



**INDIGENOUS
PLANT USE FORUM**
27-31 AUGUST 2023

Skukuza, Kruger National Park - South Africa

Programme and Abstracts





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Theme:

**“Are we maximising the potential benefits of a rich
endemic flora and associated indigenous
knowledge?”**

Programme and Abstracts

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Compiled by Ryan D. Rattray
Edited by Ben-Erik van Wyk

Our Sponsors

The IPUF Organising Committee would like to extend a heartfelt *Thank you* to the following organisations for their support in making the 25th IPUF Conference a success:



Venue of the 25th IPUF Conference 2023

Nombolo Mdhluli Conference Centre, Skukuza Rest Camp, Kruger National Park – South Africa

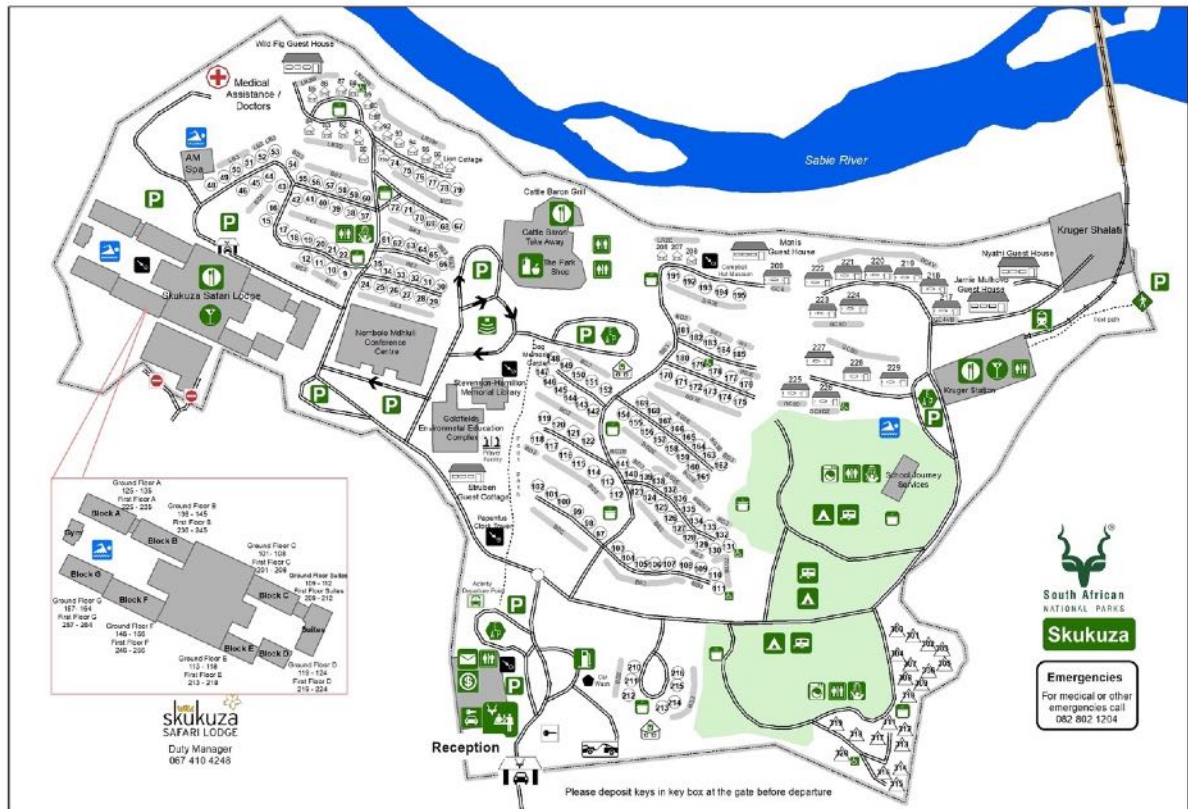


Located within the heart of African wildlife at Kruger National Park, South Africa. The Centre can host up to 700 delegates, with several smaller rooms for plenaries and workshops and is within walking distance from the accommodations.

The KNP was established in 1898 and is the South African National Park's flagship. It is home to the big five and a wide range of other species, including 336 trees, 49 fish, 34 amphibians, 114 reptiles, 507 birds, and 147 mammals.

Skukuza Rest Camp

Skukuza is the largest camp in the KNP, well situated in the heart of the 'Big 5' territory, 10 km from the Paul Kruger Gate (download layout of camp). The name Skukuza was adapted from the Tsonga word Sikhukhuza ('a new broom'), the Zulu nickname given to the first warden of the park James Stevenson-Hamilton. The rest camp is fenced-in, making it safe to move about freely, and overlooks the Sabie River, where big game such as elephants, hippopotamuses, and buffaloes are often found; there is also a high concentration of predators like lions, hyenas, and leopard in the vicinity of the camp.



Skukuza Rest Camp Facilities:

- ◆ Car hire
- ◆ Doctor
- ◆ Two restaurants
- ◆ Two swimming pools in camp (for overnight residents only)
- ◆ Shop
- ◆ Laundromat
- ◆ Petrol station
- ◆ ATM/Bank
- ◆ Wi-Fi at the conference venue, Cattle Baron Restaurant and the Skukuza Safari Lodge – there is no Wi-Fi in the units.

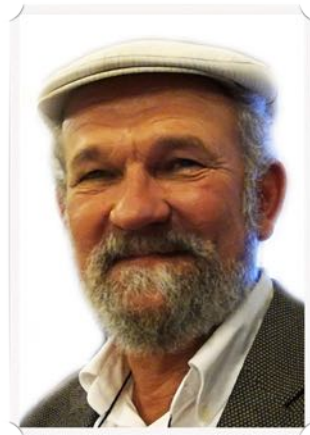
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Message from the IPUF Chairman



Dear Delegates, The Indigenous Plant Use Forum's local organising committee welcomes you to Skukuza in the Kruger National Park, an exciting venue for a very special meeting of old and new friends. We hope that the 25th Annual IPUF Conference will be a memorable occasion, not only for its intellectual contributions and new insights but also as a source of inspiration for new research projects, new collaborations, and new friendships across the globe.

A handwritten signature in black ink, reading "B-E van Wyk".

Prof Ben-Erik van Wyk

Chairman of the Indigenous Plant Use Forum (IPUF)

SARChI Research Chair in Indigenous Plant Use, University of Johannesburg



Tribute to Dr Carl Albrecht



Dr Carl Albrecht

The Indigenous Plant Use Forum (IPUF) mourns the passing of Dr Carl Albrecht, a stalwart in cancer research and indigenous plant use, who departed on 23rd March 2023. Our sympathies are with his family in Kleinmond, where he spent his retirement years. Dr Albrecht was the first Chairman of IPUF and served from 1993 to 1994.

Born in Johannesburg in 1943, Dr Albrecht dedicated his life to understanding and combating cancer. His path led him from Johannesburg to the Molecular Anatomy Laboratories and the National Chemistry Laboratory of CSIR, ultimately settling at Stellenbosch Medical School's Department of Pharmacology in 1976. His work on melanoma dormancy and the anti-cancer properties of *Hypoxis hemerocallidea* set a precedent for clinical trials using indigenous plant extracts in South Africa. Dr Albrecht's academic contributions extended beyond research, influencing over 2000 medical students throughout his 21-year teaching career. His output includes a textbook, 45 scholarly articles, and three US patents.

Transitioning into a consultancy role in 2007, Dr Albrecht later became the Head of Research at CANSA until his retirement in 2015. His substantial contributions earned him the esteemed A.G. Oetlé Memorial medal twice. Driven by an inquisitive spirit, Dr Albrecht had a penchant for life's mysteries, exploring everything from fairy circles in Namibia to the origins of *Homo sapiens*. His curiosity is captured in his unfinished book, '30 Unexplained Wonders of our Awesome Universe.'

The IPUF honours Dr Albrecht's significant contributions to indigenous plant use and his indomitable spirit and passion continue to inspire our community.

Acknowledgements

The organisers would like to thank the following institutions and persons for their valuable contributions to the 25th IPUF Conference 2023:

- ◆ The **DST-NRF SARChI: Indigenous Plant Use** for donating the 2022 and 2023 IPUF Best Product Award
- ◆ The **Mpumalanga Tourism and Parks Agency (MPTA)** for sponsoring the local flights and accommodation of two International Keynote Speakers, and the entertainment for both the Welcome Reception and Gala Dinner
- ◆ The **Technology Innovation Agency (TIA)** for generously sponsoring the IPUF-TIA Mobilisation Grants for the attendance of ten students (MSc and PhD) and ten young academics, as well as contributing to the prize money for the student awards
- ◆ The **DSI-NRF Chair in Phytomedicine – Prof Alvaro Viljoen** for his generous contribution
- ◆ **All the exhibitors** in the indigenous plant product displays
- ◆ **Management and Staff of the Nombolo Mdhluli Conference Centre**, especially **Nozipho Mkhize** for her assistance and friendly efficiency
- ◆ **The session chairpersons** for their availability and time
- ◆ **The adjudicators** for their input to determine the best papers by young scientists and the best poster awards
- ◆ **The University of Johannesburg (UJ) and the Department of Botany and Plant Biotechnology, University of Johannesburg**, for the use of their facilities and logistical support
- ◆ **Staff and students of UJ** for their assistance in organising and executing the conference
- ◆ **The organising committee** for planning, managing and executing the conference
- ◆ **All participants of the 25th IPUF Conference 2023, and especially those that travelled far** – without you, this conference would not have been possible

IPUF 2023 Organising Committee

- ◆ Prof Ben-Erik van Wyk (UJ; IPUF Chairman)
- ◆ Mr Ryan D. Rattray (UJ; Conference Co-ordinator and IPUF Secretariat)
- ◆ Ms Marlette Compion-Venter (UJ; Logistical support)
- ◆ Mrs Helen Long (UJ; Logistical support)
- ◆ Mr Johandré van Rooyen (UJ; Website and Media)
- ◆ Mr Jean-Claude Laurent (UJ; AV support)
- ◆ Mrs Jackey Deacon (MPE; Conference Agent)

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General information

Indigenous Plant Use Forum (IPUF)

The Indigenous Plant Use Forum, better known as IPUF, was started by the National Research Foundation of South Africa (NRF) in 1993 to “promote the cultural, socio-economic and scientific benefits to be derived from the sustainable use of the southern African flora”.

The annual IPUF conferences are unique, multicultural and multi-disciplinary events that serve as a meeting point for a diversity of interest groups, including academics, traditional healers, anthropologists, businesspeople, resource managers, conservationists, policymakers, and indeed anyone interested in the sustainable use of the southern African flora.

Since the first annual conference in 1996, IPUF has attracted enthusiastic support and participation from delegates from South Africa and many other countries. It has been especially successful in transforming science in South Africa and promoting scientific research amongst young black students. In 2015, IPUF and the USA-based Society for Economic Botany held a joint annual conference in Clanwilliam, South Africa (the main geographical centre of the indigenous rooibos tea industry).

The 2023 IPUF conference in Skukuza, Kruger National Park, South Africa, will be a special event. It marks the 25th conference organised from the office of Prof Ben-Erik van Wyk, who has been annually re-elected as chairman of IPUF since 1995.

The time has come to take a bird’s eye view over 25 years of IPUF conferences and to assess the impact that it has had on the original purpose for which IPUF was started in 1993, as quoted above.

Computer presentations

Delegates are requested to submit their PowerPoint files to the computer operator(s) in the Main Hall on the day of arrival or alternatively during the break before the start of each session. One of the organisers will load the files onto the computer. Make sure to save your presentation in an older version of PowerPoint, in case you are using a very modern version

(and perhaps a pdf as backup)! Furthermore, presenters are given ten (10) minutes to present their lectures – eight (8) minutes to present and two (2) minutes for any questions.

Posters

Poster presenters are personally responsible for affixing and removal of their posters. Posters to be presented will be displayed in the designated venue in alphabetical order, according to the first author's surname. Please affix the poster to the position assigned to each presenter. Participants are requested to put up their posters during registration on Sunday afternoon, 27 August, and remove them by 12:00 on Thursday, 31 August 2023.

Notice board

Please check the notice board in the main foyer for any messages and announcements.

Meals

Lunches and tea/coffee and evening meals will be served. Delegates are responsible for their own breakfast. Special dietary requirements will be clearly marked. Please note that no dietary requirements can be met for delegates who registered late and did not inform the organisers.

- ◆ Breakfasts for the delegates that pre-booked will be hosted at the Skukuza Safari Lodge Hotel
- ◆ Tea/coffee Breaks will be hosted in the Conference Venue
- ◆ Lunches will be hosted in the Skukuza Safari Lodge Hotel
- ◆ Dinners will be hosted at the Cattle Baron Restaurant (except for the Gala Dinner)
 - The following dinners are included in the conference registration fee:
 - Welcome reception (27 August 2023)
 - Dinner 1 (28 August 2023)
 - Dinner 2 (29 August 2023)
 - Dinner 3 (30 August 2023)
 - **Delegates who will not attend the Gala Dinner will be responsible for their own dinner arrangements, at their own cost.**

Beverages

Delegates will be provided two beverage tickets for the Welcome Reception, Poster Session and Gala Dinner. Any additional beverages will be at the own cost of the delegates. Tickets will be on sale from the designated organising committee representative and cash bars are available.

Indigenous plant use product display

Exhibitors are welcome to display their products or promotional materials at any time during the conference, and a representative should ideally be available during tea breaks. All individuals and companies involved in indigenous plant-based products are encouraged to participate in this informal show and promotion. This is the forum's effort to promote developing, using and manufacturing products based on indigenous plants.

Workshops

The following notes are provided to help delegates prepare for the workshops. However, it is up to the workshop facilitators to determine the final scope and format.

Workshop 1. Ethnobotanical methodology

Potential aims (outcomes) of the workshop:

IPUF declaration and IPUF Code of Ethics adopted by the 25th Indigenous Plant Use Forum, 27-31 August 2023 at Skukuza, Kruger National Park, South Africa

Suggested points for discussion (following the typical phases of an ethnobotanical survey), with important discussion points underscored):

1. Ethical clearance

- Code of ethics - modify ISE code of ethics? - more concise? Improved IPUF code of ethics?
- What are the benefits to the local community/participants?
- Interviews should be conducted by a native speaker, preferably of the same cultural group
- All participants should be explicitly acknowledged for each and every use-record
- Determine if individual contributions may justify co-authorship
- Measures to develop/empower local intellectual leadership
- Collecting permit and other permits or permissions
- Consent form and submission to an ethics committee
- Letter of approval and reference number

2. Literature review and reconnaissance of study area

- Previous surveys and available literature, cultural context
- Comprehensive list of previously recorded species
- Sampling strategy, representative sample of villages and villagers
- Formal meetings with tribal authorities/community leaders
- Informal meetings with local experts and potential participants to establish a rapport
- List of potential participants with addresses and contact details

3. Rapid ethnobotanical surveys/appraisals (to prepare a research instrument, i.e., questionnaire or

- a flip-file of images to use during interviews)
 - Collect specimens and photographs of all useful plants with associated indigenous knowledge where available
 - Repeated visits may be necessary to cater for the seasonal availability of the plants/fruits, especially in seasonal habitats
 - Ends with a preliminary inventory of relevant plants and final research instrument (questionnaire and/or flip-file of images)
4. Interviews
 - Important to follow local customs and protocols
 - Obtain consent and a clear understanding of the aims of the study
 - Clarify how personal information and portrait photographs will be used
 - Should be conducted by a native speaker, preferably a member of the same cultural group
 - Phase ends with a summary of high-quality data (e.g., excel spreadsheet)
 5. Quantification and analysis
 - Summarise and synthesise the data
 - Apply appropriate statistical analyses
 6. Publication
 - prepare a scientific publication with high-quality data
 7. Feedback phase
 - Prepare community feedback materials in the local language. These include PowerPoint presentations, pamphlets, booklets or posters.
 - The first feedback goes to tribal authorities (if relevant)
 - Then, feedback to the community in the form of prepared materials
 - All participants should be explicitly acknowledged for each and every use-record
 - Determine if individual contributions may justify co-authorship
 - Measures to develop local intellectual leadership

The complete ISE code of ethics can be found online: <http://ethnobiology.net/code-of-ethics/>

Workshop 2. Commercialisation of medicinal plants

Potential aims (outcomes) of the workshop:

Recommendations and guidelines for potential developers of medicinal products

The following points from the PhD thesis of Brendler (2022) may serve as a framework for discussions:

1. The driving forces behind commercialisation

2. Scientific aspects
 - Ingredient Identity and Quality Control
 - Ingredient Composition
 - Modes of Action and Pre-Clinical Efficacy
 - Clinical Efficacy
 - Toxicology and Clinical Safety
3. Aspects of Commerce and Economy
 - Protection of IP
 - Product Categories and Regulations
 - Sustainable Supply Chains
4. Aspects of ethics
 - Traditional Knowledge
 - Access and Benefit-Sharing

According to Brendler (2022), a developer should follow the following mantra:

- Know your ingredient.
- Respect traditional knowledge.
- Secure your supply chain.
- Comply with regulations.
- Understand your market.

IPUF Student awards

The awards for the three best paper presentations are for young scientists and postgraduate students. The poster prizes are open to all delegates. The winners will each receive a certificate and prize money.

The adjudication guidelines are available at the end of the booklet. Young scientists are the only persons eligible for the best paper awards. They must have specifically indicated that they wish to be considered for the award on the registration form. A young scientist will qualify by conforming to at least one of the following conditions at the start of the meeting:

- ◆ Under the age of 30 years at the date of the meeting, or
- ◆ Three or fewer presentations at prestigious scientific meetings, or
- ◆ Five or fewer years of work in the respective discipline associated with the presentations.

Furthermore, young scientists eligible for adjudication are indicated by the  symbol in the programme.

Mobile phones

Delegates are asked to please switch their phones to silent during the sessions. A ringing cell phone disrupts the speakers. The organisers thank you for your co-operation.

Liability

The organisers give notice that they do not accept responsibility or liability in respect of either person or property for injury, damage, loss, accident, delay, or irregularity which may be occasioned as a result of attendance of the conference and excursions.

Activities at Skukuza Rest Camp

The following activities are available at Skukuza Rest Camp at the delegate's own cost:

- ◆ AM Spa Kruger
- ◆ Guided Bush Walks
- ◆ Game Drives (in the company of trained field guides)
- ◆ Bush Breakfast and Bush Braai (Barbecue). Includes game drive to venue. Confirm availability when booking.
- ◆ 9-hole Golf Course
- ◆ Stevenson Hamilton Memorial Library
- ◆ Metsi Metsi Wilderness Trail (pre-booked overnight activity)
- ◆ Kids Educational Programme (Seasonal)
- ◆ Lake Panic Bird Hide (located approximately 7 km outside the camp)
- ◆ Through prior arrangement with the camp, catered traditional dances can be arranged.

Programme

Sunday, 27 August 2023

14h00-17h00

Registration:
Nombolo Mdhluli Conference Centre

17h00-18h00

**Welcome Reception &
Cocktail Function**

- ◆ Welcome - Prof Ben-Erik van Wyk (IPUF Chairman)
- ◆ Technology Innovation Agency (TIA Representative)
- ◆ Mr Ryan D. Rattray (IPUF Conference Coordinator)



Monday, 28 August 2023

Keynote Session 1: Ethics & Ethnobotany
Chairperson: Ben-Erik van Wyk

09h00 – 09h30	Recommended standards for conducting and reporting ethnopharmacological field studies	Marco Leonti
09h30 – 10h00	Embedding Social Justice in Ethnobotanical Research	Rachel Wynberg
10h00 – 10h30	Methodology and Ethics of Ethnobotany: The journey of Natural Product development	Namrita Lall
10h30 – 11h00	Tea Break	

Session 1 – Biological Activity & Medicinal Plant Chemistry 1

Chairperson: Lyndy McGaw

11h00-11h10	A decade of researching traditional plant knowledge in Northern Maputaland; ethnobotanical exploration and scientific validation	Sandy van Vuuren	
11h10-11h20	Chemical analysis and insecticidal activity of selected plant extracts from plant species used traditionally in southern Africa as insecticides	Calphonia Shilaluke	
11h20-11h30	<i>Momordica balsamina</i> methanol extract inhibits the metastatic potential of interleukin-6-activated MDA-MB-231 breast cancer cells through regulation of the IL-6/JAK2/STAT3 pathway	Tshwarelo Mohale	
11h30-11h40	Pro-inflammatory cytokine inhibition properties of selected southern African medicinal plants in LPS- stimulated RAW 264.7 macrophages	Gugulethu Khumalo	
11h40-11h50	Phytochemical screening and antimicrobial, antioxidant and cytotoxic activities of <i>Carissa bispinosa</i> (Apocynaceae) leaf extracts used for dental health care	Wanda Shekwa	
11h50-12h00	Phytochemistry and ethnobotany of South African <i>Senecio</i> (Asteraceae): Comparing toxic and non-toxic taxa	Lebohang Selepe	
12h00-12h10	Proteome analysis of <i>Mycobacterium</i> species following treatment with extracts of selected medicinal plants	Maphuti Matlala	
12h10-12h20	Bio-control potentials of plant-derived silver nanoparticle against multi-drug resistant <i>Staphylococcus</i> spp. from raw milk	Daniel Ajose	
12h30 – 13h30	Lunch Break: Skukuza Safari Lodge Hotel		

Session 2 – Cultivation & Production 1

Chairperson: Khathutshelo Magwede			
13h30-13h40	Survey on the yield components of Bambara groundnut (<i>Vigna subterranea</i>) accessions based on <i>Bradyrhizobium</i> inoculant and nitrogen fertilization	Olubukola Babalola	
13h40-13h50	Non-destructive methods for the propagation of <i>Bowiea volubilis</i> , a vulnerable medicinal plant species	Karin Hannweg	
13h50-14h00	<i>In vitro</i> propagation of <i>Greyia radlkoferi</i> : Effect of cytokinins on shoot proliferation	Glad Radzuma	
14h00-14h10	Production challenges around the species <i>Juncus lomatophyllus</i>	Thokozile Mtshweni	
14h10-14h20	Gaseous exchange and water use efficiency of <i>Moringa oleifera</i> grown in different locations of South Africa	Kagisho Murwa	
14h20-14h30	Assessment of symbiotic performance in three groundnut (<i>Arachis hypogaea</i>) genotypes grown in difference locations in northern Ghana	Titus Ngmenzuma	
14h30-14h40	Marula seed performance in response to imbibition and fertilisers	Rendani Nemakanga	
14h40-14h50	The role of indigenous vegetables in rural households: the case of Mogaladi village, Limpopo Province, South Africa	Mosima Masekoameng	
14h50-15h00	Harnessing the benefits derived from African yam bean (<i>Sphenostylis stenocarpa</i>), a potential food security crop	Olubukola Babalola	
15h00 – 15h30	Tea Break		

Session 3 – Commercialisation & Standardization Chairperson: Thomas Brendler			
15h30-15h40	Development of a natural-based scaffold using <i>Capparis sepiaria</i> and <i>Tabernaemontana elegans</i> extract for articular cartilage and bone tissue regeneration	Vutomi Hlungwane	
15h40-15h50	Antimicrobial synergisms in medicinal plant extracts are often caused by chlorophyll break-down products	Nicholas Sadgrove	
15h50-16h00	Importance of ISO standards for essential and vegetable oils of South Africa	Karen Swanepoel	
16h00-16h10	Phytochemical profiling of selected South African <i>Cissampelos</i> species	Zimkhitha Sotenjwa	
16h10-16h20	Perceptions of the use, consumption and commercialisation of wild edible plants	Makwena Mothupi	
16h20-16h30	Effect of pasteurisation and storage on proximate and mineral composition of indigenous and commercial watermelon juice	Paseka Mabulwana	

16h30-16h40	Quality of the essential oil from <i>Pelargonium graveolens</i> cultivated in different locations in the Eastern Cape	Bulelwa Ngcangatha-Maqhude	
16h40-16h50	Effects of different concentrations of Phytostim® biostimulant application on growth and yield of tomato	Mpho Lucious Mokwena	
16h50-17h00	Moringa leaf extract as a natural biostimulant on different potato (<i>Solanum tuberosum</i>) cultivars	Tlangelani Nghondzweni	
17h00	End of Day 1		
19h00-	Dinner 1: Cattle Baron Restaurant		



Tuesday, 29 August 2023

Keynote Session 2: Ethnobotany Chairperson: Ben-Erik van Wyk		
09h00 – 09h30	Contemporary Mexican ethnobotany: advances in the study of agrobiodiversity	Heike Vibrans
09h30 – 10h00	Methodology and ethics of ethnobotany: working with indigenous knowledge holders	Peter Tshisikhawe
10h00 – 10h30	Medicinal plants of Lesotho: A review of ethnobotanical, pharmacological and conservation studies	Lerato Seleteng-Kose
10h30 – 11h00	Tea Break	

Session 4 – Conducting Ethnobotanical Surveys Chairperson: Peter Tshisikhawe		
11h00-11h10	A quantitative survey of medicinal plants found in Bapedi home gardens at <i>Ga-Maponto</i> village, Capricorn District, Limpopo Province, South Africa	Khathutshelo Magwede
11h10-11h20	An insight into the inventory of medicinal plants prescribed by Indigenous knowledge holders in Mahikeng Local Municipality, South Africa	John Asong 
11h20-11h30	Assessment of mycotoxin contamination in traditional leafy vegetables sold in the Free State, South Africa	Idah Manduna
11h30-11h40	Local knowledge and perception of exotic plants with invasive potential in a rural municipality in a semi-arid region of Mexico	Josué Leal-Sanjuan
11h40-11h50	An analysis of the South African Vatsonga medicinal ethnobotany and a cross-cultural comparison with the Pedi, Venda, Swati, and Zulu	Eunezia Siteo 
11h50-12h00	Symbiotic performance of cowpea inoculated with native rhizobial isolates in the glasshouse	Lebohang Mzisa 
12h00-12h10	Medicinal and ritual plant-use patterns in southern Africa	Ancia Cornelius 
12h10-12h20	Utilisation of indigenous plants during and post-Covid-19 era by people of the Vhembe region	Mokgaetji Mokganya

