether. Flavonoids and iridoids were subsequently extracted using aqueous methanol and purified by silica gel column chromatography. Antimicrobial and anti-oxidant activities of fractions were determined against human pathogens. NMR techniques were used for structure elucidation of purified compounds. Relative amounts of these compounds in different aerial plant parts were compared using HPLC and found to differ. MIC tests confirmed antibacterial activity against Enterobacter faecalis and Pseudomonas aeruginosa. This exciting finding places scientific value on the medicinal use of polar extracts of L. scaberrima. The presence of active secondary metabolites in other indigenous Lippia species will be investigated to establish relationships at a subgeneric level.

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Use of Ruminally Protected Sunflower Oilcake Meal in Sheep Diets

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The effect of ruminally protected (saponified) high fat sunflower oilcake in lamb diets was investigated. Small scale oil presses envisaged for small scale production of oil for biodiesel manufacture will produce oilcakes with a high residual oil content. Value can be added to these by saponifying the residual oil improving the amount of unsaturated fatty acids flowing into the lower gastrointestinal tract (GIT). Furthermore, protein can be protected from ruminal degradation allowing a higher flow of essential amino acids to the lower GIT. This study was conducted to evaluate the effects of this product on lamb's growth performance and back fat composition.

Thirty weaned SA mutton merino lambs were fed ad libitum for 63 days on three total mixed diets containing low fat (LFSOC), high fat (HFSOC) or saponified high fat sunflower oilcake meal (SHFSOC). Slaughter data included dressing percentage, drip loss and back fat fatty acid composition, determined by gas chromatography.
The average feed intake for lambs on HFSOC (1123±29 g/day) was significantly ($P \leq 0.05$) lower than that of the other two treatments (1229 ±27 g/day and 1307±43 g/day for LFSOC and SHFSOC respectively). The average daily gains of the lambs on LFSOC, HFSOC and SHFSOC were respectively 211.2±12.0, 163.6±14.9 and 209.2±14.5 g/day. The lambs on the SHFSOC had significantly higher levels of saturated fatty acids and lower levels of unsaturated fatty acids.

Hplc Analysis of Protecting Group Migration in Myo-inositol

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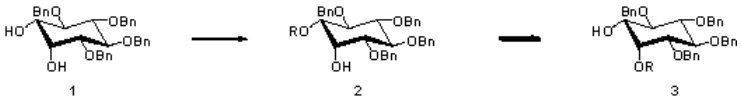
Mycothiol (MSH) serves as a self-defense antioxidant in MSH-producing microorganisms. The biosynthesis and metabolism of MSH have received considerable attention as a means of identifying potential new targets for antitubecular drug development. A class of targets would be analogues of a key intermediate -DGI whose synthesis requires suitably protected myo-inositols. The traditional synthesis of C-2 protected myo-inositol from diol 1 is lengthy and we have designed an improvement in the C-2 selective protection of myo-inositol based on a facile protecting group migration from C-1 to C-2.



R = a (Bz); b (Pv); c (Ts); d (TBS); e (TIPS)

Selective derivatisation (Pv, Bz, Ts) of the C-1 hydroxyl was achieved in good yields (83, 82, 85% respectively). Synthesis of silyl derivatives was poor at 21% (TBS) and 19% (TIPS). Migration of protecting groups to C-2 was conducted with various bases and the progress and the outcome of the reactions were monitored by HPLC. The migration of the acyl derivatives was best achieved with DBU to give equilibrium ratios of 33:66 (2b:3b) and 50:50 (2a:3a) within 4 h. The migration in sulfonyl derivative 2c was best accomplished with NaH and resulted in complete migration within 5 min. Migration of the silyl derivatives is still under investigation.

The quality of the Mpofu Training Centre borehole water and the use of the conventional methods to improve the water quality.

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This study was aimed at determining the water quality of the Mpofu training centre (MTC) borehole in the Nkonkobe District of the Eastern Cape Province and at evaluating the need for conventional treatment of this borehole. To evaluate the microbiological quality of water supplied by the MTC borehole, the following organisms were considered: total coliforms, presumptive Escherichia coli, presumptive Salmonella, heterotrophic bacteria, Vibrio spp, Cryptosporidium, Giardia as well as somatic and FRNA phages.