12h20-12h30	A comparative analysis of the <i>muthi</i> plants from Port St Johns and Tsolo, sold at Ntozonke Market, Mthatha, Eastern Cape Province	Sizwe Cawe
12h30-13h30	Lunch Break: Skukuza Safari Lodge Hotel	

Session 5 – Biological Activity & Medicinal Plant Chemistry 2
Chairperson: Nox Makunga

13h30-13h40	The use of medicinal plants for the synthesis of metal oxide nanoparticles for biomedical applications	Lillian Makgoo	
13h40-13h50	The ethnobotany and pharmacognosy of two species in the genus <i>Plecostachys</i> (Asteraceae)	Mbali Chirwa	
13h50-14h00	Copper homeostasis, a potential target of essential oil constituents in the control of malaria	Robyn van Zyl	
14h00-14h10	Phytochemical screening and antibacterial activity of the leaf and bark extracts of <i>Zanthoxylum chalybeum</i> against pathogenic bacteria	Scelo Mnguni	
14h10-14h20	The volatile and non-volatile chemistry of ethnobotanically relevant southern African <i>Stachys</i>	Ryan Rattray	
14h20-14h30	<i>In vitro</i> antiproliferative activity and upregulation of PTEN in melanoma cells using medicinal plants	Jacqueline Maphutha	
14h30-14h40	Isolation and biological activity of compounds isolated from leaf of <i>Lonchocarpus capassa</i>	Salome Mahlo	
14h40-14h50	Chemical profiling and antibacterial activity of three <i>Oncosiphon</i> species indigenous to South Africa	Tshwarelo Mathabatha	
15h00-15h30	Tea Break		

Session 6 – Cultivation & Production 2
Chairperson: David Katerere

15h30-15h40	Mapping of suitable areas for the distribution and cultivation of <i>Artemisia afra</i>	Motiki Mofokeng	
15h40-15h50	Plant phenology and bioactivity	Riana Kleynhans	
15h50-16h00	Water-use efficiency and physiological response of cowpea (<i>Vigna unguiculata</i>) to cowpea-blackjack intercropping	Thifhelimbilu Kutama	
16h00-16h10	Growth and yield performance of <i>umsobo</i> (<i>Solanum nigrum</i>) to organic and inorganic fertilizers	Ntombifuthi Msewu	

16h10-16h20	Growth and yield performance of <i>Amaranthus</i> varieties in animal manure amended and mycorrhizae enhanced acidic soil of Lusikisiki in O. R. Tambo district, Eastern Cape Province, South Africa	Simphiwe Mhlontlo
16h20-16h30	Integrating IKS and technology in crop monitoring and prediction phytochemical composition in Moringa	Ashwell Ndhala
16h30-16h40	Characterization of <i>Sclerocarya birrea</i> (marula) seed oil and investigation of the geographical origin by applying similarity calculations, differential NMR and hierarchical cluster analysis	Wilma Augustyn
16h40-16h50	Chemical characterisation of selected indigenous seed and nut oils	Karen de Jager
17h00	End of Day 2	
18h00-19h00	Poster session: Please see abstract section for poster titles and presenting authors	
19h00-	Dinner 2: Cattle Baron Restaurant	



Wednesday, 30 August 2023

Keynote Session 3: Medicinal Plants Chairperson: Ben-Erik van Wyk		
09h00 – 09h30	Delving into South African medicinal plant treasures using a biotechnological toolkit	Nox Makunga
09h30 – 10h00	Journey with my plants – A 45-year botanical adventure	Denzil Phillips
10h00 – 10h30	From compounds to products – lessons learnt on the road to Timbuktu	David Katerere
10h30 – 11h00	Tea Break	

Session 7- B Biological Activity & Medicinal Plant Chemistry 3 Chairperson: Alvaro Viljoen			
11h00-11h10	Zebrafish: a high-throughput model to investigate bioactivity and toxicity of medicinal plants	Maxleene Sandasi	
11h10-11h20	Phytochemical profiling and wound healing properties of <i>Lobostemon fruticosus</i>	Mashilo Kgosana	
11h20-11h30	Application of biochemometrics as a novel approach to identify bioactive molecules in medicinal plant research	Veronica Maphanga	
11h30-11h40	Chemical profiling, anticonvulsive and anxiolytic effects of the smoke constituents isolated from <i>Leonotis leonurus</i>	Baudry Nsuala	
11h40-11h50	Phytochemical profiling and the wound healing potential of five <i>Bulbine</i> species using <i>in vitro</i> and <i>in vivo</i> bioassays	Ramoagi Segone	
11h50-12h00	The neuroprotective and neurorestorative effects of <i>Sceletium tortuosum</i> extracts on neurotoxin-induced deficits in zebrafish larvae	Keagile Lepule	
12h00-12h10	Assessing the safety of selected South African medicinal plants through zebrafish embryotoxicity assays	Kevine Kanama	
12h10-12h20	South African medicinal plants and probiotics: a potential solution to <i>Helicobacter pylori</i>	Sarhana Dinat	
12h20-12h30	Antioxidant and anticancer potential of <i>Cotyledon orbiculata</i> crude extracts on cervical cancer cells	Thabang Marema	
12h30 -13h30	Lunch Break: Skukuza Safari Lodge Hotel		

13h30-15h00	Workshop 1: Ethnobotanical Methodology	Workshop facilitators: ♦ Heike Vibrans ♦ Marco Leonti
15h00 – 15h30 Tea Break		
15h30-17h00	Workshop 2: Commercialisation of medicinal plants	Workshop facilitators: ♦ Thomas Brendler ♦ Ulrich Feiter ♦ Cyril Lombard
17h00	End of Day 3	
19h00-	Dinner 3: Cattle Baron Restaurant	



Thursday, 31 August 2023

Annual IPUF Business Meeting

The IPUF Business Meeting will be held in the Main Hall of the Nombolo Mdhuli Conference Centre, Skukuza Rest Camp, Kruger National Park. All members and interested persons are welcome to attend the meeting, which will be held on Thursday, 31 August 2023, at 8h00.

During this meeting, those in attendance will decide the location and the topics of the symposia for the next IPUF conference. Delegates are encouraged to participate in this important process by proposing a location and a venue for the 2024 conference. This is also an appropriate time to ensure that topics or symposia of particular interest to IPUF members receive the necessary attention in planning the programme for 2024.

Annual IPUF Business Meeting

Agenda:

- 08h00-08h50**
1. Welcome
 2. Acknowledgements
 3. IPUF 2024 – Venue
 4. 2024 Theme
 5. IPUF symposia themes
 6. Plant product display
 7. Future plans for IPUF
 - a. Nominations/voting for the IPUF Chairman
 - b. Nominations/voting for the IPUF Vice-Chairman
 - c. Nominations/voting for the IPUF Treasurer
 - d. Nominations/voting for the IPUF Secretariat
 8. General

Plant product display

An opportunity is provided for individuals or companies to display and/or sell products/crafts relevant to indigenous plant use. Please contact ipuf@uj.ac.za for a stand. The product display will continue throughout the conference in the Main Hall, with time during the breaks for interested persons to ask questions directly to the exhibitors.



Keynote Session 4: Medicinal Plant Chemistry Chairperson: Ben-Erik van Wyk		
09h00 - 09h30	Red hot compounds from the red-hot poker plant, <i>Kniphofia</i> , and related taxa	Abiy Yenesew
09h30 - 10h00	Turkish Rose Oil – Yesterday and Today	K. Hüsnü Can Başer
10h00 - 10h30	The South African medicinal plant research landscape – reflecting on the past 25 years	Alvaro Viljoen
10h30 - 11h00	Tea Break	

Session 8 - Biological Activity & Medicinal Plant Chemistry 4 Chairperson: Sandy van Vuuren		
11h00-11h10	<i>Cordia grandicalyx</i> and its effect on glucose uptake by cells	Alinah Chauke
11h10-11h20	Biocidal effect and time-kill kinetics of extract and fractions of <i>Leonotis ocymifolia</i> (Lamiaceae) against selected pathogens	Mariam Oyedeji-Amusa
11h20-11h30	Inhibition of methicillin-resistant <i>Staphylococcus aureus</i> (MRSA) and Extended-spectrum beta-lactamase (ESBL) strains of <i>Escherichia coli</i> and <i>Klebsiella pneumoniae</i> by selected <i>Combretum</i> spp.	Ian Cock
11h30-11h40	<i>In vitro</i> assessment of biological activities of selected indigenous plant species used for management of respiratory tract infections and symptoms	Jessica Mnisi 
11h40-11h50	A possible solution to the dilemma, that traditional healers do not have extractants for biologically active compounds in plants, applied to tick control	Kobus Eloff
11h50-12h00	Phytochemical analysis, antioxidant potential and anti-mycobacterial evaluation of selected medicinal plants traditionally used in Limpopo province	Potsiso Koma 
12h00-12h10	Diversity, antimicrobial and extracellular enzymatic activity of endophytic fungi isolated from the stems of <i>Kirkia acuminata</i>	Mfundo Magagula 
12h10-12h20	Influence of seasonal and geographic variation on the chlorogenic acids content of <i>Helichrysum aureonitens</i>	Wilson Adeosun 

12h20-12h30	Identification and characterisation of compounds with antimycobacterial activity from the leaves of <i>Dombeya rotundifolia</i>	Matsilane Mashilo	
12h30-13h30	Lunch Break: Skukuza Safari Lodge Hotel		

Session 9 - Biological Activity & Medicinal Plant Chemistry 5

Chairperson: Namrita Lall

13h30-13h40	The holistic anti-ageing potential of plant extracts used traditionally for skin trouble	Bianca Payne	
13h40-13h50	Abiotic stress tolerance and symbiotic effectiveness of native rhizobia nodulating soybean (<i>Glycine max</i> L.) in Ghanaian soil	Mmatladi Mnguni	
13h50-14h00	Evaluation of the estrogenic activity of rooibos tea	Sasha Marais	
14h00-14h10	<i>In vitro</i> antifungal activity of fractions from the bark of <i>Albizia versicolor</i>	Tryphina Ramavhale	
14h10-14h20	The effect of phenological growth stage on the antioxidant, cytotoxicity and metabolic variation in <i>Buddleja saligna</i>	Maboka Mabusela	
14h20-14h30	Antibacterial properties of plant-derived nanoparticles against multidrug resistance bacteria	Tesleem Abolarinwa	
14h30-14h40	Utilisation of plants for crop protection in South Africa: an appraisal of antifungal effect	James Mwinga	
14h40-15h00	Tea Break		

Session 10 – Uses & Conservation

Chairperson: Lerato Seleteng-Kose

15h00-15h10	An overview of the ethnobotanical uses of selected members of the Apocynaceae family in southern Africa	Letlhogonolo Sello	
15h10-15h20	An overview of plants used for the management of crop pests and diseases in sub-Saharan Africa	Kutullo Shai	
15h20-15h30	South African medicinal plants used for the treatment of men's urological, urogenital, and reproduction health-related conditions	Mompati Chakale	
15h30-15h40	Developing the Biodiversity Management Plan for <i>Pelargonium sidoides</i>	Kate Mole	
15h40-15h50	Inventory of medicinal plants in Africa: a comparative analysis	Sibonelo Mbanjwa	

15h50-16h00	Insecticidal effects of botanical powders on <i>Sitophilus zeamais</i>	Sizwe Ngobeni
16h00-16h10	Lessons from the Warburgia conservation model – are we running out of time for people and nature?	Louise Swemmer
16h10-16h20	Quantification of phenotypic plasticity for the improvement of okra (<i>Abelmoschus esculentus</i>) collection for yield and associated traits	Abe Gerrano
16h20-16h45	Student Awards and Best Poster Awards	
16h45	End of Day 4	
17h00-19h00	Sundowners and Game Drive	
19h00-	Gala Dinner – Bush Braai	



Invited Keynote Speakers





Prof Kemal Hüsnü Can Başer

Professor Dr Kemal Hüsnü Can Başer, born in 1949 in Çankırı, Turkey, is an esteemed pharmacist and pharmacognosy professor. He completed his Ph.D. from the University of London's Chelsea College (now King's College) in 1978. For more than thirty years, he was affiliated with Anadolu University, serving as an associate professor, full professor, and the Dean of the Faculty of Pharmacy. He also initiated the Anadolu University Medicinal and Aromatic Plant and Drug Research Centre. Currently, he's associated with Near East University, Nicosia, N. Cyprus, as a pharmacognosy professor and head of the Department of Pharmacognosy at the Faculty of Pharmacy, as well as the director of the Graduate Institute of Health Sciences and the Institute of Graduate Studies.

Prof. Başer has held significant positions in several organizations. He served as the president of the International Council for Medicinal and Aromatic Plants and the Academy of Pharmacy of the Turkish Pharmacists' Association. He's been a board member of the International Society for Medicinal Plant and Natural Product Research and an expert in the European Pharmacopoeia's Group 13B (Herbal drugs) and Traditional Chinese Medicine Working Party. His research interests revolve around botanical, ethnobotanical, chemical, technological, and biological aspects of medicinal and aromatic plants, and the biotransformation of flavours and fragrances, particularly essential oils and alkaloids. He has an extensive publication record, with over 883 research papers, over 1058 national and international symposium communications, and 6 book contributions. His works are highly cited, both on SCI and Google Scholar, with H-indexes of 53 and 84, respectively.

Over his distinguished career, Prof. Başer has been recognized with numerous awards, including the Distinguished Service Medal by IFEAT, Memorial Silver Medal by Scientific Partnership Foundation, Academician Award by Pharmacy Awards, and Rotary International Centennial Success in Career Special Award. The Academy of Pharmacy of the Turkish Pharmacists Association and the Scientific and Technological Research Council of Turkey have also honoured him. He was named as the 35th in the book "100 Turks Leading Science," and four plants have been named in his honour, testifying to his invaluable contributions to pharmacognosy.

Turkish rose oil – Yesterday and Today

K. Hüsnü Can Başer

Near East University Faculty of Pharmacy, Nicosia (Lefkosa), N. Cyprus

Abstract: Rose oil is obtained by hydrodistillation of freshly picked roses from *Rosa damascena* Miller (Rosaceae). *Rosa damascena* (Damask rose, oil rose, Isparta rose) is a cultivated shrub grown for its highly precious essential oil. Turkey and Bulgaria are two major producers of rose oil for the World markets. Turkey also produces, and exports rose concrete, rose absolute, rose water and phenyl ethyl alcohol from fresh roses.

The lecture will give a brief history of oil roses and rose products, ethnobotany and trade information, and pharmacological and biological activities of rose oil and its main constituents. Traditional and modern rose oil distillation and extraction techniques, such as supercritical extraction, phytosol extraction and headspace trapping techniques, will be briefed.





Prof David Katerere

Professor David Katerere is the Research Platform Chair of Pharmaceutical and Biotech Advancement in Africa (PBA2) at Tshwane University of Technology. He is co-director of the recently established CSIR / TUT Cannabis Research Centre and the Association of African Medicinal Plants Standards (AAMPS) director. Prof Katerere holds a PhD in Pharmaceutical Science from the University of Strathclyde, Scotland. He has worked in pharmaceutical and biotech practice and research in the past 25 years in four countries on three continents. He has several inventions to his name, including the nutraceutical, Niselo and CovidConnect App for use in clinical trials and post-recovery and KovaNix hand and surface sanitiser. He has published over 50 journal articles and is co-editor of three books: *Ethnoveterinary Botanical Medicines* (T&F) (2010), *Systems Analysis Approach for Complex Global Challenges* (Springer) (2018) and *Traditional and Indigenous Knowledge for the Modern Era* (T&F) (2019).

He is a member of advisory committees of SAHPRA and the Global Health Supply Chain Consortium, co-founded by faculty at University of Michigan and University of Southern California. Prof Katerere teaches and researches across the pharmaceutical and biotech value chain including product development from medicinal plants (for food, nutraceuticals and medicines) and clinical testing, substandard and falsified medicines / vaccines and medicine governance. He is a past competitive Toastmaster and President of Pretoria Capital Rotary Club.

From compounds to products – lessons learnt on the road to Timbuktu

David R. Katerere

TUT Research Platform Chair, Department of Pharmaceutical Science, Tshwane University of Technology, Pretoria, South Africa

Abstract: Medicinal plant researchers and phytochemists place a huge focus on testing extracts and compounds for biological activity. Literature shows that over 5000 papers have been published in South Africa over the past 25 years which report, variously, antimicrobial, antioxidant, anti-cancer, and anti-diabetic effects in (mostly) *in vitro* assays. In the same period, there has not been a correspondingly large number of molecules or extracts being tested clinically or reaching the market as cosmetic, nutritional, or medicinal products. This presentation seeks to pose this uncomfortable truth and discuss a few case studies that illustrate what the IPUF community should focus on to advance indigenous plant research, development, and commercialisation. Examples will be drawn from some personal and professional examples, including working with *Sutherlandia* for topical products, developing nutraceuticals and feeds from indigenous grains and fruit waste, clinical testing of traditional medicines (including honey products) and supporting the industry in the cannabis value chain. It is hoped that these experiences will infuse the tenets of pharmaceutical science (i.e., standardisation, formulation, medicine regulation, etc) in indigenous plant use research and innovation.





Prof Namrita Lall

Professor Namrita Lall is a Research Chair at the University of Pretoria and has been placed in the Essential Science Indicators list of the top 1% of publication outputs (citations) in the disciplines of Pharmacology and Toxicology. She has recently been listed as part of Stanford's University List of the Top 2% Scientist of the World. Six start-up companies named "Bio Indigenous Solution" (a Mamelodi community-based company in Pretoria), "Tone Tribe", "Blyde Botanics", "Anoiksen", "Scholareview" and "Looksci" (formed by young postgraduates) resulted from Prof Lall's research programme.

She has international recognition for her research into the potential of medicinal plants for pharmaceutical and cosmeceutical purposes. Two pharmaceutical products for skin-hyperpigmentation and liver protection have been commercialised internationally; another twelve are close to commercialisation. Several License Agreements have also been signed for various activities researched under Prof Lall's supervision. She has published more than 177 research articles, 13 patents, more than 70 book chapters, H-index is 48 and RG score is over 45 (Top 5%). The publishers have published three books on medicinal plants edited by Prof Lall; 'Elsevier' and 'Taylor and Francis'.

Among several awards received in recognition for her work, a few are "**The Order of Mapungubwe**", South Africa's highest honour from the Honorable South African President Jacob Zuma (April 2014), and the UNESCO-L'Oreal Award for Women in Science (one of the 10 selected candidates internationally, March 2002, in Paris).

Methodology and Ethics of Ethnobotany: The journey of Natural Product development

Namrita Lall^{a,b,c,d}

^a Department of Plant and Soil Sciences, University of Pretoria, Pretoria 0002, South Africa

^b School of Natural Resources, University of Missouri, Columbia, MO, United States

^c College of Pharmacy, JSS Academy of Higher Education and Research, Mysuru, Karnataka, India

^d Senior Research fellow, Bio-Tech R&D Institute, University of the West Indies, Kingston, Jamaica

Abstract: plants hold untouched potential for the identification and development of novel therapeutics and natural products. However, there are many steps and obstacles which should be overcome to ensure the production of ethically sourced and effective plant-derived products. This seminar will cover various pre-developmental stages encountered within the natural product development journey, including the scientific and research process (including in-laboratory case studies), consisting of; problem identification, plant selection, pre-clinical efficacy and safety testing, formulation, characterisation and stability testing, and optimisation of novel therapeutics derived thereof. The talk will discuss the identification of medicinal plants, based on traditional use, and acquiring of source material in collaboration with traditional healers. Furthermore, this discussion will address the process and challenges which occur when acquiring bioprospecting permits and licensing agreements, as well as the importance and ethical need for establishing Benefit Sharing Agreements, Material Transfer Agreements, and the Indigenous Knowledge Systems (IKS) Policies involved to ensure IKS preservation and respect, and adequate royalty sharing to the relevant parties involved. The challenges faced during the establishment of patented technologies, and identifying appropriate manufacturers and initiation of licencing agreements for product development will also be discussed. The seminar further reviews the different types of complementary and natural product medicines, and will elaborate on the regulation, establishment, and appropriate labelling and marketing of plant-derived cosmeceuticals and pharmaceuticals in Southern Africa, and how it compares to natural product regulations set in place by the U. S. Food and Drug Administration (FDA).





Prof Marco Leonti

Professor Marco Leonti graduated in Biology from the University of Basel (CH) in 1996. From 1999 to 2000 he conducted ethnomedical and anthropological field research in Mexico. He got his PhD degree in pharmacognosy from the ETH (CH) in 2003, with a study focusing on the ethnopharmacological, phytochemical and biological evaluation of indigenous medicinal plants. After post-doc positions at the London School of Pharmacy and the University of Cagliari (Italy), he was made Associate Professor at the Department of Biomedical Sciences of the University of Cagliari, where he teaches pharmacognosy. He is currently engaged in the isolation and structure elucidation of cannabimimetic, antibacterial, and cytotoxic secondary metabolites from plants and traditional medicines. His research follows evolutionary approaches and focuses mainly on the cultural history of human-plant use and the rationale of human plant selection for medicine and nutrition.

Recommended standards for conducting and reporting ethnopharmacological field studies

Marco Leonti

Department of Biomedical Sciences, University of Cagliari, Cittadella Universitaria, 09042, Monserrato (CA), Italy

Abstract: What are the minimum methodological and conceptual requirements for an ethnopharmacological or ethnomedical field study? How can the results of ethnopharmacological field studies be reported so that researchers with different backgrounds can draw on the results and develop new research questions and projects?

I focus on conducting and reporting ethnopharmacological field studies on medicinal plants or *materia medica* and associated knowledge of a specific people or region. I will highlight the most frequent problems and pitfalls encountered in published literature, my own experience and insights gained from peer-reviewing field studies.

Primary ethnopharmacological field data need to be collected and presented in a transparent and comprehensible way embedded in a relevant background. This includes 1) Specific and concise research questions, 2) Information about the ethnographic and historical context, epidemiological situation, and degree of access to modern medicine and healthcare facilities, 3) Description of the methodology used to answer the research questions, 4) Proper plant use documentation, linked to voucher specimens, and 5) Qualitative and quantitative assessment of the collected relying on use-reports as basic units. Importantly, research needs to be ethical and legal and follow local and national regulations.





Prof Nokwanda (Nox) Makunga

Professor Nokwanda P. Makunga (PhD) is a Professor of Botany in the Department of Botany and Zoology at the University of Stellenbosch. She is a Group Leader for Medicinal plant biology / Medicinal plant research. Her research is centred around using a multidirectional approach that combines the areas of biotechnology, ethnopharmacology and phytochemistry. During her tenure at Stellenbosch University (2005 to current), she established the area of medicinal plant biotechnology. In her research group, they use cutting-edge multi-omics technologies where they try and understand plants from the genetic level through to their responses to the environment to allow the production of quality-assured, economically suitable phytopharmaceuticals. She has an interest in people-plant interactions and so the research is also focused on medicinal plants, their cultural significance and opportunities presented for socioeconomic development. In 2011, she was a recipient of the National Science and Technology Forum (NSTF) Annual Award under the category Distinguished Young Black Researcher (Female), TW Kambule NRF award for 2011/12, and a Fulbright Research Scholar where she was positioned at the University of Minnesota in 2017 to 2018. In 2022, she was a finalist in the NSTF Awards for science communication. Prof Makunga is a founding member of the social advocacy movement founded in 2020 (Black Botanists Week) that seeks to promote Black botanists, globally, whether they be formally or informally trained.

Delving into South African medicinal plant treasures using a biotechnological toolkit

Nokwanda Makunga

Department of Botany and Zoology, Faculty of Science, Stellenbosch University, Stellenbosch 7600, South Africa

Abstract: South Africa has an incredible floral heritage that has a strong history of being important to local people for diverse range of ethno-cultural uses and those plants that are exploited for medicinal purposes have also encouraged entry of new natural products into global markets. There are thus unique opportunities that are presented by interfacing various biotechnologies to study medicinal plants of South Africa, more especially with the intention of generating socioeconomic benefits. This talk will touch on historical aspects linked to the exploitation of medicinal plant resources and define the importance of indigenous knowledge and medicinal plants when interfaced with biotechnology in relation to the bioeconomy strategy of South Africa. Using specific examples from medicinal plants that occur in the greater Cape Floristic Region, various studies are thus presented and summarized. The application of LC-MS-based metabolomics technologies has been useful as a qualitative tool, enabling fast detection and a reliable method of studying mesembrine alkaloids produced by *Sceletium tortuosum* (Aizoaceae). Microplant and callus cultures also accumulate a wide array of these alkaloids. By applying both non-targeted and targeted metabolomics, influence of varied microenvironments on the phytochemistry and cytotoxicity of *Lessertia* (*Sutherlandia*) *frutescens* (Fabaceae) plants is evident. Proteomic analyses under stressed conditions provided new insights into the impacts of salinity and drought stress with respect to both central and specialized metabolism of *L. frutescens*. Combining microsatellite and chemometric analyses confirmed biogeographical-based genetic structure amongst populations of *Dodonaea viscosa* (Sapindaceae) and *Aspalathus linearis* (Fabaceae), pinpointing chemotype(s) that may fit domestication and industrialization for the production of phytopharmaceuticals. These studies illustrate the exciting potential of medical plants of South Africa that still remain chemically under explored.





Prof Annah Moteetee

Professor Annah Moteetee holds a BSc degree (Biology and Chemistry) from the National University of Lesotho (NUL), an MPhil degree in Botany from Queen Mary and Westfield College, University of London, United Kingdom, and a PhD degree in Botany (Plant Taxonomy) from the Rand Afrikaans University (now University of Johannesburg; UJ), Johannesburg, South Africa. She joined the Department of Botany and Plant Biotechnology, University of Johannesburg, as a Technical Lecturer in January 2005. She climbed through the ranks to Senior Lecturer (2006-2013), Associate Professor (2013-2018) and Full Professor (2018-current). She was appointed as Vice-Dean: Teaching and Learning in the Faculty of Science (2011-2015), became Acting Dean of the Faculty (2013-2014) and held the position of Senior Director, Postgraduate School, University of Johannesburg (2021-2023). She was recently elected to serve as a member of the USAf Community of Practice for Postgraduate Education and Scholarship (CoP PGES) Steering Committee (2023-2025). Prof Moteetee has just been appointed as Executive Dean of the Faculty of Science at UJ (from 1 August 2023). From January 2017-January 2021 she served as Head of Department: Botany and Plant Biotechnology. Annah served on the Teaching Portfolio Assessment Committee (TPAC) on behalf of the Faculty of Science for five years and participated as a member of the Committee for three years. She has supervised five doctoral, 16 masters, and 15 Honours students to completion. She has authored and co-authored over 60 journal articles and contributed to over 60 national and international podium and poster presentations. She has served on numerous NRF evaluation panels for postgraduate student funding applications, as well as research funding, and rating applications. She has also acted as an external examiner for master's dissertations and doctoral theses from several universities nationally and internationally. She was involved in the evaluation of professorial applications for Bindura University of Science Education (Zimbabwe), University of Zimbabwe, University of Pretoria, North-West University, and Sultan Qaboos University (Oman). Annah is a member of review boards for two journals, namely South African Journal of Botany (Editorial Board) and Systematic Botany (Associate Editor) and has reviewed articles for numerous international journals.

Medicinal plants of Lesotho: A review of ethnobotanical, pharmacological and conservation studies

Lisebo Motjotji¹, Annah Moteetee² and Lerato Seleteng-Kose^{2,3}

¹Department of Environmental and Geographical Science, University of Cape Town, Private Bag X3, Rondebosch 7701, Cape Town, South Africa

²Department of Botany and Plant Biotechnology, University of Johannesburg, P. O. Box 524, Auckland Park 2006, Johannesburg, South Africa

³Department of Biology, National University of Lesotho, P.O. Roma 180, Lesotho

Abstract: Of the approximately 2,076 plant species occurring in Lesotho, about 355 are used for medicinal purposes. Many communities in the country, mainly in rural areas with limited access to health facilities, rely on traditional medicine as primary healthcare. Several publications provide helpful information on plants used for medicinal purposes in Lesotho. These include documentation of the plants, investigation of their therapeutic potential to provide scientific validation for their use, and conservation status. However, a synthesis of all the studies conducted so far has hitherto not been undertaken. The current study aimed to provide a systematic review of ethnobotanical, pharmacological, and conservation studies undertaken on medicinal plants of Lesotho. The synthesis brings together published and unpublished literature sources, thus providing a comprehensive database for studies conducted on Lesotho plants. Furthermore, it identifies existing knowledge gaps on research that has been carried out on the species and thus provides opportunities for further research, especially in the search for new natural products. Information was gathered from published and unpublished literature sources, with the earliest publication dating back to 1917. Data was collected through keyword search using accessible literature sources from Google Scholar, Science Direct, Scopus and PubMed. Books, dissertations, theses, technical reports were also searched. Keywords used for the search were Lesotho, in conjunction with medicinal plant and traditional medicine. To be eligible for inclusion in the current review, a literature source was expected to have assessed ethnobotanical use, biological/pharmacological activity (e.g., antimicrobial activity), phytochemistry, toxicology) or conservation status of any Lesotho plant species used traditionally. A total of 116 records were identified, of which 76 were included in the review. Thirty-one ethnomedicinal, 14 pharmacological (nine antioxidant, three anti-inflammatories, and five antimicrobial activities), six phytochemical, and 15 conservation studies on plants of Lesotho were scrutinised. It is important to note that some studies evaluated more than one pharmacological activity. Ethnomedicinal studies show that numerous plants are used for medicinal purposes in Lesotho, however studies to scientifically validate their traditional use has remained far behind. Many of Lesotho's important medicinal plants have been assessed for pharmacological activity, providing scientific proof for their use. However, there are

numerous gaps in the number and type of pharmacological and phytochemical studies that have been conducted. These gaps offer endless opportunities for researchers working in these fields. In addition, the conservation status for most of these plants is unknown, therefore, a detailed red data listing of Lesotho plants, particularly those used in traditional medicine, is recommended.

Important note: Unfortunately, Prof Moteetee's recent appointment as the Executive Dean of the Faculty of Science at the University of Johannesburg prevents her from attending the conference. The lecture will be presented by **Dr Lerato Seleteng-Kose** from the University of Lesotho.





Mr Denzil Phillips

Lawrance Denzil Phillips has worked in the field of botanicals and natural products in Africa, Asia and the Caribbean for more than 35 years. Denzil co-founded High Value Horticulture plc in 1989 and launched Denzil Phillips International Ltd (DPIL) in 1998. DPIL has undertaken consultancy assignments with many of the world's leading natural product, beauty care and phyto-pharmaceutical companies. It also advised many African and Caribbean governments and international agencies such as World Bank, Commonwealth Secretariat and the European Commission (EU).

Denzil now lives in Barbados where he works on building bridges between Africa and the Caribbean in the field of high value crops. He was founder Director of the Association of African Medicinal Plants Standards (AAMPS) an organisation dedicated to promoting quality standards for African medicinal plants, founder Director of the Global Frankincense Alliance (GFA) and is an advisor to the Spa and Wellness Association of Africa (SWAA) and the Global Wellness Institute (GWI)

Denzil has worked in more than 55 countries, many of them in Africa. This includes Egypt, Morocco, Ghana, Burkina Faso, Gambia, Kenya Uganda and South Africa. He specialises in the conservation and sustainable sourcing of high-value natural products, many of which are indigenous plants. He also helped organise the first Medicinal Plants Business Forum for Commonwealth Africa in Kirstenbosch in 2000 and the World Congress on Medicinal and Aromatic Plants in Cape Town in 2008 (WOCMAP IV) Denzil has participated in many IPUF meetings during in his long career and is passionate about sharing his knowledge with young African and Caribbean researchers in the field of natural products (www.denzil.com).

Journey with my plants - A 45-year botanical adventure: *Successes, failures and lessons learnt*

Lawrance Denzil Philips

Denzil Phillips International Ltd., Louis Mar, Lisbonvale, Silver Sands, Barbados

Abstract: On a grey winters day in 1977 I started my career at the Tropical Products Institute in central London. Little did I realise this was the beginning of a global adventure involving more than 100 botanically related projects in more than 30 countries - 10 of which were African. From small island states like Mauritius and Barbados to land-locked kingdoms like Uganda and Nepal, from poverty-stricken countries like Burkina Faso and Haiti to oil rich states like Oman and UAE. Cultural and geographic diversity has always been part of my life and even more important the diversity of clients and projects has been tremendous. From eccentric millionaires and Arab Sheiks to grass root cooperatives, from giant multinational banks and corporations to struggling NGOs and charities. And the variety species and natural products particularly high value, indigenous or underutilised plants has been tremendous.

This **journey with my plants** took me quite literally to the four corners of the earthand back! So how can one make such a personal journey into something of value to those scientists and entrepreneurs who are just embarking on a career in botanicals and natural products. That is the challenge and purpose of this presentation.

Using six examples of projects I helped create and launch during my career I will try to discover what makes a good project and what makes a poor one , why some are sustainable while others are short lived, why some are of long term scientific importance while others perhaps are just a fashion, why some make money and others don't and perhaps most important of all why some help the impoverished while others just exploit them. The six projects chosen are all very different, yet they include many lessons I believe students and young entrepreneurs will not find in their textbooks or classrooms.

The six projects:

1. Village Food Systems in West Africa- living and working with Gambian farmers
2. Vanilla Wars - The struggle to launch Ugandan vanilla onto the world market
3. Banning Kava Kava - The politics and economics of natural medicine
4. The African Herbal Pharmacopoeia - The power of networking
5. Grenada Nutmeg - Branding plants from commodity to tourism product
6. Saving Frankincense - Sustainable and ethical solutions to plant conservation



Prof Milingoni Peter Tshisikhawe

Professor Milingoni Peter Tshisikhawe is an Associate Professor and Interim Head of the Department of Biological Sciences in the Faculty of Science, Engineering and Agriculture at the University of Venda. He completed his junior degrees to Master of Science in Botany at the University of Venda. He graduated his PhD in Plant Science at the University of Pretoria and his Postgraduate Diploma in Higher Education with Rhodes University.

He is a plant ecologist whose research interest is centred around indigenous plant use and the sustainability thereof. He is fascinated by the continuous use of plant resources in the daily lives of communities. Interacting with communities in establishing reasons behind utilization of plants afford him the basis of floristic composition studies. He has presented his work in numerous national and international conferences. He is a researcher who has graduated several postgraduate students (MSc and PhD) and published extensively in accredited peer-reviewed journals of plant science. He had mentored postdoctoral and junior staff members over the years.

Methodology and ethics of ethnobotany: working with indigenous knowledge holders

Milingoni Peter Tshisikhawe

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Abstract: People had a very strong relationship with their nature since time immemorial. This is the relationship that had continued to develop with time and experience. The relationship has therefore generated a body of knowledge built through such an experience. This presentation highlights the approach of ethnobotanists as they engage with traditional knowledge holders in their research work. A lot of information in this presentation comes from desktop studies and experience gained over a period while working with different communities. Different methodologies have been adopted and adapted as the field of ethnobotany develops. These methodologies at times crossed path with the aspirations of knowledge holders. In some cases, some methodologies are seen to ignore the ethical issues that they sought to respect at all times. However, most of these methodologies have been able to grow this body of knowledge to its current state. Indigenous knowledge should serve as a basis of high science rooted on it. Methodologies that are develop in order to understand the use of plants should consider the journey already travelled in building this knowledge. In conclusion, building of knowledge should always considers and respects the knowledge already in place.





Prof Alvaro Viljoen

Professor Alvaro Viljoen was born in 1969, in Pretoria, South Africa. Completed a BSc, BSc Hons (*cum laude*) and MSc (*cum laude*) in Botany at Stellenbosch University (SA). In 1994 Alvaro commenced with a PhD at the University of Johannesburg on the chemotaxonomy of the genus *Aloe*. In July 2005 he was appointed as a research fellow in the Department of Pharmaceutical Sciences, Tshwane University of Technology (Pretoria). More than eighty post-graduate students have graduated under his supervision since 2002.

His research interest is the phytochemistry and biological activity of medicinal and aromatic plants indigenous to South Africa. He has authored / co-authored >290 peer-reviewed papers (h index 50) mostly on the phytochemical exploration and pharmacological activity of indigenous medicinal and aromatic plants. He has been elected on to the editorial board of the Journal of Essential Oil Research (Francis & Taylor), Phytochemistry Letters (Elsevier), and is the Editor-in-Chief of the Journal of Ethnopharmacology (Elsevier) since 2017. In October 2013 Alvaro was awarded the National Research Chair in Phytomedicine a position which he holds concurrently as Director of the SAMRC Herbal Drugs Research Unit in South Africa.

The South African medicinal plant research landscape – reflecting on the past 25 years

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Abstract: South Africa's diverse flora and extensive local use of African traditional medicines has created unique research opportunities on medicinal plants for local and international scientists. Despite access to this extra-special botanical heritage, interfaced with equally rich indigenous knowledge systems, it remains concerning that very few indigenous botanicals have been converted into commercial success initiatives. Basic research underpins any commercialization program, which includes preclinical studies and developing a knowledge base on the safety, quality, and efficacy of a botanical extract. The Indigenous Plant Use Forum (IPUF) has been an excellent platform to observe the growth and development of local pharmacognosy research in South Africa. By default, pharmacognosy is a multidisciplinary research field and IPUF remains one of the few meetings uniting researchers from diverse, yet complementary fields, in one forum to discuss botany, chemistry, pharmacology and commercialization aspects of indigenous botanicals. A brief overview of medicinal plant research over the past 25 years in South Africa will be presented. The investment of the National Research Foundation (NRF) and the South African Medical Research Council (SAMRC) in phytomedicine research at the Tshwane University of Technology will be highlighted to illustrate that medicinal plant research extends beyond basic research but also developing human capital and research expertise in the field.





Prof Heike Vibrans

Professor Heike Vibrans is a botanist of German origin residing in Mexico, with degrees from the University of Bonn, Germany. She works as a Professor at the Colegio de Postgraduados, an agricultural postgraduate school in Texcoco, Mexico. She participates in the Botany and Agroecology Graduate Programs and teaches the Ethnobotany and Economic Botany courses.

Her main areas of interest are ethnobotany and secondary vegetation/weeds. In ethnobotany, with her students she studies subjects related to traditional agriculture and the use of wild-growing resources. On the topic of secondary vegetation, she is interested in the biology, distribution, communities and uses of weeds and invasive plants. She has more than 90 publications, numerous graduate students, is editor of the digital flora *Malezas de México* (Weeds of Mexico), and has two blogs, *Jehuite* on wild plants and *Cuexcomate* on useful plants. Currently, she serves as president of the Botanical Society of Mexico until March 2023; she is also president-elect of the Society for Economic Botany (recently renamed as the Society for Ethnobotany).

Contemporary Mexican ethnobotany: advances in the study of agrobiodiversity

Heike Vibrans

Posgrado en Agroecología y Sustentabilidad, Campus Montecillo, Texcoco, Mexico

Abstract: Mexico, like South Africa, is highly diverse biologically and culturally. Also, it is one of the original centers of origin of agriculture. Ethnobotany has grown substantially as an academic subject. Agrobiodiversity, domestication and traditional agriculture have become a major focus, partly due to outside incentives (Convention on Biological Diversity and others) but also to previous pioneering work by Mexican and foreign researchers. Spanish has grown as a means of communication and has stabilized at about 25 % of published research. This talk will address three select areas: a significant contribution to theory, an emerging field (economics of traditional agroecosystems) and outstanding collaborative projects and outreach efforts. The development and consolidation of the concept of *in situ* domestication in Mesoamerica can be attributed to a long-term project of a major university in a diversity hotspot (the dry Tehuacán Valley in south-central Mexico). The group has shown that more than 100 species of their area have uncultivated but differentiated populations due to selective management by local people. In-depth studies of the mixed-crop maize systems with their field borders have shown that this type of agriculture can be highly productive under low wage conditions; it has a much higher cost-benefit ratio and a more stable production. - Finally, large collaborative projects, both on the use and documentation of agrobiodiversity, are showing results. Examples are the webpage of the National Commission for the Knowledge and Use of Biodiversity (CONABIO, <https://www.biodiversidad.gob.mx/>) and the growth of traditional ingredients in commercial gastronomy.





Prof Rachel Wynberg

Professor Rachel Wynberg is a Professor in the Department of Environmental and Geographical Science at the University of Cape Town in South Africa where she holds a SARCHI Research Chair focused on Environmental and Social Dimensions of the Bio-economy. With a background in both the natural and social sciences, she has a strong interest in transdisciplinarity and community engagement across the humanities, arts and sciences. Her research spans topics relating to bio-politics and the biodiversity-based economy; seeds, farmers' rights and agrobiodiversity; knowledge politics, agroecology and food sovereignty; the governance of wild species; just and biodiverse bio-economies; emerging technologies; and ethics and equity in science and research.

As a scholar-activist and policy analyst, she has been involved in research and policymaking relating to access and benefit sharing since the inception of the Convention on Biological Diversity in 1992, advising governments, civil society organisations and international agencies. She continues to be actively involved with policy debates and civil society movements in southern Africa, serving on the Boards of Biowatch South Africa and the Environmental Monitoring Group, and is a founding partner of the regional Seed and Knowledge Initiative. She is currently an elected member of the Academy of Science in South Africa, a member of the High Level Panel for a Sustainable Ocean Economy (HLP) Expert Group, lead author for the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) Sustainable Use assessment, a Board member of the Union for Ethical Biotrade and co-Director of Voices for BioJustice, a collaborative initiative developing innovative approaches to build capacity and facilitate the direct, substantive and authentic contributions of local groups to policy design and implementation. Her publications include over 220 scientific papers, technical reports and popular articles, and five co-edited books and monographs. Her research outputs range from conceptual and theoretical frameworks, to review articles and those consolidating global case studies, contributions based on empirical data, and practical and grounded research outputs that are accessible to varied actors in the bio-economy, from local communities through to civil society organisations and policy-makers.

Embedding Social Justice in Ethnobotanical Research

Rachel Wynberg

SARChI Chair: Social and Environmental Dimensions of the Bio-economy, Department of Environmental and Geographical Science, University of Cape Town, South Africa

Abstract: Ethnobotanists must navigate a complex maze of ethical issues, ranging from the ways in which they engage with communities who hold traditional knowledge of plants, through the thorny terrain of commercialising interesting plant-based products. Biopiracy, meaning the misappropriation of genetic resources and traditional knowledge without consent or compensation, is increasingly under the spotlight, and new laws require researchers to forge so-called access and benefit-sharing agreements with knowledge and resource owners that are equitable and fair. Researchers are also faced with pressures to commercialise and patent their research, raising concerns about the increasing privatisation and enclosure of knowledge and biodiversity, and its ownership. Developments in biotechnology and the exponential increase in the use of genetic sequence data and information have further complicated this contested landscape, while in parallel innovative and democratic ways of working are evolving and linked to open-source science. Within the university context, engaged scholarship is emerging as a “third mission”, requiring researchers to work in non-extractive, collaborative and decolonial ways, to have a social impact, and to democratise knowledge. Combined, this situation presents a challenging climate within which ethnobotanists must operate, underpinning the need for appropriate training and curricula. Using examples from southern Africa, this paper describes the ethical quandaries of ethnobotanical research, locates them within contemporary political and social contexts, and suggests approaches for embedding social justice in ethnobotanical research and curricula.





Prof Abiy Yenesew

Professor Abiy Yenesew started his research career in Natural Product Chemistry at the Department of Chemistry, Addis Ababa University, Ethiopia. After completion of his PhD study in Nairobi in 1997, he was offered a position at the Department of Chemistry, University of Nairobi where he has remained to continue research (to identify anti-infective principles from East African plants, with a focus on malaria), teaching and postgraduate supervision (especially of Eastern African students). This has resulted in 111 articles in peer reviewed journals (h-index of 38, Citations 3624 in Google Scholar). He has also co-authored three books on medicinal plants of East Africa. While researching in this area, he has supervised 20 PhD and 37 MSc students to completion.

He is subject editor of *Phytochemistry Letters*, the official organ of the Phytochemical Society of Europe. As natural products chemist he is serving as Editorial Board member of the *Journal of Natural Products* and *Journal of Ethnopharmacology*. He has served as the Program Officer (2006-2009), and later as the Assistant Secretary (2009-2013) of a regional organization, the Natural Product Research Network for Eastern and Central Africa (NAPRECA). As one of the leaders of this network, he has been involved in organizing a number of symposia and workshops, and also coordinated postgraduate scholarships, which has promoted collaborative research in the region. In recognition of this he has been elected as a Fellow of the African Academy of Science as of February 2017.

Red hot compounds from the red hot poker plant, *Kniphofia*, and related taxa

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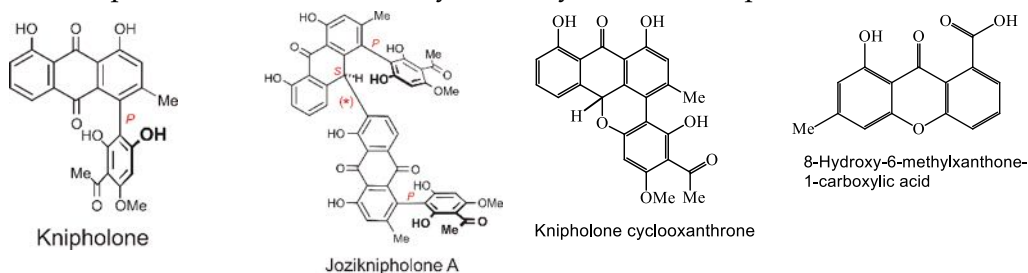
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Knipholone, the first 4-arylanthraquinone was discovered from the stem of *Kniphofia foliosa* (Asphodelaceae) in 1984¹. Since then a number of 4-arylanthraquinones have been isolated from this plant^{2,3} and other members of the Asphodelaceae, namely from *Bulbine*⁴ and from *Bulbinella* species⁵. Compounds belonging to this class of anthraquinones have rotationally hindered biaryl linkages. The absolute configuration of knipholone and the other members was established by the use of advanced quantum chemical CD calculations⁶. Recently the first dimeric arylanthraquinones, named joziknipholones A and B, have been discovered from the roots of *Bulbine frutescens*⁷. We have now reinvestigated *Kniphofia foliosa* and *Bulbine frutescens* and identified novel phenylanthraquinones, including joziknipholone A and knipholone cyclooxanthrone, and anthraquinone dimmers with remarkable biological activities^{8,9}. The roots of *Bulbine frutescens* also gave a new xanthone, 8-hydroxy-6-methylxanthone-1-carboxylic acid, whose structure was confirmed through X-ray crystallography and then used as a reference to propose the revision of six *seco*-anthraquinones into xanthenes¹⁰. The structures, antiprotozoal activities and cytotoxicity of these compounds will be discussed.

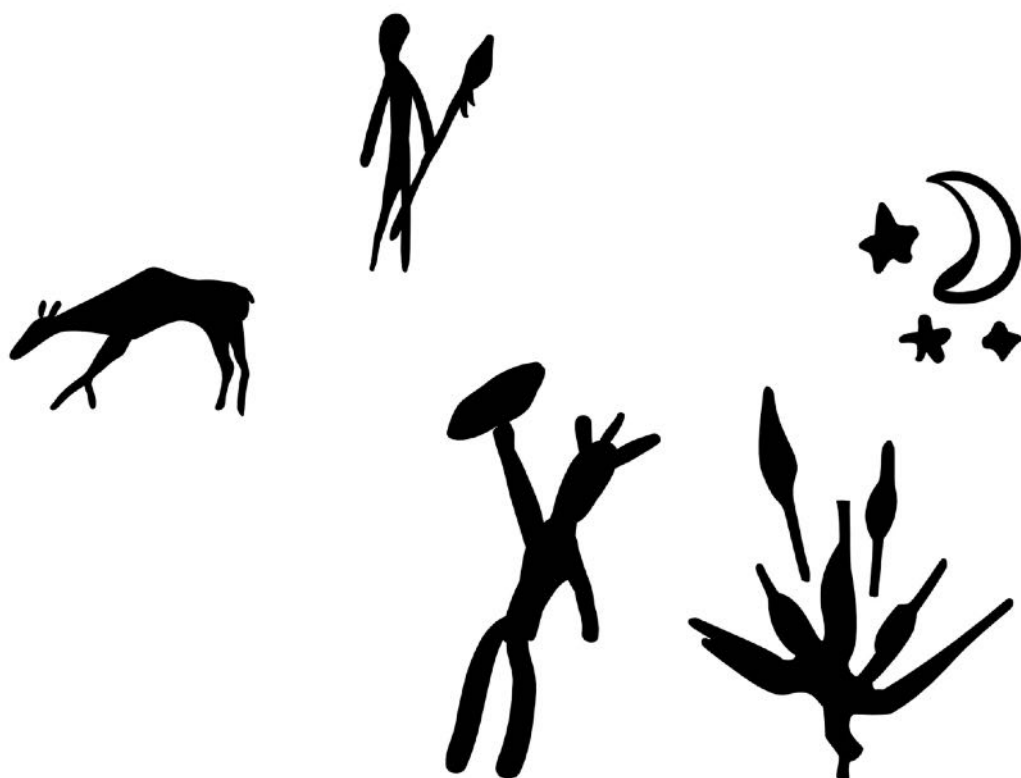


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References:

1. Dagne, and Steglich (1994) *Phytochemistry* 23: 1729-1731.
2. Dagne and Yenesew (1993). *Phytochemistry* 34: 1440-1441.
3. Yenesew, et al. (1994) *Phytochemistry* 37: 525-528.
4. Kuroda, et al. (2003) *J Nat Prod* 66: 895-897.
5. Mutanyatta, et al. (2005) *Tetrahedron* 61: 8575-8484.
6. Bringmann, G et al. (2007) *Tetrahedron* 63: 9810-9824.
7. Bringmann, et al. (2008) *Chem Eur J* 14: 1420-1429.
8. Abdissa, et al. (2013) *Phytochem Lett* 6: 241-245.
9. Induli, et al. (2013) *Nat Prod Comm* 8: 1261-1264.
10. Abdissa, et al. (2014) *Phytochem Lett* 9: 67-73

Workshop facilitators





Dr Thomas Brendler

Thomas Brendler has a consultancy business PlantaPhile®, which is based in the US, Germany, and the UK. It focuses on all aspects of herbal product development, registration and licensing. For the last 30 years, he has developed and managed projects for industry on the use of plants in medicine, food and cosmetics. As a consultant to the Millennium Challenge Corporation, the Centre for Development of Enterprise and the International Trade Centre he has been involved in the preparation, management and execution of various public funded research projects. In 2005 he co-founded the Association of African Medicinal Plants Standards and served as one of its directors until 2018. He is the editor-in-chief of the AAMPS African Herbal Pharmacopoeia (2010ff). Thomas has been an author of Herb-CD®, a digital encyclopedia of medicinal plants, and co-authored, edited and contributed to a wide range of publications on phytotherapy and natural product regulation, most notably “Physician’s Desk Reference for Herbal Medicines”, “Medicinal and Aromatic Plants of Indian Ocean Islands”, “A Practical Guide To Licensing Herbal Medicinal Products”, and the translation into English of the German Commission E monographs on medicinal plants.