The results indicated that the bacterial quality of the MTC borehole, as suggested by the bacterial, viral and protozoan parasite indicator organisms used was making the water from this borehole unfit for consumption without prior treatment. Due to the level of contamination in this borehole, the department of agriculture has resolved to treating water by conventional methods.

Isolation of Iridoid Glycosides from Indigenous Lippia Species

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Five Lippia species (Verbenaceae), indigenous to South Africa, are officially recognized: L. javanica (Burm.f.) Spreng, L. pretoriensis H.Pearson, L. rehmannii H.Pearson, L. scaberrima Sond. and L. wilmsii H.Pearson1. Traditional uses of Lippia spp. are mainly for gastrointestinal and respiratory complaints. These medications are usually prepared as infusions or decoctions which are administered orally. Emphasis has historically been focussed on the essential oil components and information regarding non-volatile constituents is scarce. Iridoids, which are useful chemotaxonomic markers of the Verbenaceae, can help to shed light on the relationships between the indigenous species of this genus.

Ground aerial parts of L. scaberrima and L. javanica were extracted with aqueous methanol after defatting of the plant material with petroleum ether and chloroform. Extracts were purified using column chromatography accompanied by TLC using acidified p-anisaldehyde as visualization reagent. NMR analysis revealed the presence of iridoid-glucosides, related to geniposide, a commonly occurring anti-inflammatory agent in traditional Chinese remedies2. The iridoid glucoside, 4a-hydroxy geniposide, produced by L. scaberrima can be used as a chemical marker to distinguish this species from the other indigenous ones. The relative amounts of these compounds in the different species and in different plant parts were determined using HPLC analyses.

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Synthesis of 2-pinanol From Waste Stream of Pulp Processing

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Crude sulphated turpentine (CST) is an industrial waste stream from Kraft pulp and paper process. CST could be used as input material in the synthesis of linalool, an essential oil with a large commercial demand, if the mixture of and -pinenes could be selectively reduced to preferentially give cis–pinane; cis-pinane is a key intermediate in the production of linalool via oxidation to pinane hydroperoxide, which spontaneously decomposes to 2-pinanol at elevated temperatures[1].

A mixture of /-pinenes (CST) was hydrogenated at 80˚C and 15 bar using partially poisoned Ni catalyst to give high purity pinane with a cis/trans ratio of 20:1 (92%). The optimal conditions found for the oxidation of pinane were using benzoyl peroxide as a radical initiator and O2 as the oxidant (3 bar) in the presence of base, at 110˚C. The desired product, 2-pinanol, was obtained at a great selectivity (96%) albeit at a poor conversion (31%) since the 2-pinanol starts to decompose to unwanted side-products including 3-pinanol and pinane-2,9-diol. However, the unreacted pinane was easily distilled off and submitted to further oxidation to improve the overall yield of 2-pinanol per pass of pinane.

(Footnotes)

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A Comparative Study of the Terpenoid Profiles of Four South African Mango Cultivars

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Differences in the extent of insect predation between four commercially important mango cultivars (Sensation, Kent, Tommy Atkins and Keitt) grown in South Africa, can be ascribed to differences in their terpenoid composition. Volatile terpenoids from the leaves and fruit of these four cultivars were studied by means of in situ sampling and thermal desorption-gas chromatography. This methodology allowed the assessment of normal metabolic processes and secondary metabolite formation without interference caused by the release of cytoplasmic substances due to disruption of tissue during traditional sampling procedures1. Observed volatile profiles therefore resembled natural emissions during leaf and fruit development. Within each cultivar, leaf terpenoid profiles showed significant correspondence with those of fruit throughout the season. Major changes in obtained profiles during fruit development and ripening were due to reallocation of resources during formation of complex aroma and flavour components2. Comparing the terpenoid profiles from the four cultivars, it was found that myrcene, -pinene, -terpinene and 3-carene are some of the distinctive major terpenoids from cultivars grown in South Africa. This technique and finding allows differentiation of the metabolic chemistry of each cultivar, indicating the possible role of such constituents in selective insect predation among cultivars.

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Comparing segregation profiles of Sn and Sb in single and polycrystalline Cu

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Heat treatment of alloys can cause segregation, leading to impurity/solute enrichment of the surface or grain boundary. Segregation can change the physical and chemical state of an alloy. Knowledge of elemental-solute segregation parameters within bulk-solvent-matrix would eventually lead to the fabrication of super-alloys of known properties under different temperature regimes.