He is a member of the editorial boards of Phytotherapy Research, Journal of Ethnopharmacology, and Frontiers in Pharmacology – Ethnopharmacology and a regular peer reviewer for a variety of scientific journals. From 2009-2010 Thomas spent one year as a visiting scholar at Rutgers University (NJ, USA), Department of Plant Biology and Pathology, Natural Product Research Group. He has received a PhD in Botany from the Faculty of Science at the University of Johannesburg on the commercialization of southern African medicinal plants. He is also associated with Traditional Medicinals, Inc., USA, as Principal Scientist R&D.





Mr Ulrich Feiter

Ulrich Feiter was born in 1959 in Germany and received his horticultural training in the country. He emigrated to South Africa in 1982 and worked with physically and mentally challenged adults in both Germany and South Africa. During this time, he developed a strong interest in culinary and medicinal plants and received in-house training in the cultivation and processing of these plants for cosmetics and medicinal products.

In 1992, he started his own pharmaceutical business, Parceval Pty, which works with both indigenous Southern African and exotic plants in the cultivation and supply chain set up for local and international clients. Ulrich has been involved in the extraction and manufacturing of finished medicinal products and herbal medicines and has been working with bioprospecting legislation in South Africa since 2002. He has been consulting and implementing ABS compliance for local and international companies and holds many discovery phase, biotrade and bioprospecting permits. Ulrich is also participating in revising the South African bioprospecting legislation.





Mr Cyril Lombard

Cyril Lombard has more than 30 years' experience in the biotrade, natural products and small and medium size business development sectors. In Namibia in the 1990s he worked with the team that established commercial marula oil production including the set-up of the supply associations and co-operatives and driving the commercial linkages to global companies. In 1999 he set up the Southern African Marula Oil Producers' Network and facilitated the transfer of technology and know-how to community-based business in Botswana, Swaziland, South Africa and Zimbabwe. In 2000 Cyril was a member of the project formulation team that led to the establishment of the Southern African Natural Products Trade Association – PhytoTrade Africa. There he set up the European office, had roles of Head of Market Development and Head of R&D. He took on the post of CEO of PhytoTrade Africa from 2013 to 2016, and during this time also served on the board of directors of the Union for Ethical Biotrade.

He has served on evaluation and advisory panels for bioscience institutions in Southern Africa and is a research associate at the University of Johannesburg. More recently Cyril has been involved in fundraising for the development of the biotrade sector, and provides advisory services to the GIZ ABioSA project and the BioInnovation Africa project.



Abstracts: Oral presentations



Antibacterial properties of plant-derived nanoparticles against multidrug resistance bacteria

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Abstract: Plant-derived nanoparticles (PDNPs) are gaining importance in the field of medicine to treat various diseases, due to their enhanced physicochemical properties. This study assessed the antimicrobial properties of nanoparticles derived from *Melia azedarach* leaf extracts and ferric chloride hexahydrate ($\text{FeCl}_3 \cdot 6\text{H}_2\text{O}$). The ultracentrifugation method was used to produce extracts from *Melia azedarach* leaves. Nanoparticles were produced with the extracts serving as reducing, capping, and stabilizing agent on precursor metal $\text{FeCl}_3 \cdot 6\text{H}_2\text{O}$. The synthesized nanoparticles were characterized by UV- spectroscopy, SEM, FTIR, and TEM to confirm the formation, morphology, functional group, and shape, respectively. The biosynthesized nanoparticles were tested against multidrug-resistant bacteria to determine the minimum inhibitory concentration (MIC), minimum bactericidal concentration (MBC), and rate of kill. In this study, nanoparticles with an average particle size of 49 nm and an irregular shape were successfully produced. The biosynthesized nanoparticles displayed significant antimicrobial activities with MIC of 2.5, 1.25, 2.5, and 1.25 mg/mL and MBC of 5.0, 1.25, 5.0, and 2.5 mg/mL against *E. coli*, *Salmonella enterica*, *Shigella dysenteriae* and *Vibrio cholerae*, respectively. The lowest killing times against *E. coli*, *Salmonella enterica*, *Shigella dysenteriae* and *Vibrio cholerae* by PDNPs at a concentration of 5.0 mg/mL were 4, 3, 2, and 3 hrs, respectively. Based on the promising antimicrobial activities of the PDNPs at low concentrations and within a short period of time against the tested bacteria, they could be useful in important therapeutic applications aimed at combating pathogens. Further studies to assess their mechanisms of action and toxicity is recommended.

Influence of seasonal and geographic variation on the chlorogenic acids content of *Helichrysum aureonitens*

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Abstract: Pharmacological studies conducted in the past revealed the potential source of medicinal plants in the development of novel medicines. The phenolic contents containing chlorogenic acids (CGA) have been linked to a variety of therapeutic effects, especially antiviral activity. *Helichrysum aureonitens* Sch. Bip is a medicinal plant that has been reported to contain chlorogenic acids compounds and has also shown biological activities against several bacteria, fungi and viral species. Since traditional users argue that the curative potential of plants depends on the time of harvest, this study aimed to determine the influence of both seasonal variation and locality on the chlorogenic acids content of *H. aureonitens*. Ultra-performance liquid chromatography-quadrupole time-of-flight mass spectroscopy (UPLC-qTOF-MS) was employed to determine the metabolic profile variations of three derivatives of chlorogenic acids-caffeoylquinic acid (CQA), dicaffeoylquinic acid (DCQA) and tricaffeoylquinic acid (TCQA) in the harvested plants growing in two diverse geographical climates (Mpumalanga and KwaZulu-Natal) and two different seasons (spring and autumn). The UPLC-qTOF-MS result revealed that the chlorogenic acids are significantly impacted by both season and location, with dicaffeoylquinic acids (DCQA) being the most abundant, with higher concentrations in both regions and seasons. 3-CQA was also shown to be the most abundant isomer of caffeoylquinic acid in this investigation.

Bio-control potentials of plant-derived silver nanoparticle against multi-drug resistant *Staphylococcus* spp. from raw milk

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Abstract: The search for novel antimicrobials has become more urgent as a result of the increase in multi-drug resistant (MDR) bacteria. Green nanotechnology has emerged as a viable new treatment approach. In this study, the bio-control ability of silver (Ag) nanoparticles (NPs) synthesised from *Acacia nilotica* leaf extract against three MDR *Staphylococcus* species was investigated. The effectiveness of the AgNPs against the isolates was examined using the disc diffusion method. The broth microdilution technique established minimum inhibitory and bactericidal concentrations (MIC and MBC). Ultraviolet-visible (UV-Vis) spectroscopy, Fourier transform infrared (FTIR) spectroscopy, X-ray diffraction (XRD), and electron microscopy were used to analyse the synthesised NPs. AgNPs were synthesised carbon-neutrally, as evidenced by the UV-Vis absorption spectra, which had a surface plasmon resonance peak of about 290 nm. The decrease and stability of NPs were attributed, according to the FTIR spectroscopic investigation, to peptides and flavonoids. XRD measurements revealed 21 nm-sized crystalline NPs. The synthesised NPs were found to be circular in shape by scanning electron microscopy, and their diameters ranged from 36 to 86 nm, with an average of 41 nm, by transmission electron microscopy. MIC and MBC were found to be 2.5 and 5 mg/mL, respectively, while zones of inhibition ranged from 7.00±0.57 mm at 0.625 mg/mL to 30.00±0.82 mm at 10 mg/mL. A positive control, chloramphenicol (30 µg), demonstrated an inhibitory zone of 27.00±0.61 mm. According to the current study, AgNPs may be a beneficial antibacterial agent against MDR *Staphylococcus* species.

An insight into the inventory of medicinal plants prescribed by indigenous knowledge holders in Mahikeng Local Municipality, South Africa

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Abstract: Despite advances made by modern medicine, medicinal plants still play key roles in the primary healthcare of resource-poor communities. This study aimed to assess the ethnobotanical knowledge focusing on medicinal plants used for human and animal healthcare needs in Mahikeng's local municipality. We engaged 84 participants comprising traditional healers and community members representing the 28 wards in the local municipality. They were interviewed using a semi-structured questionnaire. Ethnobotanical data were documented, including the local names of the plants, plant parts used, method of preparation, administration, and dosages of remedies. The data were analysed using ethnobotanical indices, including Use-value and frequency of citation. A total of 107 plants representing 52 families were identified for managing various health problems. The most representative families were the Asteraceae, Asparagaceae, Fabaceae and Solanaceae. *Bulbine frutescens* (L.) Willd., *Elephantorrhiza burchellii* (Burch) Skeels, *Helichrysum paronychioides* DC., *Hypoxis hemerocallidea* Fisch., C.A Mey & Avé-Lall and *Senecio longiflorus* (DC). Sch.Bip., were the most cited plants. Most of the plants were used in combinations, with the most frequently used parts being roots (38%), leaves (35%) and the whole plant (22%). Decoctions and macerations were the preferred methods of preparation while oral (46%) and topical (33%) were the main routes of administration. The bulk of the plant materials (58%) were sourced from the wild. The assessment of ethnobotanical knowledge and the plants used necessitates further studies to preserve the knowledge for current and future generations. Additionally, evaluating the biological activity of the plants and their phytochemical analysis remains imperative.

Characterization of *Sclerocarya birrea* (marula) seed oil and investigation of the geographical origin by applying similarity calculations, differential NMR and hierarchical cluster analysis

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Abstract: Marula fruit are very important in southern African cultures, and the oil is especially valued in the cosmetic industry as a moisturiser for the skin, hair and nails and for treating acne. The demand for marula oil has grown substantially, with increased exports from Africa to Europe. In this study, metabolic profiling of forty-four commercial marula oils was performed using ¹H NMR. The typical profile of marula oil was established, and marker compounds were identified that enable the differentiation of marula oils from other commercial oils. The rapid classification of the oils was achieved by similarity calculations and principal component analysis. Marula oil was found to be most similar to macadamia and olive oils. Differential NMR analysis detected minor components and accurately compared them with other oils. The concentrations of nine oil components were determined and used to differentiate marula oil from macadamia and olive oils. Marula oil is differentiated from these oils by the absence of α -linolenic acid, relatively high levels of mono- and diglycerides, and an approximately 1:1 ratio of 1,2- and 1,3-diglycerides. Hierarchical cluster analysis demonstrated the clustering of samples according to the geographic region of origin. Clustering of the oils from Namibia and Zimbabwe was observed and was related to the quantities of linoleic acid and mono- and diglycerides. Some samples displayed deviations in their composition, which might indicate adulteration or contamination during production.

This study demonstrates the potential of NMR as a tool in the quality control of marula oil. The technique requires very little sample preparation, circumvents derivatisation of the oil components and run-times are fast compared to other techniques. In addition, samples with chemical profiles that differ from the signature profile can easily be identified.

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Survey on the yield components of Bambara groundnut (*Vigna subterranea*) accessions based on *Bradyrhizobium* inoculant and nitrogen fertilization

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Abstract: This study was designed to compare the inoculation of *Bradyrhizobium japonicum* strains with the growth and yield of Bambara nut accessions. Field studies at Ibadan and Ikene, Nigeria were arranged in a complete random block design (RCBD) randomised at both locations and seasons, and each block represented each replication three times. The collected data were assessed for variance and mean analysis, and the Duncan Multiple Range Test (DMRT) was separated at a probability level of $p > 0.05$. The study's results suggest that *B. japonicum* strains are more beneficial. The strains could reduce their dependence and spending on inorganic fertilisers and avoid the adverse effects of N fertilisers on the environment after their use. It was found that FA3 inoculation significantly improved the growth characteristics of accessions than other species and N fertilisers. In both locations and seasons, the planting height (5.5–22.71 cm), the number of branches (33.63–62.77 cm), the number of leaves (116.54–22.25 cm), the length of the ends (5.62–6.00 cm) and the width (2.09–2.56 cm) were recorded for seven weeks and twelve weeks after planting. The components of harvesting yield and yield were as follows: pod length (13.27 cm), pod width (9.08 mm), seed length (9.39 mm), seed width (6.92 mm), the weight of 100 seeds (56.85g) and yield/ha (750.72 kg). The components of yield and yield were also significantly affected by the FA3 and RACA6 at both locations and seasons.

Harnessing the benefits derived from African Yam Bean (*Sphenostylis stenocarpa*), a potential food security crop

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Abstract: The need for an increased global food supply due to a geometric increase in human population coupled with changes in climatic conditions led the United Nations to develop the Sustainable Development Goals (SDGs), which seek to mitigate hunger and malnutrition by 2030. This can be achieved by promoting the utilization of Africa's indigenous crops rich in nutrients and bioactive compounds. African yam bean (*Sphenostylis stenocarpa*) Hochst ex A. Rich, is a cultivated, underutilized legume in the humid tropics of Africa that produces edible seeds and underground tubers. Nutritionally, the seeds are rich in potassium, phosphorus, magnesium, calcium, and zinc with high protein content (19-37%) and up to 15.5% in tubers and essential amino acids. In addition, the bioactive compounds in the grains are known to possess pharmacological and beneficial effects on disease management, with the ability to mop up free radicals due to their antioxidant power. Despite these benefits, it largely remains neglected and underutilized. Nevertheless, concerted efforts are being made to enhance its cultivation and utilization, with an increased research focus and the deployment of modern technologies. *Sphenostylis stenocarpa* will no doubt have an important place in addressing human food, livestock feeds, and nutritional problem in Africa if given much-needed attention.

Pigmented potatoes: A potential panacea for food and nutrition security and health?

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Abstract: Although there are over 4000 potato cultivars in the world, only a few are commercialised due to marketability and shelf-life. Most non-commercialised cultivars are pigmented and found in remote regions of the world. White fleshed potatoes are well known for their energy enhancing complex carbohydrates; however, pigmented cultivars are potentially high in health promoting polyphenolic compounds. Therefore, we reveal the comprehensive compositions of pigmented cultivars and associated potential health benefits including their potential role in ameliorating hunger, food, and nutrition insecurity and prospects. The underutilisation of such resources is a direct threat to plant-biodiversity and local traditions and cultures.

A comparative analysis of the muthi gatherers and the muthi plant species they gather from Port St Johns and Tsolo districts for sale at Ntozonke Market, Mthatha, South Africa

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Abstract: Sustained commercial exploitation of natural resources almost inevitably leads to their exhaustion. The harvesting of medicinal (muthi) plants from the wild for sale in urban markets has been a cause for concern in South Africa for a very long time, but few studies have been carried out to monitor this trade with a view to identifying muthi plant species that are in high demand that may be at high risk of being exhausted or going extinct. This study was aimed at monitoring and comparing the identities and frequency of sales of muthi plants sourced from the coastal district of Port St Johns (PSJ) and the inland district of Tsolo (TSL). All species from each of the two districts that were brought to the local market in Mthatha were recorded during the course of 35 trips from mid-November 2021 to early December 2022. In total, 136 species were recorded and 129 of these were identified to species. The identified species belonged to 69 families, the largest of which were Asteraceae (9 species), Apocynaceae (8), Hyacinthaceae (7), Amaryllidaceae (5) and Fabaceae (5). They included the Endangered *Ocotea bullata*, three Near Threatened species, viz., *Curtisia dentata*, *Merwillia plumbea* and *Encephalartos natalensis*, plus six vulnerable species, viz.; *Clivia miniata*, *Dioscorea sylvaticus*, *Euphorbia flanaganii*, *Prunus africana*, *Stangeria eriopus*, and *Bowiea volubilis*. Five of the species traded were both exotic and invasive. One hundred and twenty-two species came from PSJ and 90 from Tsolo. There were 77 species common to Port St Johns and Tsolo, amounting to a similarity of 57%. Most of the species harvested were herbs (56 species) followed by trees (36). The most common plant part sold was bark (56 species) followed by whole plants (27). The most frequently traded species recorded were *Croton sylvaticus*, *Cryptocarya woodii*, *Rapanea melanophloeos* and *Dioscorea dregeana*. *Croton sylvaticus*, *C. woodii* and *D. dregeana* were the most frequently traded species from Port St Johns, with a relative frequency of 1.00. From Tsolo, *R. melanophloeos*, *Hypoxis hemerollicadea*, *Rhoicissus rhomboidea* and *Pimpinella caffra* were the most frequently traded species. The coastal and inland areas have almost two-thirds overlap in the species they supply to the market, but these are not supplied equally to the market. Such important differences could not have been brought to light without detailed monitoring of the market. Such monitoring should be a focus of future ethnobotanical studies of muthi markets if conservation concerns are to be addressed adequately.

South African medicinal plants used for the treatment of men's urological, urogenital, and reproduction health-related conditions

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Abstract: Men's health conditions have turned out to be a denunciation for public health due to the limitations associated with the available drugs and men's health behavioural seeking character. However, Indigenous communities have relied on medicinal plant-based treatments to manage men's health ailments, which remains poorly explored, and its therapeutic potential needs to be critically evaluated. This review focused on ethnobotanical information about the traditional practices and knowledge of medicinal plants used in South Africa to treat health issues in men. A systematic review and meta-analytical approaches were used to assess the existing literature. Data were analysed and reported using descriptive statistics, frequency, and percentage. The results revealed that a single and combination of medicinal plants were used to treat three (3) categories of health conditions (urinary, reproductive, and urological systems) in men across the nine (9) provinces in South Africa. Common plant parts used were roots and leaves. Standard preparation methods were infusion and decoction, while the administration mode was often unspecified. In terms of diseases, erectile dysfunction, urinary tract infections, and sexually transmitted infection were the most treated conditions. The review revealed the significant use of plants to treat men's health conditions, especially in rural areas of South Africa. However, it was evident that provinces such as Northern Cape, North West, Free State, and Western Cape remain understudied. Therefore, further detailed studies in other provinces may provide meaningful ways to promote the use of medicinal plants for the benefit of managing health conditions in men.

Cordia grandicalyx and its effect on glucose uptake by cells

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Abstract: Type 2 diabetes is characterised by insulin resistance, a phenomenon in which cells do not respond to insulin function. Insulin receptor substrate recruits downstream effectors such as PI3K and Akt, in order to elicit cellular responses involved in glucose uptake, lipid metabolism and cell proliferation. The purpose of this study was to examine protein expression of the principal glucose transporter (GLUT4) and other associated diabetes-related genes, in skeletal, adipose and liver cells treated with extracts of *Cordia grandicalyx*. Akt phosphorylation and IRS-1 expression were determined using ELISA-based methods, while the other diabetes-related genes were assessed using Real Time PCR (RT-qPCR). GLUT4 protein was sufficiently expressed in cells treated with bark acetone (BA) extract. The extracts also upregulated the expression of IRS, and enhanced phosphorylation of Akt-1. Similarly, there was upregulated expression of IRS, Akt and PI3K genes at mRNA level. These findings therefore suggest that extracts of *C. grandicalyx* possibly exert their hypoglycaemic effects by modulating insulin signalling, potentially through protein expression and upregulation of diabetes related proteins and genes involved in the PI3K/Akt pathway.

The ethnobotany and pharmacognosy of two species in the genus *Plecostachys* (Asteraceae)

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Abstract: The two aromatic medicinal species *Plecostachys serpyllifolia* and *P. polifolia* (Asteraceae), are used traditionally for respiratory ailments and as a pleasant tasting tea. While there is minimal published information on *P. polifolia*, the ethnobotanical uses, essential oil composition and antimicrobial activity for *P. serpyllifolia* is known but requires elaboration. Anecdotal sources demonstrate that a member of the monotypic genus *Tenrhynea* (*T. phyllicifolia*), phylogenetically considered as a sister taxon of *Plecostachys*, has been used for similar applications in the Limpopo Province. In the current study, anatomical characters of potential diagnostic value (trichomes, stems and leaves), the chemical composition of essential oil (by gas chromatography-mass spectrometry) and the antimicrobial activity of crude extracts (minimum inhibitory concentrations: MIC) were studied for both species in *Plecostachys*. Two Gram-negative (*Klebsiella pneumoniae* and *Moraxella catarrhalis*) and two Gram-positive (*Staphylococcus aureus* and *Streptococcus pyogenes*) bacteria were selected for MIC testing based on reported ethnobotanical uses. The anatomical study revealed taxonomically useful characters and showed similarities between *Plecostachys* and *Tenrhynea*. The oil composition was similar between the two taxa in *Plecostachys*. The major components were *E*-caryophyllene, α -phellandrene and sabinene. Minor components included linalool, γ -cadinene, *E*-nerolidol and several others. Organic extracts of *P. serpyllifolia* showed moderate activity against *Klebsiella pneumoniae* and *Staphylococcus aureus*, while water extracts of *P. polifolia* showed moderate activity against *Klebsiella pneumoniae*.

Inhibition of methicillin-resistant *Staphylococcus aureus* (MRSA) and Extended-spectrum beta-lactamase (ESBL) strains of *Escherichia coli* and *Klebsiella pneumoniae* by selected *Combretum* spp.

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Abstract: The development of β -lactam resistant bacteria has rendered many common therapies ineffective and has driven the search for new antibiotics from plants. The antibacterial activities of selected southern African *Combretum* spp. leaf extracts were screened against β -lactam resistant and sensitive pathogens using disc diffusion and broth microdilution minimum inhibition concentration (MIC) assays. *Artemia* nauplii and human dermal fibroblast (HDF) assays were used to evaluate the toxicity of the extracts, and GC-MS headspace analysis was used to identify volatile terpenoid components. All extracts had noteworthy inhibitory activity against MRSA, and ESBL strains of *E. coli* and *K. pneumoniae*. The activity of the *Combretum hereroense* Schinz leaf extract was particularly good (MICs = 170-680 $\mu\text{g/mL}$) against all strains. Interestingly, this extract was a better inhibitor of MRSA than it was against β -lactam sensitive *S. aureus*. *Combretum vendae* A.E.van Wyk, *Combretum collinum* Fresen. and *Combretum molle* R.Br. ex G.Don extracts were also good bacterial growth inhibitors (MICs 120-890 $\mu\text{g/mL}$). Noteworthy inhibition (MICs 500-1625 $\mu\text{g/mL}$) of the MRSA and ESBL strains was also noted for the *Combretum bracteosum* (Hochst.) Brandis and *Combretum erythrophyllum* (Burch.) Sond. extracts. All extracts were non-toxic in the *Artemia* nauplii lethality assay (ALA) and HDF assays. The calculated therapeutic indexes (TIs) indicate their safety for therapeutic use. Cineole, terpineol, camphor, borneol and limonene were identified by GC-MS headspace analysis in abundance in all extracts. Further phytochemical and mechanistic studies of these extracts are warranted.

Medicinal and ritual plant-use patterns in southern Africa

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Abstract: There are currently 21 467 described and accepted plant species in southern Africa, as recorded by the database records of the South African National Biodiversity Institute. This enormous diversity of plants, in combination with a rich cultural heritage, greatly contribute to the large and growing practice of traditional medicine in this region. This presentation aims to illuminate the diversity and dynamics of medicinal plant use in this region. An overview of the total number of medicinal and ritual plants in southern Africa is presented. We compare historical and contemporary medicine by exploring the documentation of medicinal and ritual plant use over time. Traditional plant use patterns are also investigated across cultures and biomes. Results showed a total of 3640 medicinal plant species, 1055 ritual plant species and 911 plant species with a dual medicinal and ritual purpose in southern Africa. Compared to the previous checklist by Arnold *et al.* (2002), 1223 new records have been documented in the last two decades. The number of exotic plant species used in traditional practice has increased proportionally to the use of indigenous plant species over time. *Artemisia afra* Jacq. ex Willd. has consistently been the most cited plant species in medicinal plant research in southern Africa. Fascinating patterns of plant use can be seen across cultures regarding dominant plant families and the use of exotic plant species. These patterns reveal the adaptive and dynamic nature of medicinal systems in the region. The numerous new records of the last two decades point towards the urgency of documenting this unique ethnobotanical heritage before it disappears.

Chemical characterisation of selected indigenous seed and nut oils

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Abstract: Indigenous fruits are considered a valuable source of nutrition and could play a role in improving the lives of rural communities by adding value such as the extraction of seed oil. Seed oils were extracted from *Sclerocarya birrea* (Marula), *Trichilia emetica* (Natal mahogany), *Trichilia dregeana* (forest mahogany), *Sterculia murex* (Lowveld chestnut), *Oncoba spinosa* (snuffbox) and *Ximenia caffra* (sourplum). Oil parameters that were determined included percentage yield, free fatty acids, peroxide, iodine, saponification, and unsaponifiable values. The seed oil composition was determined using Gas Chromatography - Mass Spectrometry. Solvent and cold press extraction were compared for *S. birrea* and *T. dregeana*. In general, all oil parameters for these two methods were similar, however peroxide values for solvent extracted oil were much higher than for cold pressed oil. Acid values for *S. birrea*, *S. murex*, *X. caffra* and *O. spinosa* oils were low which indicates less free fatty acids and therefore lower rancidification. This was confirmed by the low peroxide values obtained. Low peroxide and free fatty acid values are indicators of oil stability. All the oils analysed contained high saponification values between 200 and 410 mg KOH/g and confirm the use of these oils in the cosmetic industry. The oil composition of the seeds varied considerably. *O. spinosa* oil was the only oil that contained significant levels of linoleic and linolenic acids. *S. birrea*, *O. spinosa* and *S. murex* contained β -sitosterol. Indigenous seed and nut oils have the potential to be used in food and cosmetic products. Adding value to these fruits and nuts can result in job creation and improved quality of life in rural areas.

South African medicinal plants and probiotics: a potential solution to *Helicobacter pylori*

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Abstract: Numerous medicinal plants are used traditionally in South Africa for gastric ulcer treatment. *Helicobacter pylori* is known for causing inflammation and the onset of gastric ulcers. Probiotics are used to treat gastric ulcers and for *H. pylori* infection. Based on the ethnobotanical evidence, 21 South African medicinal plants used traditionally for treating gastric ulcers were collected. Their antimicrobial activity was assessed against five clinical *H. pylori* strains, and in combination with one of three *Lactobacillus* probiotic strains, using the minimum inhibitory concentration (MIC) and minimum bactericidal concentration (MBC) assays. Toxicity was assessed using the brine shrimp lethality assay. Seven organic and five aqueous extracts showed noteworthy activity against at least one *H. pylori* strain. The lowest mean MIC of the organic extracts was from *Carissa edulis* Vahl (0.18 mg/ml) while that of the aqueous extracts was from *Sansevieria hyacinthoides* (L.) Druce (0.26 mg/ml). Aqueous extracts were combined with probiotics, and showed increased activity compared with the extracts alone. All *Lactobacillus rhamnosus* combinations showed at least a two-fold decrease in the MBC against all *H. pylori* strains tested. *Lactobacillus acidophilus* combined with either *Protea repens* (L.) L, *Carpobrotus edulis* (L.) L.Bolus or *Warburgia salutaris* (Bertol.f.) Chiov. showed the best activity (mean MBCs of 0.10 mg/ml for each combination). Only four organic and one aqueous extract(s) were considered toxic. These results highlight the potential of medicinal plants for inhibiting *H. pylori* growth and their role in the traditional management of ulcers, as well as the potential benefit of including probiotics in treatment.

A possible solution to the dilemma, that traditional healers do not have extractants for biologically active compounds in plants, applied to tick control

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Abstract: The Phytomedicine Programme have consistently shown that the active compounds against microorganisms, nematodes, blowflies and ticks are relatively non-polar. Acetone leaf extracts usually have good activities, but water extracts made under laboratory conditions have very low activity. Because water is the only extractant widely available to rural farmers, many of the highly active compounds present in plants cannot be extracted and used by them. Acetone is not available to rural farmers. We decided to try another approach. Surfactants can solubilise non-polar compounds in water. Considering which compounds were available to rural farmers, we tested the use of an emulsion of water and widely available cooking oil and detergent in small shops as extractant on several plants used traditionally against ticks. In the laboratory acetone extracts were active while water extracts were not. The emulsion had some activity. In a field trial in Zimbabwe the emulsion extract of some parts of *Maerua edulis* was as effective in protecting ticks as a commercial amitraz based acaricide [Nyahangare et al. BMC Veterinary Research (2019) 15:404 <https://doi.org/10.1186/s12917-019-2078-3>] This opens possibilities for extracting non-polar plant compounds by rural healers.

Quantification of phenotypic plasticity for the improvement of okra (*Abelmoschus esculentus*) collection for yield and associated traits

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Abstract: The family Malvaceae has only one important vegetable crop, called okra or ladyfinger, which exhibit a great potential for economic viability, nutritional, and industrial values. The crop is underutilised and research on breeding of the crop in South Africa has been neglected. An initiative was undertaken to develop a breeding programme for okra, at the Agricultural Research Council-Vegetables, Industrial and Medicinal plants. This study was conducted in collaboration with the DALRRD and Alliance-Biodiversity International, with the objective to characterize and evaluate collection of accessions using agronomic traits. The data was subjected to analysis of variance, principal components analysis and correlation analysis. The analysis of variance showed significant differences among the accessions for yield and related traits across the two environments. The higher yielders were okra 24 (grain yield of 400 kg/ha) and okra 5 (grain yield of 290 kg/ha). Principal components analysis revealed 68.85% total variation, phenotypic coefficient of variance (PCV) was higher than genotypic coefficient of variance (GCV) on all the measured parameters, and phenotypic variation was larger than genotypic variation. The study revealed medium for yield (33%), high ($\geq 60\%$) heritability, for hundred seed weight and number of fruits per plant. A positive significant correlation between grain yield and fruit yield per plant ($r=0.390$) was observed. The study recommended accessions okra 24, okra 7 and okra 5 as they indicated potential identification of genetic variability that enables breeders to select traits of interest for an improvement programme.

Non-destructive methods for the propagation of *Bowiea volubilis*, a vulnerable medicinal plant species

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Abstract: The use and trade of medicinal plants are embedded in African culture. Despite access to western medicine, about 72% of South Africans still use medicinal plants. The extent of use is unfortunately threatening the survival of many plant species in the wild. In response to this challenge, the South African National Biodiversity Institute (SANBI), together with various collaborators who comprise the Medicinal Plant Working Group (MPWG) including, South African National Parks (SANParks), the Agricultural Research Council (ARC-TSC), Mpumalanga Parks and Tourism Agency (MTPA), Botanical Society of South Africa (BotSoc), and the Endangered Wildlife Trust (EWT), has piloted the development of a Biodiversity Management Plan (BMP-S) for six threatened medicinal plant species in the Ehlanzeni District Municipality of Mpumalanga province, South Africa. *Bowiea volubilis* is one of the six priority species identified by Traditional Healer Practitioners (THPs) in Ehlanzeni District Municipality. The species is listed as Vulnerable in the Red Data List of species and sourcing plant material is challenging for THPs. To this end, several non-destructive methods of propagation were assessed for the propagation of this species. These methods include propagation using seeds and bulb scales *ex vitro* and seed and inflorescences *in vitro*. While *ex vitro* seed propagation is most cost-effective, the relative unavailability of seeds precludes this method for rapid propagation. *In vitro* propagation using seeds and/or inflorescence stems as starting material resulted in rapid multiplication. Acclimatisation of *in vitro* plantlets was also relatively straightforward.

Development of a natural-based scaffold using *Capparis sepiaria* and *Tabernaemontana elegans* extract for articular cartilage and bone tissue regeneration

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Abstract: Natural-based scaffolds in the field of tissue engineering have recently received much attention because of their essential features such as biocompatibility, affordability, mechanical stability, easy mass production, renewability, and biodegradability with low toxicity. The development of good tissue-compatible natural-based scaffolds plays an essential role in various tissue engineering applications. This study focuses on developing biocompatible and biodegradable scaffolds using aqueous extracts from *Capparis sepiaria* roots and the bark of *Tabernaemontana elegans* (CSTE) incorporated with alginate and chitosan by freeze-drying method. The synthesized scaffold was characterised using a scanning electron microscope (SEM). The results on the effect of aqueous and ethanol CSTE extracts yielded 1.9 % and 10.9%, respectively. In the CSTE ethanol extract, dark red colour was observed while the aqueous extract of CSTE resulted in a light red colour. Thereafter, the developed scaffold incorporated with aqueous and ethanol CSTE extract resulted in a colour change from dark red to light red. Even though the evaporated ethanol extracts seemed to be darker than the aqueous extract prior to the development of the scaffold. The SEM microgram clearly shows the 3-D pore structure of the scaffold incorporated with the aqueous and ethanol extract as compared to the scaffold without the extract. Our findings suggest that the scaffold incorporated with plant extract could be a promising therapeutic candidate for cartilage and bone tissue engineering.

Assessing the safety of selected South African medicinal plants through zebrafish embryotoxicity assays

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Abstract: Many consumers assume the safety of and therefore use indigenous medicinal plants without knowledge of their potential toxicity. *Eucomis autumnalis*, *Merwillia plumbea* and *Pelargonium sidoides* are traditionally used to treat gastrointestinal disorders, wounds and respiratory infections, respectively. Due to the scarcity of research reporting on the safety of South African medicinal plants, this study was undertaken to evaluate the potential toxicity of extracts prepared from *E. autumnalis*, *M. plumbea* and *P. sidoides*, using the zebrafish embryotoxicity assay. The effect of these plant extracts at varying concentrations on overall embryo activity, cardiac effects, and morphological changes during the developmental stages was investigated. Pericardial oedema, swim bladder abnormality and inadequate yolk reabsorption were among the developmental malformations observed. The embryo survivability decreased with increasing extract concentrations in a time-dependent manner, where higher concentrations and longer exposure to extracts affected embryo survival. Survival rates were decreased by approximately 50% when embryos were exposed to 8.5-12 µg/mL extracts at 24 hours post-fertilisation. Exposure of the embryos to the three methanolic extracts triggered high burst movements at high concentrations. The extracts of *M. plumbea* and *P. sidoides* decreased heart rate in zebrafish larvae at 9.5 and 10.5 µg/mL concentrations, respectively. Generally, all three extracts were found to be embryotoxic to the spontaneous movements of zebrafish embryos at lethal concentrations. This study emphasises the need for toxicity studies of all medicinal plants, that should ideally take place before commercialisation.

Phytochemical profiling and wound healing properties of *Lobostemon fruticosus*

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Abstract: *Lobostemon fruticosus* (L.) H.Buek is a perennial and woody shrub of the family Boraginaceae, found in the Cape region of South Africa. Leaves and twigs are used to treat dermatological conditions such as wounds. Antibacterial, antiviral, anti-proliferative and anti-inflammatory activities of *L. fruticosus* have been reported, however, the wound healing properties have been neglected. Comprehensive phytochemical profiling and chemotypic variation studies have not been done on this species. This study aimed to investigate intra-species chemical variation within *L. fruticosus* and to assess the wound healing properties, in line with its traditional use. Aqueous methanolic (80%) extracts of *L. fruticosus* were prepared from 24 samples collected from the Western Cape Province of South Africa. The chemical profiles were obtained using high-performance thin layer chromatography (HPTLC) and ultra-performance liquid chromatography coupled with mass spectrometry (UPLC-MS). To assess potential wound healing, the *in vitro* scratch assay as well as the *in vivo* caudal fin amputation assay on zebrafish larvae were performed. The HPTLC profiles of *L. fruticosus* from different locations displayed a high level of similarities between samples. However, some chemotypic variation ($R^2X_{cum}=58.7\%$), mostly quantitative, was observed following multivariate analysis of the UPLC-MS data. The scratch assay showed increased cell migration of both the keratinocytes and fibroblast (increased by $\pm 20\%$ at $100\ \mu\text{g/mL}$) following treatment with the extracts. Regeneration of the caudal fin was faster compared to the negative control (increased by $\pm 30\%$ at $100\ \mu\text{g/mL}$). The study demonstrates the potential wound healing properties of *L. fruticosus* supporting its traditional use.

Pro-inflammatory cytokine inhibition properties of selected southern African medicinal plants in LPS-stimulated RAW 264.7 macrophages

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Abstract: The preferred use of medicinal plants as alternative therapeutics against pain and inflammatory disorders is increasing worldwide. However, many of these herbal medicines have not been scientifically explored for inhibitory properties against key signalling pathways that regulate an inflammatory response. An extensive literature review identified 555 southern African medicinal plants from 118 families to be traditionally used to treat inflammation and pain. Of these medicinal plants, 18 species were selected and evaluated for immunomodulatory properties against anti-inflammatory cytokines (interleukin-(IL)-2 and IL-10) as well as the pro-inflammatory cytokines [(interleukin (IL)-1 β , IL-6, tumour necrosis factor- α (TNF- α), and interferon-gamma (IFN- γ)) and the chemokines (monocyte chemoattractant protein 1 (MCP-1) and macrophage inflammatory protein (MIP)-2)] inhibition activity in LPS-induced and unstimulated RAW 264.7 macrophage cells. The aqueous and ethanol extracts of *Melianthus comosus* Vahl, *Pterocelastrus rostratus* Walp., *Syzygium cordatum* Hochst. ex Krauss, and *Warburgia salutaris* (G. Bertol.) Chiov., exhibited significant inhibition of several pro-inflammatory cytokines with up to 90% decrease against IL-1 β , IL-6, and TNF- α .

Plant phenology and bioactivity

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Abstract: Bioactivity in plants can be affected by many factors including the environment, cultivation methods, post-harvest treatments, biotic and abiotic stress, genotype and habitat. All these factors can lead to physiological and biochemical changes in the plant as the plant react to especially external factors. Furthermore, normal plant growth cycles also affect the physiology and biochemistry of the plant as different compounds are used in different processes. Phenology or plant growth patterns can however shift during different seasons, and it is therefore important to link higher activity to a recognizable plant stage rather than simply a month or a season. The aim of this presentation is thus to discuss how phenology affects bioactivity in *Greyia radlkoferi*, *Helichrysum odoratissimum* and *Leucosidea sericea*. In *Greyia radlkoferi* better tyrosinase activity was observed in extracts from plants at full flowering and from young leaves. For *Helichrysum odoratissimum* improved antioxidant activity varied with assay used and growth location. *Leucosidea sericea* ethanolic leaf extracts resulted in improved activity against displayed improved activity against *Cutibacterium acnes* (MIC values of 3.9 µg/mL) during the dormant period of the plant, just before flowering started. Activity was good (7.8 µg/mL) throughout the growth of the plant except when plants were growing vegetative just after a growth flush was observed (>15.6 µg/mL). These differences clearly demonstrate the importance of investigating bioactivity of plants during different times of the year to establish optimum harvest periods. Linking these harvesting times to recognisable pheno-phases can benefit farmers that do not always have easy access to analytical laboratories.

Phytochemical analysis, antioxidant potential and anti-mycobacterial evaluation of selected medicinal plants traditionally used in Limpopo province

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Abstract: Tuberculosis is a global pandemic which poses a health security as one of the leading causes of death. The study aimed to determine the antioxidant activity, antibacterial activity, synergistic and cytotoxic effects of five selected medicinal plants (*Zanthoxylum capense*, *Ziziphus mucronata*, *Rosmarinus officinalis*, *Ximenia caffra* and *Rhoicissus tridentata*). Collected leaves were dried, and extracted using solvents of varying polarities (hexane, dichloromethane, acetone, methanol, and water). The phytochemical profile of the plant extracts was determined using Thin Layer Chromatography (TLC). Standard chemical methods were used to screen major phyto-constituents. The quantitative antimicrobial activity and synergistic effects of plant extracts were determined using broth-micro dilution assay. The anti-inflammatory activity was determined using egg albumin denaturation inhibition assay. Cell viability was determined using the MMT reduction assay. The quantity of phytochemicals showed that *R. tridentata* had the highest total phenolic and tannin content from its water extracts. Qualitative antioxidant activity analysis showed that all plants had antioxidant compounds except *Z. capense*. Antibacterial activity showed that *R. officinalis* had the highest antibacterial activity as compared to all plants and a synergistic outcome was observed when the hexane extracts of *R. officinalis* and *Z. capense* were combined. All the plants were able to inhibit protein denaturation, even though *Z. capense* had poor anti-inflammatory activity with percentage inhibition of 42%. Cell viability assay revealed that acetone extracts of *R. tridentata* had the highest percentage cell viability. Further studies are recommended on *Mycobacterium tuberculosis* and *in vivo* studies.

Water-use efficiency and physiological response of cowpea (*Vigna unguiculata*) to cowpea-blackjack intercropping

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Abstract: Intercropping has been practiced for decades to solve food security and land scarcity challenges. Despite the well-documented effects of intercropping on plant yield and physiological performance of most legumes, cowpea-blackjack intercropping has not been fully explored. This is because blackjack is considered a weed. Even though it's consumed by native people and is one of the most nutritious indigenous vegetables with medicinal properties. Cowpea is a legume, mostly intercropped with cereal crops, and that's the area most studies have investigated. Therefore, the objective of this study was to assess the effects of intercropping on physiological performance and water-use efficiency when the two are intercropped. The experimental design was arranged in a 3 x 2 randomized complete blocked design (RCBD) in three blocks. The treatments included three cowpea genotypes (Dr. Saunders, Bechuana white, and Glenda) and two cropping systems (intercropping and monocropping). The gas exchange measurements were taken using portable infrared gas analyser (LI 6400 XT, version 6.2). The stable carbon isotopes were used to determine the water-use efficiency ($\delta^{13}\text{C}$) of cowpea. The results revealed significant differences in photosynthetic rate, stomatal conductance, intercellular carbon dioxide concentration, transpiration, and water-use efficiency among the cowpea genotypes and between cropping systems. The gas exchange parameters and instantaneous water-use efficiency were enhanced by intercropping as compared to the monocropping system. In contrast, the $\delta^{13}\text{C}$ values were less negative on mono cropped cowpea indicating higher water-use efficiency. Dr. Saunders was the most water-use efficient compared to other genotypes and could be recommended under water-limited cropping systems.

Local knowledge and perception of exotic plants with invasive potential in a rural municipality in a semi-arid region of Mexico

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Abstract: Effective control of potentially invasive plants requires the collaboration of local people who live with them. Many exotic species were originally introduced for their uses - food, fodder, medicinal, ornamental, among others- and they continue to be useful. So, the perception and cost-benefit calculations of local stakeholders may determine the degree of success of control or containment efforts. However, there are relatively few in-depth studies on local people's perceptions of these plants, particularly in traditional societies and from tropical America. In addition, local people can provide useful information on the biology and impact of invasive species. We collected information on a selection of 20 introduced species in a rural area of the state of Hidalgo, Mexico. Fifty semi-structured interviews with farmers yielded data on uses, history, ecology, impacts, and general perception of the species. Most people knew the species and associated them with common names and uses. There were some differences between the perceptions of women and men. Estimations of arrival times and pathways were plausible, considering the literature on the species. Exotic species with more time in the region had more uses and positive evaluations than new arrivals. Finally, an invasiveness index is proposed that identified the most important invasive species (with *Setaria adhaerens* in the first place), and also those not considered threats. According to the results that people will collaborate more with efforts to control newly introduced species and less with long-time residents.

The neuroprotective and neurorestorative effects of *Sceletium tortuosum* extracts on neurotoxin-induced deficits in zebrafish larvae

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Abstract: Parkinson's disease (PD) is characterised by the loss of dopaminergic neurons, resulting in reduced levels of dopamine in the brain. The exact cause of dopaminergic neuron loss remains unknown but factors such as increased oxidative stress (OS), neuroinflammation and mitochondrial dysfunction have been implicated. The behavioural and molecular repertoire of PD can be modelled in zebrafish larvae using a neurotoxin, 6-hydroxydopamine (6-OHDA). Currently, there is no cure for PD, however, medicinal plants such as *Sceletium tortuosum* may provide neuroprotective and restorative benefits because of their psychoactive nature. This study aimed to evaluate the neuroprotective and neurorestorative effects of *S. tortuosum* extracts on 6-OHDA-induced deficits using the zebrafish larvae model. In the neuroprotection assay, zebrafish larvae at 2 days post-fertilisation (dpf) were pre-treated with extracts and Zembrin® (commercial *Sceletium* product) for 30 min, followed by chronic (72 h) exposure to 6-OHDA (250 µM). In the neurorestorative assay, zebrafish larvae 2 dpf were pre-treated with 6-OHDA (250 µM) for 24 h without extracts. The following day, the larvae were treated with *Sceletium* extracts and Zembrin® for 48 h. Both assays utilised L-dopa and selegiline as positive controls. Locomotion was monitored daily using high-throughput EthoVision XT locomotion tracking software. Endpoint OS was monitored using 2'7' dichlorofluorescein diacetate. The results indicate that 6-OHDA induced behavioural and molecular deficits in zebrafish larvae consistent with PD. However, these deficits were consistently reversed by L-dopa, Zembrin® and lower concentrations of the extracts. This high-throughput model may be used as a primary screening assay for antiparkinsonian drugs.

Effect of pasteurisation and storage on proximate and mineral composition of indigenous and commercial watermelon juice

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Abstract: Watermelon is a popular vegetable crop widely distributed in the tropical and subtropical regions of the world. It is an essential healthy food and a rich source of vitamins, minerals, and antioxidants. However, watermelon juice is a scarce commodity due to its perishable nature attributed to the high-water activity and less acidic pH. Although commercial watermelons are well-known, indigenous watermelon landraces are considered an essential food source for some local communities. Indigenous watermelons exist in two edible forms: the sweet and bitter types. The aim of the study was to determine the effect of pasteurisation and storage duration on the proximate and mineral composition of indigenous and commercial watermelon juice. Pasteurisation and storage duration (28 days at ambient temperature) significantly affected the nutritional parameters (moisture, ash, protein, and minerals) of indigenous and commercial. The moisture content of all juice samples was more than 90%. Commercial pasteurised watermelon juice had the highest ash content (27.41 %). The highest protein content was found in commercial non-pasteurised juice at the end of the study period (28 days). Potassium was the most abundant mineral and the highest value (602.64 mg.L⁻¹) was recorded in commercial non-pasteurised watermelon juice. Indigenous watermelon juice generally contained higher concentrations of heavy metals detected in the samples. Although a little lower than commercial watermelon juice, the nutritional value of the indigenous watermelon juice was remarkable. Therefore, indigenous watermelon juice could be further exploited to obtain similar benefits as offered by commercial watermelon juice.

The effect of phenological growth stage on the antioxidant, cytotoxicity and metabolic variation in *Buddleja saligna*

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Abstract: *Buddleja saligna* (BS) is traditionally used to treat sores, colds and coughs and its phytochemical and pharmacological activities have been extensively researched. Due to its promising pharmacology, BS has the potential to be used as an additive in sunscreens. The phenological stages influence the phytochemistry and biological activity of plants. The study aimed to identify a recognisable harvest stage with better bioactivity. Leaves and twigs of BS were harvested at seven different phenological stages and shade dried. Ethanolic extracts were tested for antioxidant activity {DPPH and nitric oxide assays (NO)}. The antiproliferative activity of BS was tested on UCT-MEL-1 cells. A ¹H-NMR metabolomic analysis was performed to compare chemical profiles of samples harvested at different phenological stages. The phenological stages affected the antioxidant activity as samples collected during flowering and vegetative growth had higher DPPH (EC₅₀ of 4.7 and 5.4 µg/ml, respectively) and NO activity (EC₅₀ of 65.0 and 53.8 µg/ml, respectively). Furthermore, these stages had better antiproliferative activity against UCT-MEL-1 cells with EC₅₀ values around 60 µg/ml. Samples collected from flowering and vegetative growth stages in the current study resulted in improved activity compared to the best reported DPPH activity (EC₅₀ of 8.1 µg/ml). PCA showed clear separations with good predictability scores (Q² > 0.5), while OPLS-DA showed unclear separations with low predictability scores (Q² < 0.1). High antioxidant activity is essential for the use of extracts in sunscreens. The leaves of BS should therefore be harvested when the plants are actively growing, or during the flowering stage to ensure higher activity.

Diversity, antimicrobial and extracellular enzymatic activity of endophytic fungi isolated from the stems of *Kirkia acuminata*

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Abstract: Medicinal plants are essential therapeutic agents used by around 80% of people in developing countries for primary health care. However, over-reliance on medicinal plants poses a threat of extinction for many plant species as harvesting is not accompanied by replanting. *Kirkia acuminata*, a medicinal plant used to treat various ailments, is declining in the natural environment due to overharvesting by ethno-medicine practitioners. This necessitates the search for sustainable alternatives for obtaining plant-similar secondary metabolites. Medicinal plants harbour endophytic fungi that can produce plant-similar secondary metabolites and novel natural compounds with beneficial bioactivities including antimicrobial and anticancer activities. Endophytic fungi also produce various enzymes with application in industries, including the food and pharmaceutical industries. Interestingly, fungal endophytes of South African medicinal plants are relatively under-explored. The aim of this study was to isolate and screen the antimicrobial and enzymatic activities of endophytic fungi of *K. acuminata* stems. Nineteen morphologically distinct endophytic fungi were isolated from surface sterilized stems. Sequencing of the internal transcribed spacer region revealed that all the isolates belong to phylum Ascomycota. Ethyl acetate crude extracts of the isolates had minimum inhibitory concentrations ranging from 1,25 to 2,5 mg/ml against clinically significant bacteria. Enzyme screening revealed that 90% of the isolates possess amylase and lipase activities, 58% exhibited laccase activity, 74% exhibited peroxidase activities and 53% exhibited protease activity. Interestingly, four isolates produced all the screened enzymes. This study substantiates the potential of South African medicinal plants as sources of fungal endophytes with potentially significant biological and biotechnological applications.

A quantitative survey of medicinal plants found in Bapedi home gardens at *Ga-Maponto* village, Capricorn District, Limpopo Province, South Africa

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Abstract: The compilation of ethnomedicinal information using both qualitative and quantitative methods is slowly and precisely gaining momentum with a certain degree of validation of the data collected. Data on medicinal plants were gathered through a survey conducted amongst Sepedi-speaking residents found at *Ga-Maponto* village, Capricorn District, Limpopo Province, South Africa. The study aimed at highlighting medicinal uses and medicinal species found in the Bapedi home gardens. A flip file with 40 composite photo plates of Bapedi medicinal plant species from 26 families and 38 genera was used as a research tool. A total of 40 research participants were identified for the study. The study results were analysed using different statistical methods or indices. At the end of the survey, *Citrus limon* (0.98), *Punica granatum* (0.95), *Ziziphus mucronata* (0.89), *Psidium guajava* (0.86), *Adansonia digitata* (0.83) and *Moringa oleifera* (0.81) recorded the highest Species Popularity Index (SPI). The ailments with the highest citation included analgesics (252), followed by stomach problems (228), reproductive problems (91), dermatological problems (71), and others (68) covering pediatric, cardiovascular, and endocrine diseases. Ethnomedicinal Knowledge Index (EKI) indicates children with an average EKI of 0.49, youth with 0.71, adults with 0.85, and elderly with 0.82. The high SPI, EKI, as well as high citation of treated ailments, reflect the popularity of traditional medicinal practice to be still relevant in *Ga-Maponto* village. It was also interesting to find that enigmatic species like *Adansonia digitata* are among the popular species found within the home gardens of Bapedi residing at *Ga-Maponto* village. This quantitative data will allow future comparisons of Bapedi medicinal plant uses with other cultural groups as well as the recording of use change patterns over time.