It is in the pursuance of measuring segregation parameters and the test of theories explaining the phenomenon that the present study involving Cu(solvent) and two impurities/solutes Sn (0.14 at%) and Sb (0.12 at%) was based.

The kinetics as well as the equilibrium segregation behaviours of the solutes in a polycrystalline and single, (100)- and (111)- Cu samples (0.90 mm thickness) were measured by Auger electron spectroscopy at a heating rate of 0,075 K/s. The solute profiles in the Cu samples measured at the same experimental conditions were compared.

The different results are explained in terms of the solute segregation to the grain boundary and surface interfaces. The comparison also indicate that not only bulk diffusion, interactions and segregation energies play a role in the surface enrichment of the species, but in polycrystalline samples surface and grain boundary diffusions are to be taken into account as well.

Optimisation of Analytical Parameters for Slurry Nebulisation ICP-OES determination of major, minor and trace elements in raw coal

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Coal remains an important raw material, especially in the power generation industry. However, emissions to the environment from coal combustion have raised growing concerns about pollution risks. In recent years, nuclear power plants that utilise high purity graphite have been developed as alternative clean energy sources. Such high purity graphite is produced by subjecting raw coal to various cleaning procedures to remove impurity elements that could pollute the environment and/or degrade performance of the nuclear power plant. Analytical procedures that permit the accurate evaluation of the quality of clean graphite to establish its suitability as a feedstock in nuclear power plants are highly desirable. Our laboratory has considerable experience in slurry sample preparation techniques for the determination of major, minor and trace elements in solid samples by ICP-OES. Consequently, it has been well established that particle size greatly affects the efficiency of aerosol formation and analyte transportation for accurate detection by ICP-OES.

In this study the development and critical assessment of a procedure for the direct nebulisation of coal slurries into the ICP-OES for the determination of major, minor and trace elements is described. A McCrone micronising mill with agate grinding elements was used to grind coal samples for preparing up to 0.6% m/v coal slurries in 0.1% m/m Triton X-100. Particle size of raw coal ground for 30 min, slurried and sonicated for 15 min was analysed with the Malvern particle size analyzer and was < 5 µm for 50% and 10 – 14 µm for 90% of the particles. These conditions are known to provide accurate results in studies involving slurries. It was discovered that oven drying of the McCrone micronising mill vessel for 1 h prior to introduction and grinding of coal sample plays important role in achieving desirable particle size distribution. Plasma operating conditions have been optimized. Further studies are being carried out to accurately determine 13 elements (B, Ca, Cl, Co, Cr, Li, Mg, Na, P, K, Pb, Ti, and Zn), evaluate the accuracy of analytical results, and apply ICP-OES for the assessment of the purity of coal samples subjected to various cleaning processes.

Evaluation of slurry preparations for multi-element determinations in coal by ICP-OES

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Coal is used in various industries as a raw material. Hence, accurate evaluation of its fitness through multi-element analysis is highly important. Existing analytical methods are costly, involve long sample preparation times, or are prone to contamination and loss. A better analytical procedure that permits accurate determination of elements in coal is desired. One such possibility is slurry nebulisation with ICP-OES. Independent studies done for a few elements assumed that the developed methods would work for all elements. It was shown that particle size remains critical for accurate multi-element determinations in slurry nebulisation.

Slurries prepared by various dispersants were characterized by SEM and Zeta Potentials. Slurry preparations were also evaluated for the simultaneous multi-element determination of major and minor elements in coal using ICP-OES. In the procedures, DMF was used as a solubilising aid for coal, mixed with dispersants such as Triton X-100 and glycerol. Wet grinding of the coal with DMF was shown to drastically reduce particle sizes (50%: 0.277 µm and 90%: 6.167µm) as compared to dry grinding (50%: 5.254µm and 90%: 11.065µm). Reduced particle sizes, increases transport efficiency of the slurries and lead to accurate determinations. Improved recoveries relative traditional methods for a number of elements were obtained (Al 93.00 – 100%; Ca 100.00%; Cr 100.00%; Fe 89.00 – 100.00%; Si 82.00 – 100.00 and Ti 73.00 – 83.00%).

Notes