Isolation and biological activity of compounds isolated from leaf of *Lonchocarpus capassa*

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Abstract: The leaf extracts of *Lonchocarpus capassa* were investigated for antifungal activity against *Cryptococcus neoformans*. Solvent-solvent fractionation was used to partition acetone extracts into four fractions: chloroform, *n*-butanol, acetone, and water respectively. All fractions were screened for antifungal activity using serial extraction and bioautography assays. Acetone fraction were active against the fungal pathogens with MIC value of 0.02 and 0.63 mg/ml. Antioxidant activity of the plant extracts were investigated using a qualitative assay (2, 2-diphenyl-1-picrylhydrazyl (DPPH)). The methanol and acetone extracts of *L. capassa* was the most active radical scavenger in the DPPH assay as compared to other plant species. Bioassay-guided fractionation using column chromatography of acetone fraction led to the isolation of two pure compounds. Nuclear Magnetic Resonance (NMR) and Mass Spectrometry (MS) were used for the identification of isolated compounds. Compound 1 was identified as Lupeol and Friedelin (compound 2). The efficacy of the traditional preparation methods was endorsed by the activity of water extracts and fraction against the tested fungal pathogens.

The effect of growing media on phytochemical constituents of *Bulbine frutescens* and extract antifungal activities against *Fusarium oxysporum*

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Abstract: The effects of growth media on physiological response, nutritional compositions, and bioactive compounds in *Bulbine frutescens*, an important South African folkloric medicinal and ornamental plant were evaluated. Furthermore, the antifungal activity of acetone crude leaf extracts was also tested against the *Fusarium oxysporum* pathogen. The growth media comprised of Vermicompost + Biochar + Sand in the ratios 2:1:1; 1:2:1; 1:1:2 and 1:1:1 (Control). The ratio 2:1:1 recorded the highest leaf number (84), leaf length (18.36 cm), number of roots (7), root length (35.03 cm) and nitrogen (26.30 g/kg), while P levels were higher in the control (3.57g/kg). The highest concentrations of Cu (9 mg/kg), Fe (82.33 mg/kg), Mn (30.67 mg/kg) and Zn (53.67 mg/kg) were also reported at ratio 2:1:1. The MIC (mg/ mL) of the extracts ranged between 0.62 - 1.25 and 0.50 – 1.25 respectively 6 and 12 hrs after exposure. The total polyphenols, flavonols and alkaloids ranged between 7.08 and 9.31 mg GAE/g, 2.35 - 3.10 mg QE/g and 4.14 - 6.29 mg/g respectively. The anti-fungal activity at 6 and 12 hours significantly correlated with the secondary metabolites of *B. frutescens* found in this study except for polyphenols. These results indicate that *B. frutescens* possesses antifungal activities against *F. oxysporum* regardless of growth media. A high composition of vermicompost in the growth media, however, conceivably favours *B. frutescens* physiological growth, nutrient accumulation, and secondary metabolite production.

Application of biochemometrics as a novel approach to identify bioactive molecules in medicinal plant research

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Abstract: The biological activities and identification of the biologically active compounds of medicinal plants have long been determined through the reductionist approach. However, this process has proven to be costly and time-consuming. Metabolomics, an unbiased holistic method, is used to identify and quantify the large number of compounds in a metabolome. Biochemometrics combines chemical profiles and biological activity data using multivariate data analysis tools to identify bioactive compounds in medicinal plants. In this study, a biochemometrics approach was used to correlate essential oil profiles to anxiolytic activity data, and subsequently identify bioactive compounds. Commercially available essential oils (n = 60) reported to exhibit possible anxiolytic activity were identified and sourced internationally from Pranarôm. The anxiolytic activity assay was performed on five days post fertilisation (5 dpf) zebrafish larvae using light-dark transitions to induce anxiety and monitoring locomotor activity. Essential oil profiles were determined using gas chromatography coupled to mass spectrometry (GC-MS). The essential oils of *Boswellia carterii*, *Pogostemon cablin* and *Lavandula burnatii* displayed the best anxiolytic activity, comparable to that of the positive control, diazepam. Following integration of the anxiolytic activity data with the chemical profiles, biochemometrics analysis revealed the putative biomarkers in the 15 active essential oils (mean difference greater than 5%) to be α -pinene, p-cymene, camphene, camphor, linalyl acetate, trans-anethole and carvone. This study supports the use of biochemometrics as a reliable, untargeted and fast approach for the identification of bioactive constituents in medicinal plants.

***In vitro* antiproliferative activity and upregulation of PTEN in melanoma cells using medicinal plants**

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Abstract: Phosphatase tensin homolog (PTEN) is inactivated in melanoma due to loss-of-function mutations, thereby the PI3K/Akt/mTOR cascade is hyperactivated. The aim of this study was to evaluate the antiproliferative activity of 36 plant extracts (prepared using ethanol, dichloromethane, and water) on melanoma cell lines, bio-assay guided fractionation from a bioactive extract, encapsulation of the bioactive extract and bioactive compounds in solid-lipid nanoparticles (SLNs) and to determine the mechanism of action by targeting various factors related to the PI3K/Akt/mTOR cascade. An ethanolic extract of a plant belonging to the Acanthaceae family (HF), displayed high antiproliferative activity against human malignant melanoma (RPMI-7951 & A375), and moderate antiproliferative activity against non-tumorigenic kidney cells (Vero) with fifty percent inhibitory concentrations (IC₅₀) of 46.79 ± 2.25 , 38.47 ± 0.92 and 68.52 ± 6.00 µg/mL, respectively, resulting in selectivity indexes of 1.46 and 1.78, respectively. Mechanistic studies (Akt and PTEN modulation) were carried out using RPMI-7951 due to the PTEN-null mutation present in this cell line and A375 which expresses PTEN. HF inhibited Akt after four hours at a concentration of 3.00 µg/mL and upregulated PTEN activity by 18.94 ± 4.56 % at 1.50 µg/mL. The collective data highlights the potential use of HF as a targeted therapeutic for human malignant melanoma as it upregulates PTEN activity, thus, regulating the PI3K/Akt/mTOR cascade. The data also highlights the potential for the inhibition of hypoxia-inducible growth factor alpha (HIF-1-α), the link between PTEN and angiogenesis in melanoma.

Evaluation of the estrogenic activity of rooibos tea

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Abstract: Rooibos, an indigenous South African herbal tea, has been shown to contain plant polyphenols structurally mimicking estrogen. This finding prompted the Memorial Sloan Kettering Cancer Centre to caution estrogen-sensitive cancer patients, such as breast cancer patients, against rooibos tea consumption. However, there is limited literature demonstrating whether rooibos mimics the biological activity of estrogen in a manner that indeed poses a risk. Hence, the warning may be premature and could adversely affect the international rooibos industry as breast cancer is the most common cancer globally. Most breast cancer cells contain the estrogen receptor alpha (ER α), which requires 17 β -estradiol (E2), an endogenous estrogen, to activate E2-responsive gene signalling events and thereby regulate various proteins that promote or influence breast cancer. Importantly, ER β inhibits ER α activity. Moreover, plant polyphenols, which mimic E2 (phytoestrogens), show preferential activation of ER β . This research aims to, firstly, determine whether rooibos extracts display estrogenic activity and, secondly, evaluate whether this activity promotes poor prognosis in ER-positive breast cancer. Specifically, different rooibos extracts were evaluated via promoter-reporter assays to determine whether the extracts induce gene regulation via ER α or ER β . Furthermore, the levels of E2-regulated proteins associated with breast cancer development and progression in response to the extracts were evaluated via western blot. The results suggest that the extracts display weak estrogenic activity at both gene signalling and protein expression levels. This project may provide novel insight into the molecular mechanism of rooibos estrogenic activity which may indirectly affect affiliated global herbal tea and nutraceutical markets.

Antioxidant and anticancer potential of *Cotyledon orbiculata* crude extracts on cervical cancer cells

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Abstract: Cervical cancer is rated the fourth most common cancer and the leading cause of mortality in women, worldwide. This may be attributed to the lack of adequate healthcare facilities and late diagnosis, especially for underprivileged women; thus, novel, affordable and effective anticancer alternative strategies are needed. Moreover, medicinal plants have gained a lot of interest as alternative source of drugs for several diseases, including cancer. Therefore, this study was aimed at exploring the antioxidant and the potential anticancer activities of various *Cotyledon orbiculata* crude extracts against cervical cancer cells. *Cotyledon orbiculata* leaves were collected, dried and extracted using distilled water, methanol, acetone and hexane. The extracts were reconstituted in acetone for antioxidant assays and in dimethylsulphoxide (DMSO) for cell culture-based assays. The antioxidant activity of the plant crude extracts was analysed using DPPH free radical scavenging and the ferric reducing antioxidant power assays. Cervical CaSki (ATCC®CRL-1550™) and HeLa (ATCC®CCL-2™) cancer cells were cultured and maintained as described by the American Type Culture Collection (ATCC), and then the MTT assay was used to assess the cytotoxic effect of *C. orbiculata* crude extracts on these cervical cancer cells. The acetone crude extract recorded the highest antioxidant activity, while the least activity was observed from the distilled water crude extract. The acetone, methanol, and hexane crude extracts significantly ($P < 0.001$) reduced the viability of CaSki and HeLa cells after 48-hour treatment. Therefore, the *C. orbiculata* crude extracts demonstrating biological and therapeutic activities may possess compounds that may either be used as anticancer agents or serve as templates for anticancer drug development.

The role of indigenous vegetables in rural households: the case of Mogaladi village, Limpopo Province, South Africa

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Abstract: Indigenous vegetables have been consumed by rural communities for centuries and can contribute to household food security by providing access to readily accessible nutritious food. To assess the importance of indigenous vegetables, a survey was conducted in Mogaladi rural village in the Sekhukhune District of the Limpopo Province. Data was collected by means of focus group discussions, the seasonal calendar, an open-ended questionnaire, and a check list. Thirty-two women living in Mogaladi village participated in the research. The results showed that indigenous vegetables were abandoned in summer. Pumpkin, amaranth, blackjack and cowpea leaves were the most popular vegetables. Because it supplies leaves, fruits, and seeds, pumpkin was the most popular vegetable. Respondents' cooking times and processing of indigenous vegetables varied, causing some concern about the loss of nutrients. Most respondents indicated that they consume indigenous vegetables more than twice a week. It was also evident that the consumption of indigenous vegetables is declining because of changes in food behaviour patterns, climate change and land use. Information on agronomy and education in nutritional values and food preparation methods to avoid nutrients loss are needed. It is recommended that indigenous vegetables be promoted by health practitioners and agricultural extension workers so that knowledge of indigenous vegetables is passed on from one generation to the next.

Identification and characterisation of compounds with antimycobacterial activity from the leaves of *Dombeya rotundifolia*

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Abstract: Plants are not only an important source of medicines, but also play a significant role in drug development for the treatment of diseases such as Tuberculosis (TB). TB is a pulmonary disease that is caused by *Mycobacterium tuberculosis* complex. The aim of the study is to identify and characterise antimycobacterial compounds from *Dombeya rotundifolia*. The plant was collected from the University of Limpopo. Extraction was done using different solvents that differ in polarity, the plant was screened and analysed for phytochemicals. The antioxidant activity of the plant was determined using DPPH and ferric reducing power assay. The antibacterial activity was determined using bioautography and serial microplate broth dilution assay. The isolated compounds were analysed and identified using nuclear magnetic resonance spectroscopy (NMR). The results obtained in this study showed that water was the best extractant, extracting 57.6 mg of the plant material. In the phytochemical analysis of TLC plates, there was a separation of compounds in all the mobile systems, and a clear separation of compounds was observed in the BEA mobile system. The plant extracts had antioxidant activity, which was confirmed by the quantitative assays. The high inhibitory activity of the extracts was indicated by low MIC values that inhibited the bacterial growth. The butanol extract had the lowest MIC value (0.13 mg/mL). The isolated antimycobacterial compounds were identified as Eicosanoic acid and Docosanoic. The isolated compounds showed that the plant has a potential to treat TB or symptoms related to TB. However, further studies are needed before use.

Chemical profiling and antibacterial activity of three *Oncosiphon* species indigenous to South Africa

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Abstract: The genus *Oncosiphon* (Asteraceae) consisting of aromatic herbs and is indigenous to the Cape Floristic Region of South Africa. *Oncosiphon* species have been documented in the Cape Dutch ethnobotany as herbal remedies for the treatment of typhoid fever and pneumonia. Very few studies have been conducted to scientifically validate the medicinal claims, as well as to document the phytochemical profiles of these species. This study aimed to use various chromatography methods to profile both the volatile and non-volatile constituents of three South African *Oncosiphon* species, namely *O. suffruticosus*, *O. grandiflorum* and *O. africanus*, and to evaluate the antibacterial properties in relation to their traditional uses. Plant specimens (n=48) were collected from various locations in the Western Cape Province of South Africa. Phytochemical profiling was performed on the crude extracts using high-performance thin layer chromatography (HPTLC) and ultra-performance liquid chromatography coupled to mass spectrometry (UPLC-MS), while two-dimensional gas chromatography (GCxGC-ToF-MS) was used to determine the headspace volatile profiles of the aerial parts. Multivariate data analysis was performed on UPLC-MS dataset using SIMCA-P+ 14.0 and rTLC software was used to analyse the HPTLC fingerprints. The antibacterial activity of the crude extracts was investigated using the broth microdilution assay, and biochemometrics was applied to determine possible biomarkers associated with activity. The study revealed chemotypic variation in both the non-volatile and volatile constituents of the three species. Moderate to poor antimicrobial activity (1-8 mg/mL) was observed for majority of samples. This study is the first to comprehensively document phytochemical profiles of the three *Oncosiphon* species.

Proteome analysis of *Mycobacterium* species following treatment with extracts of selected medicinal plants

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Abstract: *Mycobacterium tuberculosis*, a causative agent of tuberculosis uses specialised mechanisms to evade the immune system and ensure its survival and persistence. Knowledge of protein molecules that are induced and play a role in the survival and pathogenicity of the bacterium in response to antimicrobial agents including medicinal plants could be vital to the effective treatment, management, and control of the TB disease. This study uses a bottom-up proteomic approach to trace proteomic changes correlated with exposure of *Mycobacterium smegmatis* ATCC 14468 to bioactive extracts from medicinal plants. The leaves and stem of nine plants (*Gardenia volkensii*, *Clerodendrum glabrum*, *Croton gratissimus*, *Senegalia senegal* (= *Acacia senegal*), *Citrus limon*, *Ziziphus mucronata*, *Rosmarinus officinalis*, *Carissa edulis* and *Zanthoxylum capense*) that are used traditionally to treat TB- related symptoms were dried, ground, and extracted by five solvents of varying polarities. The Phyto-constituents were detected using biochemical tests. Seven plant extracts that exhibited antimicrobial activity against *M. smegmatis* were selected. For differential protein expression, *M. smegmatis* was treated with plant extracts that were able to inhibit its growth in broth microdilution assay with rifampicin and untreated *M. smegmatis* culture as controls. The differentially expressed proteins from the treated and untreated cultures of *M. smegmatis* were precipitated with TCA-acetone, centrifuged, resuspended in lysis buffer, separated, and analysed on SDS-page gel. The gel results demonstrate that the extracts induced a statistically significant increase of some specific proteins' expression compared to the positive control (rifampicin). This indicates that the plant extracts might have a different and a more aggressive mechanism of action on *M. smegmatis*.

An inventory of medicinal plants in Africa: a comparative analysis

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Abstract: This study analysed and synthesised the use of African Traditional Medicine, specifically its use of botanical materia medica and regional diversity patterns. The research examined the number of medicinal plant taxa, including families, genera, and species, in traditional medicine across various African regions and countries and provided a comparative analysis of families, genera and species used. The data was collected using a checklist of flowering plants for the African continent, an online checklist called *Plants of the World Online*, and electronic search engines and reviews of published books, journals, and other relevant materials. By using search engines and databases, the study aimed to better understand the diversity of African Traditional Medicine with a specific focus on the sub-Saharan region. One of the key findings included 219 families, 3643 genera and 10957 species. It also indicated the top 30 families and genera with the highest species richness, and among those, Rubiaceae, Poaceae, and Euphorbiaceae families are the top three. The research found low similarities in plant families between East Africa and West Africa (0.56), East Africa and South Africa (0.56), and Southern Africa and West Africa (0.58). This result is surprising, because families are universally distributed (unlike genera and species). The degree of likeness decreases even further among regions regarding the genera and species utilised for medicinal reasons compared to families. These findings indicate that African traditional medicine is diverse and dynamic. It is important to note that there are notable regional differences in the specific taxa utilised for their medicinal properties.

The use of medicinal plants for the synthesis of metal oxide nanoparticles for biomedical applications

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Abstract: Medicinal plants have gained recognition from the Western, Asian and African cultures, as a source of medicines for the treatment of a plethora of diseases and conditions. Their use has extended to a number of various applications, including nanotechnology, especially, the synthesis of nanoparticles (NPs). This is due to their possession of numerous secondary metabolites that can act as reducing agents for green synthesis of nanoparticles with bioactivities, encompassing bactericidal, anticancer and antioxidant activities. We have used several plants to synthesise metal oxide nanoparticles with both anticancer and bactericidal properties. The medicinal plants that we have used to produce NPs with biomedical activities include *Commelina benghalensis* and *Millettia stuhlmannii*. These NPs have shown activity against lung and breast cancer cells. Both the synthesis and activities of the nanoparticles can be attributed to the plants' phytochemicals; namely, phenolic compounds, glycosides, saponins, flavonoids, terpenoids, tannins, and other metabolites, depending on the plant involved. These medicinal plants-derived NPs can be fine tuned as delivery vehicles with intrinsic anticancer or bactericidal activities.

Phytochemical screening and antibacterial activity of the leaf and bark extracts of *Zanthoxylum chalybeum* against pathogenic bacteria

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Abstract: Bacterial resistance is a major problem that threatens the health systems globally. The problem is compounded by the emergence of MDR pathogens such as the ESKAPE pathogens. Given the MDR pathogen mortality projections that exceed 10 million per annum by 2050, there is a need to continuously search for new therapies. *Zanthoxylum chalybeum* leaf and bark material was extracted with solvents (hexane, chloroform, Dichloromethane, and methanol), to determine its chemical diversity and antimicrobial potential against *Staphylococcus aureus*, *Pseudomonas aeruginosa* and *Klebsiella pneumoniae*. The leaf acetone (average MIC 0.520 mg/ml) extract and both methanol extracts (average MIC 0.729 mg/ml for both) were found to be more potent, being capable of exerting significant inhibitory activities against all three pathogens. *S. aureus* was the most sensitive pathogen with an average MIC value of 0.43 mg/ml. Qualitative phytochemical screening was carried out using standard methods, which demonstrated the presence of alkaloids, flavonoids, triterpenoids and terpenoids. Thin layer chromatography and bioautography revealed that spots with Rf values of the inhibiting components were spot A, at Rf values between 0.43 and 0.47 in all but the leaf methanol extract in all bacteria, and spot B at Rf 0.28 in the leaf acetone and leaf DCM extracts in *P. aeruginosa*. The spots represented terpenoids and flavonoids respectively. The results show that the presence of bioactive compounds and the antibacterial activity in *Z. chalybeum* can suggest its possible use in the treatment of infectious diseases.

Growth and yield performance of *Amaranthus* varieties in animal manure amended and mycorrhizae enhanced acidic soil of Lusikisiki in O. R. Tambo District, Eastern Cape Province, South Africa

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Abstract: Indigenous leafy vegetables such as amaranth (*Amaranthus* sp.) possess attributes that make them ideal for production under marginal production and harsh climatic conditions. In the Eastern Cape, *Amaranthus* is very popular among the rural communities but is rarely cultivated. Production of vegetables in the province is hindered by factors such as soil acidity. In acidic soils, phosphorus tends to be adsorbed to the surfaces and becomes unavailable to plants. To ameliorate acidic soils, lime is required but most smallholder resource limited farmers do not afford it. These farmers also use animal manures to fertilize their gardens and when applied to acidic soils, animal manures have an ameliorative effect. Another affordable alternative towards making phosphorus more available to plants in acidic soils is inoculation of plants with Arbuscular Mycorrhizal Fungi (AMF). AMF colonize the plant's root system and draw nutrients and water from the soil. A study was therefore conducted to evaluate the effectiveness of augmenting acidic soil with different animal manures namely: cattle, sheep, poultry, goat and mineral fertilizers i.e. NPK and lime as well as inoculating with AMF, used singly or in combinations, on growth and yield of *Amaranthus* varieties. Fertilization of plants with animal manures singly or in combinations with NPK fertilizer and inoculation with AMF improved growth and yield of *Amaranthus* varieties to be comparable with those fertilized with recommended NPK and lime. These plants performed better than the unfertilized and those inoculated with AMF only.

Abiotic stress tolerance and symbiotic effectiveness of native rhizobia nodulating soybean (*Glycine max*) in Ghanaian soil

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Abstract: Soybean forms a symbiotic relationship with nitrogen-fixing bacteria generally called rhizobia. Abiotic stress factors such as soil salinity, drought, and extremes of pH adversely affect the growth of both soybean and rhizobia. Meanwhile, the establishment and persistence of rhizobia in stressed environments are required for effective nodulation, which depends primarily on their ability to reproduce and survive in those conditions. This study aimed to evaluate the symbiotic effectiveness of rhizobia nodulating soybeans and to assess their tolerance to stress factors such as extreme pH, salinity, and drought. For this, the root nodules of soybean were randomly sampled from the upper west region in Ghana, surface sterilized, streaked on yeast mannitol agar plates, and incubated at 28°C for growth. The pure cultures were further characterized using morphological and biochemical methods. The results showed that 30%, 23%, and 47% of the isolates tested were ineffective, moderately effective, and highly effective, respectively. Isolates TUTGMGH25, TUTGMGH20, TUTGMGH17, and TUTGMGH16 which had the highest relative symbiotic effectiveness values and also exhibited higher nodulation and shoot dry weight. Moreover, 67% of the 30 isolates tested with bromothymol blue turned the media to yellow, indicating that they were acid producers and fast growers. While isolates TUTGMGH8, TUTGMGH9, and TUTGMGH12 were able to tolerate NaCl concentrations up to 5%, only isolate TUTGMGH9 could withstand a PEG600 concentration of 5%. The best performing isolates can be used to produce inoculants for sustainable soybean cultivation upon further testing in the field.

***In vitro* assessment of biological activities of selected indigenous plant species used for management of respiratory tract infections and symptoms**

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Abstract: Microorganisms are constantly developing resistance to known antibiotics and that necessitate discovery of new antimicrobial agents. The study aims to evaluate the antimicrobial properties of four selected plants used for respiratory tract infections. The stem powders were extracted with n-hexane, dichloromethane, acetone, methanol, and water. Qualitative and quantitative phytochemical analysis were performed. Antioxidant activity was determined using DPPH and ferric reducing power assays. Protein denaturation was used to determine the anti-inflammatory activity. The ability of the plant extracts to inhibit *Pseudomonas aeruginosa* and *Klebsiella pneumoniae* was evaluated using bioautography and broth micro-dilution assays. Cytotoxicity was evaluated using brine shrimp lethality assay. Phytochemical compounds were observed on non-polar TLC chromatograms, furthermore, cardiac glycosides, phlobatannin, saponins, steroids, tannins, terpenoids were present in all the plant extracts. *P. africanum* acetone extract had the highest phenolic (294.17 ± 4.73 mg GAE/g) and flavonoid (1155.87 ± 2.79 mg QE/g) contents, whereas *C. bispinosa* acetone extract had the highest tannin content (1571.77 ± 0.81 mg GAE/g). The water extracts of these two plants had the highest free radical scavenging activity than L-ascorbic acid. *S. petersiana* acetone and *P. africanum* methanol extracts had the highest ferric reducing power. The plant extracts had moderate anti-inflammatory. *S. petersiana* acetone extract had the lowest MIC value (0.078 mg/mL) against *K. pneumoniae* whereas *P. africanum* had the lowest MIC (0.078 mg/mL) against *P. aeruginosa* and it was the least toxic plant. The study highlights the effectiveness of the plant extracts as potential treatment for bacterial respiratory tract infections.

Yield and chemical composition of *Greyia radlkoferi* leaves exposed to different watering regimes

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Abstract: *Greyia radlkoferi* Szyszyl. is one of the southern African medicinal plants used in development of cosmeceutical products. *Greyia radlkoferi* leaves contain flavonoids reported to inhibit the production of melanin and therefore hyperpigmentation. Although the flavonoid content in plants is influenced by environmental factors such as rainfall and soil conditions, there is little research work done evaluating the growth and chemical composition of *G. radlkoferi* under various irrigation treatments. The study was aimed at investigating the effect of water stress on the yield and chemical composition of *G. radlkoferi*. Two-year-old plants were exposed to six different irrigation regimes. The treatments included irrigating to 100% of the depleted water from the pots once (T1), twice (T2), and three times (T3) every week, 75% once a week (T4), and 50% twice (T5), and three times (T6) a week. The average leaf yield per plant was significantly affected by the irrigation frequency (associated with water stress levels). Plants exposed to treatment T3 recorded a significantly higher leaf yield than T1, T2, T4 and T6. The stomatal conductance measurements taken before and after each watering session showed a significant effect of water stress on the parameter. The total phenolic content was significantly higher in T4 and T6, while the flavonoid content was significantly reduced in the two treatments. Clustering based on the nuclear magnetic resonance analysis grouped T1 to T4 together by the presence of catechin, epigallocatechin, galangin, gallocatechin, 2',4',6'-trihydroxychalcone, and 2',4',6'-trihydroxydihydrochalcone, while pinocembrin was responsible for the grouping together of T5 and T6. The study recommends growing *G. radlkoferi* under adequate irrigation regime (with reduced water stress) for improved yield without compromising its currently known active ingredients (2', 4', 6'-trihydroxydihydrochalcone) in cosmeceutical preparations.

***Momordica balsamina* methanol extract inhibits the metastatic potential of interleukin-6-activated MDA-MB-231 breast cancer cells through regulation of the IL-6/JAK2/STAT3 pathway**

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Abstract: Interleukin-6 and STAT3 are constitutively overexpressed and activated in triple-negative breast cancer and mediate tumour cell survival, progression, invasion, metastasis, immunosuppression, and poor patient outcome. Medicinal plants contain tolerable phytochemicals with anti-oxidative and anti-inflammatory properties for the treatment of various diseases including cancer, making them a better alternative to current cancer treatments. This study investigated anti-metastatic effects of *Momordica balsamina* methanol extract (MBME) in interleukin-6-activated MDA-MB-231 breast cancer cell line. The Muse® cell count and viability assay revealed that the MBME (≤ 100 $\mu\text{g/ml}$) exhibited minimal toxicity to the viability of breast cancer MDA-MB-231 cells and kidney HEK-293 cells. Determination of the mode of cell death using the annexin-V assay showed that the reduction in cell viability was associated with apoptotic cell death. Furthermore, an increase in *Bax* and decrease in *Bcl-2*, *JAK2*, *STAT3*, *MMP-2* and *MMP-9* mRNA expression, was observed in extract-treated MDA-MB-231 cells as determined by RT-PCR. Western blot analysis showed that the extract decreased MMP-2, MMP-9, and vimentin and increased TIMP-3 protein expression in IL-6-activated MDA-MB-231 cells. In addition, gelatin zymography also showed a decrease in the activity of MMP-2 and MMP-9 in extract-treated IL-6-activated MDA-MB-231 cells. Furthermore, MBME treatment significantly inhibited the invasive, migratory, and attachment to extracellular matrix proteins potential of IL-6-activated MDA-MB-231 cells. In conclusion, the MBME inhibited the IL-6-induced MDA-MB-231 cell invasiveness, migration, and adhesiveness through the modulation of the IL-6/JAK2/STAT3 pathway.

Utilisation of indigenous plants during and post-Covid-19 era by people of the Vhembe region

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Abstract: The outbreak of Coronavirus shocked people around the world; inhabitants of rural villages were negatively impacted as the treatment was unknown. As a result, local people developed their traditional ways of treating any symptoms related to Influenza by using different indigenous plant species. This study investigated indigenous plant species that were used by inhabitants of the rural villages of the Vhembe region during and post-COVID-19 era. Results emerged from the semi-structured interviews conducted with 15 adult participants from the four rural villages. The study recorded a total of 13 plant species identified to have capabilities of treating symptoms related to influenza, sore throats, cough, and fever. These plants belong to nine taxonomic families with Asteraceae at the top of the list. The treatment of these symptoms is achieved by the administration of oral decoctions, giggling by the decoctions extracted from leaves of the recorded plant species. Leaves of some plant species are boiled and the boiling infusions are used for steaming. Some participants burnt the leaves of one plant and sniff the smoke for the treatment of the symptoms. The continued use of these plants even post-COVID-19 era is a clear indication of their indispensability to rural communities. The traditional plant-derived medicine revealed during this study may be checked for their safety and efficacy to simply discover the new local and affordable drugs that could be used for conditions such as COVID-19.

Effects of different concentrations of Phytostim® biostimulant application on growth and yield of tomato

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Abstract: Cherry tomatoes are climacteric fruit that are susceptible to perishability at ambient temperature. The aim of the study was to evaluate the impact of different concentrations of Phytostim biostimulant on growth and yield parameters in cherry tomato. Four treatments based on different concentrations of Phytostim untreated, 1%, 0.5% and 3%, replicated eight times, applied in foliar application in 14 days interval. cherry tomato seeds were sown and germinated in polystyrene trays filled with Hygromix growth medium prior to transplanting. After 4 weeks of germination, seedlings were transplanted in a mixture of growth medium consisting with hygromix growth medium, pasteurized loam, and sandy soil at a ratio of 2:1:1. Data for stem diameter, number of fruits per cluster and plant height were collected weekly, whilst data such as leaf length, root length, fresh-biomass, fresh-aerial mass, fresh-root mass, dried aerial mass, and dried root mass and number of fruits per plant were collected at termination day after 14 weeks. All collected data were subjected to analysis of variance and LSD for separation of means statistix 10.0. 1% improved plant height, stem diameter, increased number of fruits whilst the application of 0 and 0.5% showed lower but increasing trends in the same growth and yield components. Application of 3 % showed to inhibit plant growth by retarding plant height, stem diameter, leaf length, decreased number of fruits, and root length. Application of 1% concentration can be recommended for improved growth and yield in *cherry tomato*. Phytostim is environmentally friendly and organic product that can be adopted by farmers.

Developing the Biodiversity Management Plan for *Pelargonium sidoides*

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Abstract: TRAFFIC has been involved with the sustainability and conservation of the African medicinal plant *Pelargonium sidoides* since the early 2000's and has played a central role in developing the current Biodiversity Management Plan (Newton *et al.* 2013) for the species as well as focusing on the sustainable harvest, biological, legislative and socio-economic issues related to the conservation management of this important medicinal plant resource. *Pelargonium sidoides* is endemic to Lesotho and South Africa and is used locally and internationally in the production of phytomedicines. South Africa's domestic and international export markets are focused on a handful of indigenous plant species that supply ingredients to specific bioproducts, one of which is *Pelargonium sidoides*. The plant's root extract is used to treat a range of ailments, including common colds, respiratory infections, diarrhoea, colic and dysentery, making it one of the most important and high demand species in South Africa. TRAFFIC is currently implementing the *Pelargonium sidoides* component of the project "Development of Value Chains for Products derived from Genetic Resources in Compliance with the Nagoya Protocol on Access and Benefit Sharing and the National Biodiversity Economy Strategy". TRAFFIC's overall project goal is to update the Biodiversity Management Plan (BMP) for *Pelargonium sidoides* to ensure resource management and regulatory framework is in place. This presentation will provide a snapshot of the *Pelargonium sidoides* BMP process and the importance of this management plan.

Perceptions of the use, consumption and commercialisation of wild edible plants

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Abstract: Wild edible plants (WEPs) form a significant part of livelihoods and diets for many societies around the world. Nevertheless, the consumption, use and trading of WEPs is often viewed as a 'backward' practice, pursued mostly by elderly women and low-income households in rural areas. This study aimed to determine the consumption and perceptions of use and commercialisation regarding WEPs in four rural villages under the Moletjie tribal authority in the Polokwane local municipality, South Africa. A total of 120 Semi-structured interviews stratified by age, gender, and income groups, were conducted. Overall, perceptions relating to taste (98%), health (97%), nutrition (87%), and tradition (94%) were positive. Despite the positive perceptions, most participants (70%) expressed doubt over the commercial success of WEPs if they were to compete with exotic crops in the market as the majority (58%) would buy exotic foods more. However, they would be interested in buying WEPs from retail stores if they were available. As a result, they perceive the future of WEPs to be limited as 95% of respondents believe that WEP consumption is in decline due to deagrarianisation, climate change, and disinterest by the youth. Commercial availability of WEPs products in retail stores should be considered to improve acceptability, preference and to preserve future consumption of WEPs.

Growth and yield performance of *umsobo* (*Solanum nigrum*) to organic and inorganic fertilizers

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Abstract: A two-season experiment was conducted at the North West University Research Farm (Molelwane) to investigate the effect of organic and inorganic fertilizer on the growth, yield, and mineral content of *Solanum nigrum* (nightshade) accessions (N.Scabrum, N0096, Ncampus, and N4457). The experiment was a four-by-four factorial arrangement with three replicates in Randomized Complete Block Design (RCBD). The experiment lasted for two seasons. Soil physicochemical properties were assessed prior to cropping, but no soil analysis was performed after fertilizer application. At harvesting, data was measured and recorded (6 after transplanting). The area of the third leaf on the main apical stem was measured. SAS version 9.4 was used to perform analysis of variance and mean separation on the data. The results revealed significant differences ($p = 0.05$) between treatment, genotype, and treatment by genotype interaction. Maximum values for all studied characters were recorded in the 2019/20 cropping season for the NPK; 15:8:4 (27) group, followed by poultry treated groups. A similar trend was observed in the second cropping season (2020/21); however, the application of poultry manure produced the smallest and largest leaf area, followed by the application of NPK. At harvesting, the yield and yield-related parameters of the accession varied significantly. N.scabrum had a low number of leaves per plant (80.92) but a high leaf area, resulting in a high leaf fresh mass. Meanwhile, while Ncampus had a high number of leaves and primary branches per plant, the leaves were found to be small in size when compared to N.scabrum and N5547. Both cropping seasons showed a similar pattern. Significant differences were also found in the interaction between fertilizer treatment and genotype across the two cropping seasons. Across both seasons, the interaction of *N. scabrum* and fertilizer treatments was greatest in stem diameter, leaf area, leaf fresh mass, and stem fresh mass per plant with the application of NPK followed by poultry. For all genotypes used in the study, a similar trend was observed in the interaction between fertilizer and genotype. In terms of the traits studied, the results also revealed little variation between the values obtained for control and cattle manure. NPK (15:8:4) (27) and poultry manure treatments resulted in plants with significant vegetative growth, resulting in higher yields. In both cropping seasons, the yield of *N. scabrum* and Ncampus was either higher or come second in fields amended with poultry manure, comparable to the effect of NPK (15:8:4) (27) on yield. It thus implies that poultry manure can be used instead of mineral fertilizers to improve marginal soil fertility and nightshade performance.

Symbiotic performance of cowpea inoculated with native rhizobial isolates in the glasshouse

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Abstract: Selecting inoculants is a major challenge for farmers and BNF is an option for environment-friendly source of N, to optimize the application of fertilizer and sustain agricultural production. Cross infectivity studies are important for identifying rhizobial strains with potential for use as inoculants. Legumes and rhizobia symbiosis has the potential to contribute about 80% nitrogen to agricultural systems, they offer a potential sustainable source of N and their ability to fix N from the atmosphere. The study assessed N₂ fixation of diverse legume species inoculated with native rhizobial isolates in the glasshouse during 2022 cropping season. The ¹⁵N natural abundance determination of the shoot ¹⁵N was carried out at the Stable Isotope Laboratory. Approximately 2.0 mg of finely ground plant material was weighed into aluminium (Al) tin capsules to determine the %N, δ¹⁵N, N concentration and N-fixed values using a Carlo Erba NA1500 elemental analyzer coupled to a Finan MAT252 mass spectrometer. The results revealed highly significant differences among tested treatments in both 2021 and 2022 cropping seasons. In 2021, N-fixed derived between 3.78 kg.ha⁻¹ on the commercial inoculant to 0.38 kg.ha⁻¹ on isolate DA-PUA 2. In 2022, N-fixed ranged from 5.63 kg.ha⁻¹ isolate VUSA 1 to 0.13 kg.ha⁻¹ isolate DA-PUA 3. Commercial inoculant showed high level of N content in both seasons compared to the other strains. The N-fixed increased in 2022 season compared to 2021 season. Host range and cross-infectivity studies are important for identifying rhizobial strains with potential for use as inoculants, therefore Isolated cowpea strains VUSA 1, VUSA 2 and VUSA 3 were found to induce markedly increase in all the parameters which includes shoot DM, δ¹⁵N, %N, N concentration, N content and N fixed, suggesting that the three (3) native isolates have the potential for use as inoculants.

Production challenges around the species *Juncus lomatophyllus*

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Abstract: There has been little documentation on indigenous South African aquatic plants for bioactivity and propagation. Leaf extracts of aquatic plant *Juncus lomatophyllus* have been proven to inhibit the tyrosinase enzyme and inhibit skin hyperpigmentation. Propagation methods have however not been explored. In the current study propagation methods and seed histology were investigated. The difficulty to acquire enough plant material for trials highlighted the importance of establishing propagation protocols. The effect of five different growth media mixes on the growth of two *J. lomatophyllus* ecotypes (MP & WC) was investigated (complete randomized design, 4 replicates). Excessive rain and flooding complicated trials. Media2 (26.5 plants) and Media5 (25 plants) resulted in significantly more plants produced compared to other media. The Western Cape ecotype produced more biomass (wet and dry weight of leaves) when harvested. No seeds were available in the market and seeds harvested from the mother plants were used to evaluate the effect of different constant temperatures (15, 20, & 25°C). After various attempts, over 12 months germination was observed in the WC ecotype at 20 °C, however, germinated seeds died a week after due to fungal growth. Histology studies attempted to explain the difficulty in seed germination. The small size of the seeds was challenging, but results indicated that the seed had 3 seed coat layers. No embryo was visible in some of the seeds after a cross- and longitudinal-sectioning. Further germination and histology trials are being explored to overcome challenges faced in developing propagation protocols for better reliable results.

Gaseous exchange and water use efficiency of *Moringa oleifera* grown in different locations of South Africa

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Abstract: *Moringa oleifera* Lam. is a fast-growing plant tolerant to harsh climatic and environmental conditions where many agricultural plants would not survive. Moringa leaves, fresh pods, seeds, and roots are being widely and increasingly used for both humans and animals because of their higher contents of essential nutrients. The study was evaluated/compare the gaseous exchange measurement and the water use efficiency of *Moringa* grown in Gauteng and Limpopo province of South Africa. *Moringa oleifera* trees planted Limpopo exhibited higher photosynthetic rate, and water use efficiency compared to those that were planted at ARC in Gauteng. However, trees at ARC showed higher carbon assimilation as compared to those in Limpopo province. The data showed that carbon dioxide assimilation by the moringa trees is not an attribute of photosynthetic rate, transpiration rates as well as stomatal conductance. Under low rainfall area and high temperatures which is Limpopo province, *M. oleifera* used an adaptation strategy by reducing stomatal conductance and transpiration rate and hence increased water use efficiency. The study showed that *M. oleifera* can survive in harsh climatic conditions and environmental conditions, which makes it a potential crop to contribute to climatic change mitigation and nutritional security for both animals and humans given its many nutritional attributes.

Utilisation of plants for crop protection in South Africa: an appraisal of antifungal effect

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Abstract: Increased food insecurity caused by factors including crop diseases has prompted the use of medicinal plants as alternative control agents other than chemical treatments which have been associated with various limitations. This review critically assessed the antimicrobial studies of plants used for managing fungal-related crop diseases in South Africa. Electronic databases were accessed for scientific literature that meets the inclusion criteria. A systematic assessment resulted into 16 studies that generated an inventory of 66 plants (44 families) that are used in mitigating fungal-related crop diseases. In terms of plant families, Fabaceae and Solanaceae were dominant as they were each represented by five plants. Antifungal activities using microplate dilution method (62.5%) was the most common technique. Approximately 80% of the screened plants exerted some good antifungal activity ($MIC \leq 0.01$ mg/ml) against phytopathogens. *Breonadia salicina*, *Harpephyllum caffrum*, *Lantana camara*, *Moringa oleifera*, *Tagetes minuta* and *Vangueria infausta* were identified as the most screened plants, exerting potent antifungal activity against the highest number of phytopathogens (≥ 3 studies; ≥ 2 pathogens). Among the tested phytopathogens, fungi belonging to the genus *Fusarium* (69%) were the most investigated. This review provides a valuable reference material for future antimicrobial activity studies pertaining to medicinal plants with the potential of mitigating diseases in crops. More emphasis should be put on antimicrobial activity studies relating to other phytopathogens including bacteria and viruses as they are also responsible for crop losses.

Integrating IKS and technology in crop monitoring and prediction phytochemical composition in moringa

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Abstract: *Moringa oleifera* Lam., often grows well under cultivation in the tropics and sub-tropics. The plant is well-known for its nutritional and medicinal properties; hence it is fast gaining popularity in South Africa and the rest of the world. The objective of this study was to explore the potential use of technologies such as crop monitoring using satellite-based software as well as hyperspectral data in predicting the need for irrigation, fertilisation and estimating biomass yield and phytochemical composition of different cultivars of *M. oleifera*. Canopy hyperspectral data were collected on five *M. oleifera* cultivars when they were one month and two months old using a handheld spectroradiometer. First-order derivative was used to transform the reflectance spectra and analysis of variance (ANOVA) as well as random forest (RF) regression and classification algorithm were used to analyse the data. The results showed that the first-order spectra of the five cultivars were significantly different ($p < 0.05$) from each other in most portions of the electromagnetic spectrum. Furthermore, the results indicated that the studied *M. oleifera* cultivars can be discriminated from each other using their first-order derivative of reflectance and RF classifier. Satellite observations using crop monitoring software gave in-depth maps showing areas of low water and low soil nutrients over time.

Marula seed performance in response to imbibition and fertilisers

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Abstract: Marula plays an important role in diet, tradition and culture of many people however challenges on pre-treatment and germination of marula seed yielded often poor results. The objective of the study was to determine the effect of stress created by imbibition at different temperature regimes on the performance of marula during germination and seedling development. Marula seeds collected at Makonde Village were placed at room temperature for 18 months. The imbibition experiment was determined by soaking seeds for 48h in 75 mL distilled water at room temperature at four respective temperatures in growth chambers. Seeds were weighed daily and data on seed mass was recorded. The germination experiment was determined by a 3x4 factorial RCBD wherein seeds were planted on 30x30 cm pots filled with sandy loamy soil and fertilizer rates of 3 g/kg of kraal manure, 3 g/kg of compost and 2 g/kg of 3: 2:1(28) granule per treatment in the nursery. Control pots did not receive fertilizer. Irrigation and weeding were done when necessary. Data was taken on seed mass, radicle protrusions of seeds, plant height and leaf numbers of seedlings from emergence daily for 21 days. All data were analysed using SAS. Imbibition caused an increase of 49% in seed mass with rapid imbibition rate of marula seeds observed. Our results conformed with report by Moyo *et al.*, 2009 who indicated that opercula removed seed had a rapid water uptake rate for 8 hours which slowed down thereafter. It was concluded that seed imbibition and germination are useful marula seed quality measures as shown by a consistent effect of stress on germination and seedling development.

Quality of the essential oil from *Pelargonium graveolens* in different locations in the Eastern Cape

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Abstract: *Pelargonium graveolens* L'Herit. is a species in the *Pelargonium* genus and is often called a geranium because it falls within the plant family Geraniaceae. *Pelargonium graveolens* is an important high-value perennial, aromatic shrub that can reach a height of up to 1.3 m and a spread (lateral growth) of 1 m. Its hairy stems are incised, soft to the touch and strongly rose scented. This plant is cultivated in different parts of the world for its essential oil production. In south Africa, small holder farmers in the Eastern Cape province are cultivating *P. graveolens* to supply the high demand for essential oil in the perfumery, toiletries, cosmetics, food, and pharmaceutical industries. The ratio of citronellol and geraniol is used to determine the quality of the essential oil. In this study, the essential oil was extracted from the plant (cultivated at three locations) using steam distillation method and analysed for its quality using Gas Chromatography (Fame Ionization and Mass Spectrometer). The components of the essential oils were identified from National institute standard and Technology (NIST) library and retention index values of the standard. The results of the study showed the essential oils obtained at all cultivation sites were of higher quality, with citronellol to geraniol ratio of less than 3. This demonstrates that farmers at different districts in the Eastern Cape produce very good quality essential oil and may, thus, negotiate for better selling prices in the market.

Moringa leaf extract as a natural biostimulant on different potato (*Solanum tuberosum*) cultivars

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Abstract: There is a continuing search for natural plant biostimulants and fertilizers to improve plant and soil health and consequently the crop yield. The leaf extracts of moringa (*Moringa oleifera*) are rich in essential phytohormones (cytokinins, auxins and gibberlins), vitamins, phenolics and several phytochemicals which are essential for plant growth and development. Potato (*Solanum tuberosum*) is the fourth most important food crop (after maize, wheat and rice) and most important vegetable crop worldwide. However, the crop is affected by a number of abiotic stress conditions, which affect growth and yield. Understanding the influence of moringa leaf extract on improving potato tolerance to abiotic stress to enhance growth and yield is important. A single factor greenhouse pot experiment was conducted to evaluate the potential of moringa leaf extract as a biostimulant on five potato cultivars (Mondial, Sifra, Georgina, Taurus and Valor). The experiment was laid out in a completely randomized design with four replicates. The extract was applied as a drench at a concentration of 1.5% at two weeks interval from emergence until maturity. This is still an ongoing experiment which will also be repeated as a field experiment, with more application rates. Preliminary results indicate improved stem height and diameter on potato plants that are treated with moringa leaf extracts, compared to untreated plants (control). There is also an improved leaf canopy coverage, which could translate to increased leaf size. Shoots and root dry weight, as well as yield will be measured at the end of the experiment. Soil microbial population will also be analysed to assess improvement on soil health.

Assessment of symbiotic performance in three groundnut (*Arachis hypogaea*) genotypes grown in difference locations in Northern Ghana

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Abstract: Groundnut is a major grain legume in Africa, often cultivated for its oil and dietary protein. But most cropping fields in low-input systems are characterized by low concentrations of macro- and micronutrients. Of the macronutrients, the most limiting are nitrogen (N) and phosphorus (P). Although their deficiency can be corrected by synthetic fertilization, this is expensive, inaccessible to resource-poor farmers and can pollute the environment. Groundnut can easily form symbiosis with native soil rhizobia and fix atmospheric N₂ for its N nutrition. The aim of this study was to assess the symbiotic performance of three groundnut genotypes grown at difference locations in Northern Ghana. The data revealed significant variation among groundnut genotypes and locations, with Pungu site contributing the highest amount of N-fixed (262 kg N ha⁻¹) and genotype Samnut 22 the highest growth, grain yield and N contribution. Genotypes planted at Sisala West, Kasena Nankana West and Wa West recorded high percent N derived from fixation but still took up substantial amounts of N from soil. The findings of this study show that the three groundnut genotypes can make a significant contribution to the N economy of cropping systems. Because the groundnut genotypes differed in their growth and symbiotic performance at difference locations in Northern Ghana, widespread field-testing is needed to ascertain their suitability for cultivation in different parts of the country.

Insecticidal effects of botanical powders on *Sitophilus zeamais*

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Abstract: Maize (*Zea mays*) is among the widely grown agronomic crops from the Poaceae family used as a predominant food and primary source of carbohydrates to the masses of people in sub-Saharan Africa and used for animal feed around the world. Irrespective of the importance of this crop, its yield is greatly threatened by field and storage pests worldwide. *Sitophilus zeamais* (Order Coleoptera, Family Curculionidae), is a cosmopolitan insect regarded as the most significant primary pest of cereals in storage worldwide. This research assessed the insecticidal effects of powders derived from *Helichrysum odoratissimum*, *Lantana camara*, *Momordica balsamina*, and *Tulbaghia violacea*. Shade-dried leaves were ground separately and used to treat 100 g of uncontaminated *Zea mays* at different levels, (e.g., 1.5 g, 3 g, and 6 g). Five pairs of *S. zeamais* were added. Low mortality was observed at *L. camara* and *H. odoratissimum* treated treatments compared to *T. violacea* and *M. balsamina* treated maize kernels. Further research should be carried out on *Tulbaghia violacea* and *Momordica balsamina* since they were mostly studied for their medicinal properties for humans and animals, not for insect pest control.

Chemical profiling, anticonvulsive and anxiolytic effects of the smoke constituents isolated from *Leonotis leonurus*

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Abstract: The use of medicinal plants for central nervous system (CNS)-related ailments, such as epilepsy and anxiety, is prevalent in South Africa. Plants from the Lamiaceae family are commonly used for their therapeutic benefits. *Leonotis leonurus* has been reported to have anticonvulsant and anxiolytic effects through the inhalation of pyrolysis products obtained by combustion of the aerial parts. This study aimed to explore the chemical profiles and CNS activity of the smoke extract and isolated constituents of *L. leonurus* in zebrafish larvae, through anticonvulsive and anxiolytic activity assays. The smoke extract of *L. leonurus* was obtained using a specially designed smoke collection apparatus. The liquid chromatography and mass spectrometry (LC-MS) profiles of the smoke extract revealed the presence of two main compounds, leoleorin A and leoleorin B, which were targeted and isolated using preparative high-performance liquid chromatography. Nuclear magnetic resonance spectroscopy confirmed the chemical structures of the two compounds to be labdane diterpenoids. Both compounds and the smoke extract displayed suppression of the PTZ induced seizure-like behaviour in 6 days post fertilisation (dpf) zebrafish larvae. Under light or dark conditions, the smoke extract and compounds at low concentrations displayed anxiolytic activity. Higher concentrations of the isolated compounds resulted in decreased swimming activity and reduced responsiveness to external stimuli. Our results suggest that smoke constituents of *L. leonurus* may exert their anticonvulsant and anxiolytic effects.

Biocidal effect and time-kill kinetics of extract and fractions of *Leonotis ocymifolia* (Lamiaceae) against selected pathogens

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Abstract: Species of the genus *Leonotis* (Lamiaceae) are commonly used in Africa as traditional herbal remedies for various ailments such as bronchial illness, epilepsy, stomach aches, and skin diseases. Most of these species are found in South Africa, and *Leonotis ocymifolia* (Burm.f.) Iwarsson (*klipdagga*) is one of them, which is used for similar medical conditions as *Leonotis leonurus*. The recorded medicinal uses of *L. ocymifolia* include treating diabetes, hypertension, anemia, eczema, and several skin irritations. However, little is known about its antimicrobial activity. Therefore, this study aimed to investigate the antimicrobial potential of *L. ocymifolia* by reviewing its ethnomedicinal importance and testing extracts and fractions (ethyl acetate, *n*-hexane, and *n*-butanol) against six bacteria and three fungi pathogens.

The results showed that all fungi pathogens tested were highly susceptible to all extracts, with moderate to noteworthy activity against all fungi isolates studied. The *n*-hexane extract exhibited the most significant antimicrobial activity against all tested pathogens, with a mean MIC value of 0.25 mg/ml to 0.0625 mg/ml. Moderate activity was observed for all extracts against all bacteria tested, except for *Klebsiella pneumoniae*, where noteworthy activity (MIC value of 0.13 mg/ml) was found for the *n*-butanol fraction. The time-kill potential was concentration-dependent. *Leonotis ocymifolia* has demonstrated promising antimicrobial properties, but further studies are required to determine its toxicity and mechanism of action.

***In vitro* propagation of *Greyia radlkoferi*: Effect of cytokinins on shoot proliferation**

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Abstract: *Greyia radlkoferi* Szyszyl. (Family: Melianthaceae) is an indigenous South African medicinal plant possessing bioactive flavonoids for treating skin hyperpigmentation. Its leaf extract is an active ingredient in some cosmeceutical products. Development of efficient propagation technologies to ensure production of sufficient quality biomass remains essential for sustainable product development. The current study aimed to investigate the effect of four aromatic cytokinins on shoot proliferation of *G. radlkoferi* propagated through plant tissue culture techniques. Following culture initiation, nodal explants were cultured for seven weeks in full-strength Murashige and Skoog media with 2.5 µM indole butyric acid (IBA) combined with cytokinins [6-benzyladenine (BA), kinetin (Kin), *meta*-topolin (*mT*), and *meta*-methoxytopolin riboside (*MemTR*)] at different concentrations (0, 1.0, 2.5, 5.0, 7.5, and 10 µM). An increase in Kin, *mT* and *MemTR* concentrations induced an improved shoot proliferation whereas an increase in BA concentration reduced shoot proliferation. BA produced cultures with abnormalities and low to no root development. *MemTR* elicited greater root number, shoot length and root length compared to other cytokinins whereas the highest number of shoots was observed with 5.0 µM *mT* treatment. The positive effect of *mT* on shoot multiplication could be attributed to its faster translocation when compared to BA. The toxicity of BA metabolites localized at the basal end of the explant could result in physiological disorders such as hyperhydricity and undifferentiated tissues. The overall growth of *G. radlkoferi* can be improved using the topolins under *in vitro* conditions and as a suitable alternative to overcome challenges associated with BA.

In vitro antifungal activity of fractions from the bark of *Albizia versicolor*

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Abstract: *Albizia versicolor* Welw. ex Oliv. is used to combat “*u wela*” in Limpopo Province, Vhembe District. This plant species was selected from the database of over 300 plant species used for the treatment of various ailments in four Districts of Limpopo province. The study aimed to investigate the biological activity of the fractions from the bark of *A. versicolor* against *Candida albicans* and *Cryptococcus neoformans*. Serial exhaustive extraction was used to extract bark material with solvents of increasing polarities such as hexane, butanol, acetone, and MeOH. Amongst the four extractants, acetone and hexane extracted the largest quantity of plant material (13%) as compared to other extractants. The crude acetone extract was subjected to solvent-solvent fractionation using hexane, chloroform, n-butanol, and aqueous. The antifungal activity of the fractions was investigated using the micro-dilution and bioautography assay against *C. albicans* and *C. neoformans*. All fractions were active against the tested fungal pathogens with MIC values ranging between 0.02 and 2.5 mg/mL. Antifungal compounds were observed in acetone, methanol, and chloroform fractions with R_f values ranging between 0.50 and 0.85. The excellent activity of the plants against the selected fungal strains, suggests that these plants may have the potential to be a novel source of antifungal drugs.

The volatile and non-volatile chemistry of ethnobotanically relevant southern African *Stachys*

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Abstract: The *Stachys* L. genus, belonging to the Lamiaceae, is known for its medicinal applications, mainly as teas and tonics, and has a wide geographical distribution. Despite being the third largest genus in the family, research on this group has been limited, including in southern Africa, which is home to 42 species (22 of which are endemic), of which only a few have been studied. Medicinal uses of these species include treatments for ailments such as pain, respiratory issues, topical applications, teas and tonics for general wellbeing. Notwithstanding the size of the genus, many of the species remain underexplored; therefore, this study provides the first account of the chemical compositions of ethnobotanically relevant *Stachys* species, such as *S. aethiopica*, *S. linearis*, *S. rugosa*, and *S. flavescens*. Advanced techniques such as Headspace Solid-Phase Microextraction coupled with Gas Chromatography-Mass Spectrometry (HS-SPME-GC-MS) and Ultra-high performance liquid chromatography-MS (UPLC-MS) detected a total of 83 volatile and 24 non-volatile compounds across the ten species investigated. Major volatile compounds include α -pinene, β -pinene, β -caryophyllene, caryophyllene oxide, limonene and spathulenol, and notable non-volatile compounds include harpagide and verbascoside, which have potent anti-inflammatory effects, potentially explaining the traditional medicinal uses of these species. This study provides a solid foundation for further chemical and pharmacological investigations of the *Stachys* genus and the comparison of southern African members in a global context.

Antimicrobial synergisms in medicinal plant extracts are often caused by chlorophyll break-down products

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Abstract: Chlorophylls are best known for conferring the green pigment to the leaves and young bark of plants. They are a light trapping group of molecules, classified as metal chelated porphyrins, normally with a magnesium ion in the centre. While there are different types of porphyrins in nature, such as chlorophyll a or chlorophyll b, the diversity increases as the chlorophylls break down into other metal-free porphyrins during the processing of medicinal plants, producing pheophytins and pheophorbides as intermediates. There are also several metal-free porphyrins that occur naturally, such as those in *Ficus* or *Vepris*. This family of natural products includes several well-known efflux inhibitors of bacteria and yeast, so they frequently behave as potentiators of antimicrobial molecules. When crude botanical extracts are produced and used in antimicrobial assays, these porphyrins are often co-extracted and are therefore present in the extracted mixture, increasing the inhibitory potency of extracts via a synergistic mechanism. But when bioassay guided fractionation is performed, the minimum inhibitory concentration of the identified active ingredients does not explain the potency of the whole extract. We have, therefore, examined the degree of synergism that pheophytins and pheophorbides enact in a selection of extracts from African medicinal plants, against a selection of bacterial and fungal strains. We have also taken our study further by examining the frequency in which these porphyrins are found in medicinal plant leaves, using NMR and HPLC. This enables us to comment on how frequently this type of synergism will affect routine antimicrobial studies.

Zebrafish: a high-throughput model to investigate bioactivity and toxicity of medicinal plants

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Abstract: Zebrafish (*Danio rerio*) is a freshwater, tropical fish characterised by horizontal blue stripes that run along its body and appear blue in colour. The embryos and larvae are transparent, and they develop *ex utero* into adult zebrafish, which grow up to 4 cm in length. This small vertebrate has become increasingly important in scientific research as it displays characteristics that make it a valuable model to study human diseases. Due to their small size, the handling and housing of zebrafish is easier, and it saves costs and space compared to higher vertebrates. Embryos and larvae are small enough to fit into 96-well plates, which allow easy manipulation and replication of experiments. Zebrafish have a high physiological and genetic homology to humans (~70%), high fecundity and the transparent embryos allow manipulation to start from few hours post fertilisation. Rapid embryonic development makes it possible to visually monitor developmental changes and toxic effects. Passive diffusion of test samples through the skin from the surrounding media is non-invasive compared to injections and oral gavages used in higher vertebrates. The ethical, economic and regulatory concerns associated with the use of higher vertebrates are overcome with zebrafish larvae, since they are less sentient, and the model is aligned with the '3Rs' (reduction, refinement and replacement) of animal use for scientific purposes. Herein, we demonstrate the feasibility of using the zebrafish larvae model to assess the effects of medicinal plants on wound healing and neurological conditions such as epilepsy and anxiety. The application of the model to explore potential toxicity of herbal extracts will also be briefly discussed.

Phytochemical profiling and the wound healing potential of five *Bulbine* species using *in vitro* and *in vivo* bioassays

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Abstract: *Bulbine* Wolf is one of four major genera of the Asphodelaceae family. Five ethnobotanically important *Bulbine* species indigenous to South Africa namely; *B. abyssinica*, *B. asphodeloides*, *B. frutescens*, *B. latifolia* and *B. narcissifolia*, were selected for this study. Traditionally, the leaf exudates of the *Bulbine* species are used to treat wounds, which guided the development of cosmetic products, but little research has been done to support the claimed benefits, highlighting the need for evidence-based methods to investigate the wound-healing properties of bulbines. In the current study, the *in vitro* scratch assay and *in vivo* zebrafish caudal fin amputation assay were used to evaluate the wound healing properties of the bulbines. Two of the investigated species, *B. frutescens* (100 µg/mL extract) and *B. abyssinica* (100 and 250 µg/mL) promoted wound healing both *in vitro* and *in vivo* assays. The other three species showed varying effects that were not significant when compared to the negative control. Phytochemical profiling using ultra-performance liquid chromatography coupled to mass spectrometry identified knipholone as a marker compound which varied quantitatively between species. The results of the study solidified the use of *B. frutescens* and *B. abyssinica* in wound healing, which could inform further research for cosmetic and pharmaceutical product development involving these species.

Phytochemistry and ethnobotany of South African *Senecio* (Asteraceae): Comparing toxic and non-toxic taxa

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Abstract: The genus *Senecio* (Asteraceae) is of considerable medicinal, toxicological and forensic importance in South Africa and other African countries. While many species are used safely in medicine or food, several others accumulate macrocyclic pyrrolizidine alkaloids, which are hepatotoxic, pneumotoxic, genotoxic, and carcinogenic to humans and animals when ingested at harmful quantities or sub-lethal doses over prolonged periods. Unfortunately, for various reasons the toxic species have contaminated food products or medicines, resulting in several illnesses or deaths in adults and children, creating complications such as veno-occlusive disease, among others. Therefore, this study aims to conduct a thorough ethnobotanical review of the literature, perform a phytochemical analysis to determine the presence/absence of toxic alkaloids, and create an inventory of all the species of *Senecio* used in traditional medicine in South Africa, with comparison to the species determined as toxic by our phytochemical analysis. Out of the three hundred species and infraspecific taxa that occur in the South African flora, forty-six are used medicinally, while another 12 have uses in other African countries. Only 18% of the South African taxa have associated phytochemical data, and 5% have been screened in bioassays. To fill the knowledge gap on the chemistry of *Senecio* in South Africa, we screened nearly 100 specimens and determined their profile of alkaloids, linking them to medicinal use where relevant. The data enables us to comment on the gap between medicinally useful and edible versus poisonous species of *Senecio*.

An overview of the ethnobotanical uses of selected members of the Apocynaceae family in southern Africa

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Abstract: The Apocynaceae Juss., is a relatively large family comprising approximately 4 500 species in ca. 370 genera, with a cosmopolitan distribution, but primarily diverse in tropical and subtropical regions. In southern Africa, this family comprises of about 94 genera and more than 700 species. The Apocynaceae is undoubtedly one of the most economically essential families in the plant kingdom. Many members are used as ornamentals; some are timber, rubber and fibre sources. Other species are valuable in the food, beverage, cosmetic and pharmaceutical industries. Furthermore, the Apocynaceae is notably one of the most medicinally important families and as a result, some members are valuable in both conventional and traditional medicines. The presence of major active phytochemical constituents in several members of this family, highly attributes to their biological activities. This family is rich in alkaloids with anticancer, antibacterial and antihypertensive activities, phenolic compounds, terpenes and flavonoids with anti-inflammatory properties, cardiac glycosides widely used to treat heart failure, and sterols with antioxidative, antihyperlipidemic and hepatoprotective properties. Other compounds present in some Apocynaceae members include fatty acids, esters, hydrocarbons, vitamins, and glycoproteins. The phytochemical constituents of the Apocynaceae species contribute not only to their overall biological activities but also to their toxicity. This present study aimed to conduct an extensive ethnobotanical literature review of species belonging to the Apocynaceae family in southern Africa. Overall, this study will provide the link between the ethnomedicinal uses, phytochemistry and biological activities of selected Apocynaceae species, consequently adding scientific validation to their safety and efficacy.

An overview of plants used for the management of crop pests and diseases in Sub-Saharan Africa

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Abstract: Since time immemorial, plants have been utilised for the management of crop pests and diseases in Sub-Saharan Africa. This review entails a critical appraisal of ethno-botanical studies on plants used to manage crop pests and diseases in Sub-Saharan Africa. The review covered literature from January 2010 through February 2023, consisted of an inventory of 20 eligible sources. A total of 208 plants belonging to 60 families were identified as resources used to manage 28 crop pests and 110 diseases. The most commonly used families were Fabaceae (26%), Asteraceae (22%), Solanaceae (17%), Lamiaceae (12%), Euphorbiaceae (11%) and Amaryllidaceae (8%). The most common plants recorded were *Azadirachta indica* A. Juss., *Alium cepa* L., *Alium sativum* L., *Artemisia afra* Jacq. ex Willd., and *Bidens pilosa* L. Based on the frequency of mention, the most commonly treated diseases were powdery mildew (10%), bacterial spot (9%), downy mildew (8%), sclerotinia (8%) and root rot (7%) while the most common pests that were managed included insect pests (31%), aphids (23%), termites (22%), fungi (17%) and diamond back moths (15%). The frequent of plant parts used were the leaves (80%), fruit (25%), tubers (22%), stem (21%), and seeds (18%). The review has demonstrated that the practice of using locally sourced plant species play a pivotal role and contributes to the management of crop pests and diseases. It is therefore important to conduct additional research on a larger scale, as well as work on the efficacy of plants or plant parts and their potential chemical properties, which should be prioritized. This will contribute to the eco-friendly management of crop pests and diseases.

Phytochemical screening and antimicrobial, antioxidant and cytotoxic activities of *Carissa bispinosa* (Apocynaceae) leaf extracts used for dental health care

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Abstract: A plethora of medicinal plants in South Africa presents a possibility for the discovery of alternative drugs against problematic and prevalent diseases such as dental diseases. Dental diseases affect about 49% to 83% people globally. This study evaluates the antimicrobial, antioxidant and cytotoxic activities of the leaf extracts of *Carissa bispinosa*. The plant leaves were dried, ground and extracted by nine solvents of varying polarities. The phyto-constituents were detected using biochemical tests and the major phytoconstituents (phenolics and tannins) were quantified using the folin-ciocalteau method. Antioxidant activity was evaluated using the ferric reducing power and DPPH free radical scavenging assays. Bioautography and MIC assays were employed to determine the antimicrobial activity. The cytotoxic activity was assessed against the THP-1 cell line using MTT calorimetric assay. The plant constitutes all the tested phytochemicals except flavonoids. Water and hexane extracted the highest total phenolic and tannin content (94.74 mg of GAE/g and 22.98 mg of GAE/g) respectively. Methanol extract demonstrated strong antioxidant potentials with an IC₅₀ value of 72 (µg/ml). All the extracts exhibited antimicrobial activity against the tested dental pathogens (*S. aureus*, *E. faecalis*, *S. pyogenes* and *C. albicans*). Methanol extract had the most promising antimicrobial activity (0.81 mg/ml) and *Candida albicans* was the most susceptible pathogen. Acetone extract (0.25 mg/ml) exhibited an acceptable percentage cell viability level (93%) and an IC₅₀ value of 0.63 mg/ml. *Carissa bispinosa* had a promising antimicrobial and antioxidant activity, however further studies are required to identify the active compound(s) for possible drug development.

Chemical analysis and insecticidal activity of selected plant extracts from plant species used traditionally in southern Africa as insecticides

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Abstract: Environmental and health risks associated with using chemical pesticides have increased the demand for safer and biodegradable alternatives to control insect pests in agriculture. Plant-derived botanicals have emerged as a promising alternative to chemical pesticides due to their active biochemicals. The main objective of this study was to investigate an ecologically safer method for controlling the fall armyworm, *Spodoptera frugiperda*. Therefore, extracts from four plant species were evaluated for their insecticidal properties and assessed for their phytochemical profile. The insecticidal activity of leaf methanol extracts was evaluated using the direct contact toxicity bioassay, where three treated larvae per extract were placed in a petri dish with a block of diet for 72 hrs. Each treatment was done in triplicates. Contact toxicity bioassay revealed that significant mortality rates were dose dependent. The maximum mortality rate at 200 mg/ml was 49.21% for *Agave sisalana* and *Zanha africana* extracts. Meanwhile, extracts from *Podalyria sericea* were the most effective, exhibiting the lowest LC₅₀ value of 5.62 mg/ml. UPLC-MS analysis showed that phenolic compounds were the major constituents found in the extracts, particularly flavonoid glycosides (kaempferol and quercetin derivatives). Overall, the results highlighted the promising potential of plant extracts as biocontrol agents against insect pests.

An analysis of the South African Vatsonga medicinal ethnobotany and a cross-cultural comparison with the Pedi, Venda, Swati, and Zulu

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Abstract: This study aims to provide the first comparative analysis of some south-eastern African cultures by determining the similarities and differences between Tsonga medicinal ethnobotany and Pedi, Swati, Venda, and Zulu medicinal ethnobotany. Ethnobotanical surveys were conducted through structured interviews, using the Matrix Method and a flip-file of 369 photographic plates of known medicinal species. The data were analysed using Microsoft Excel and R Studio tools. Checklists for the Pedi, Swati, Venda, and Zulu medicinal plants were compiled using various literature sources. Two hundred thirty-eight medicinal plant species and infraspecific taxa were recorded for the Tsonga culture of South Africa. From the literature survey, 327 medicinal plant taxa were recorded for the Pedi, Venda (397 taxa), Swati (841 taxa), and Zulu (986 taxa). Eighty-two medicinal taxa were shared between the Tsonga and Pedi cultures, of which only 30 had the same or similar medicinal uses (82 shared taxa; 30 taxa with same/similar uses). Between the Tsonga and Swati cultures (119 shared taxa; 21 taxa with same/similar uses), Tsonga and Venda (131 shared taxa; 22 taxa with same/similar uses), and Tsonga and Zulu (100 shared taxa; 30 taxa with same/similar uses). Rahman's similarity index indicated only 6.6% similarity between the Tsonga and Pedi, Tsonga and Venda (4.3%), Tsonga and Swati (2.4%), and 2.7% between the Tsonga and Zulu. This study shows first-hand that the Tsonga culture is unique compared to its counterparts. Even though the number of shared medicinal taxa might be notable, the scantiness of the same or similar uses and similarity percentages indicate that each culture independently selects medicinal plants based on what is available in their area.

Phytochemical profiling of selected South African *Cissampelos* species

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Abstract: The family Menispermaceae includes 75 genera, consisting of 520 species. The genus *Cissampelos* is one of the nine genera used in Africa and the rest of the world due to the rich diversity of biologically active bisbenzylisoquinoline alkaloids in the plants. South Africa harbours four indigenous *Cissampelos* species, namely *Cissampelos capensis* L.f., *C. hirta* Klotzsch, *C. mucronata* A.Rich. and *C. torulosa* E.Mey. ex Harv. & Sond. Information on the phytochemistry of these species remains scant, despite their widespread use as traditional remedies by indigenous South African populations. The aim of this investigation was to undertake a chemotaxonomy study of four *Cissampelos* species found in South Africa, with the objective to develop simple and rapid analytical protocols for the identification and differentiation of the four species. Acid-base extracts were profiled using ultra-performance liquid chromatography-mass spectrometry (UPLC-MS) and chemometric data analysis was performed to determine intra- and inter-species variation of the alkaloid constituents. The *Cissampelos* species showed four distinct clusters following principal component analysis and orthogonal projections to latent structures discriminant analysis, and the plant parts (leaves, stems and roots) also displayed varying chemical profiles. The chemical markers namely, bebeerine, curine, dicentrine, glaucine and boldine were targeted for isolation using preparative liquid chromatography (prep-HPLC-MS). Using high-performance thin layer chromatography (HPTLC), chemical fingerprints suitable for species authentication were established and the marker compounds identified for quality control purposes. Vibrational spectroscopy revealed chemotypic variation between and within the *Cissampelos* species.

Importance of ISO standards for essential and vegetable oils of South Africa

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Abstract: Standards of aromatic and medicinal plants are not very well published and applied in developing countries. In South Africa, there have been only two International Standards (ISO), standards published for medicinal plants: *Aloe ferox* and *Moringa oleifera*. This situation led to the exploitation of the producers of oils by the buyers. The recent increase in demand is observed but the standards should keep up with the new development in the industry. The fact that a lot of misnomers exist in the trade, can also be corrected botanically through the use of standards. In this presentation, the procedure for the writing of standards and the status of ISO standards as submitted by the South African Bureau of Standards (SABS) is explained for *Pelargonium* cv. *rosé* (rose geranium), *Adansonia digitata* (baobab), *Sclerocarya birrea* (marula). A thorough database of the certificates of analysis of producers throughout South Africa was used to compile a range of expected values. This was then used for the ISO-amended standard for the essential oil of rose geranium, and it has now been published by the SABS. The baobab standard for oil has been accepted by the technical committee while marula is also submitted by the technical committee and was available for public comment. The standards are important to distinguish South African oil from that of other countries as well as to indicate it as authentic and not fake. It also allows negotiation for better prices and internal quality control by the industry. The ranges on which the standards are based on were compiled using the analysis of several producers in different locations and in different seasons. This was deliberately done as to include all the variations that might occur for a species.

Lessons from the *Warburgia* conservation model – are we running out of time for people and nature?

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Abstract: Over two decades ago, the Kruger National Park (KNP) started elevating their concerns about the status of conservation of *Warburgia salutaris*, an important medicinal plant growing in the KNP, used for healing various ailments including colds and flu. Illegal harvesting of bark inside KNP, combined with widescale unsustainable harvesting outside of protected areas resulted in *Warburgia* making Redlist status as “endangered”. However, by the end of 2022, through many diverse partnerships, a lot of persistence, and a fair amount of passion, more than 40 000 nursery-grown *Warburgia* plants have been shared with user groups adjacent to the KNP, and further afield, with many successes. Not only do local traditional healers in the area no longer purchase illegally harvested bark, but some of the home-grown plant material is making its way organically to the more commercial markets. The tree has subsequently been downlisted on the IUCN red list to “vulnerable”. Although the programme has expanded to include other species, such as *Siphonochilus aethiopicus*, and with partnerships with SANBI currently looking into growing *Boweia* and *Alepidia*, context specific solutions to accommodate challenges associated with sustainably using the various growth forms (for example bulbs versus leaves) are required. Regardless, hundreds of medicinal species face extinction risk, and we do not have the luxury of 20 years to dedicate to each of these. We make a case for using what we know from *Warburgia* to leapfrog the conservation of these for people and the planet.

A decade of researching traditional plant knowledge in Northern Maputaland; ethnobotanical exploration and scientific validation

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Abstract: Northern Maputaland has a diverse and novel source of ethnobotanical knowledge where indigenous communities rely on medicinal plants for the treatment of various diseases. This study aims to collate ethnobotanical survey studies undertaken over a 10-year period where our field work focused on traditional plant use for various infectious diseases involving the respiratory tract, gut, skin and sexually transmitted infections (STI). In addition, the concept of blood purification was explored, as well as ailments related to woman health and hypertension. This diverse set of medical conditions revealed a number of plant species that were documented for the first time and a quantitative analysis demonstrates common medicinal plants used across all medical conditions. Scientific validation studies were undertaken from plant species collected *in situ* and the antimicrobial model (minimum inhibitory concentration assays) was used to validate medicinal use for infectious diseases. *Ranunculus multifidus* for example was found to demonstrate excellent (MIC 20 µg/ml) STI activity. Brine shrimp lethality assays were used to evaluate toxicity. Plant species such as *Trichilia dregeana* was found to be highly toxic (75-92% mortality), and this correlated with the traditional use as an abortifacient. The most antimicrobially active plant species across all the studies will be presented together with combination studies based on traditional practises. One synergistic plant combination was *Acanthospermum glabratum* with *Krauseola mosambicina*, having fractional inhibitory concentrations between 0.01-0.30 against five diarrhoeal pathogens. These findings provide valuable ethnobotanical insight and strengthen the *in vitro* evidence of traditional plant knowledge in KwaZulu-Natal, South Africa.

Copper homeostasis, a potential target of essential oil constituents in the control of malaria

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Abstract: Copper is a crucial metal required for metabolism and growth in all living organisms including *Plasmodium* malaria and *Anopheles* mosquitoes. Consequently, novel copper chelators with antimalarial and insecticidal properties could prevent disease progression and transmission. The aim was to determine the interaction of fifty-five essential oil constituents (EOCs) with copper and to determine the chemotherapeutic effect on *Plasmodium falciparum* (3D7) and *Anopheles gambiae* (KGB). The EOCs displayed variable Cu(I) and Cu(II) chelating properties, along with promising copper reducing ability. Where (±)-menthone chelated both Cu(I) and Cu(II), (-)-α-pinene preferentially chelated Cu(I) and thymol and citral chelated Cu(II) in comparable affinity to neocuproine (Cu(I)) and tetrathiomolybdate (Cu(II)). When combined, (±)-menthone and tetrathiomolybdate interacted in a synergistic manner to chelate Cu(II). Using the TroloxTM equivalent antioxidant capacity assay, eugenol was more effective in reducing copper than TroloxTM and (±)-menthone. The promising chelating ability of (±)-menthone did not correspond to its ability to inhibit malaria as determined by the parasite dehydrogenase assay. Although (+)-α-pinene had poor copper chelating activity, it potently inhibited parasite growth by inhibiting haemozoin formation. Whilst citral may have killed the malaria parasite via haemozoin formation inhibition, as well as copper chelation. (±)-Menthone, (-)-α-pinene and citral possessed significant larvicidal activity compared to DDT but was not as active as carvacrol and linalyl acetate. The isomeric nature of the EOCs played a critical role in the variable pharmacological activities. The copper chelating properties of (±)-menthone and citral may be a potential mechanism of action in inhibiting *Plasmodium* and *Anopheles*.

Abstracts: Poster presentations



Exploring Nature's Pharmacy toward the development and discovery of alternative antimalarial drugs from traditional medicinal plants

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Abstract: Malaria, a disease caused by *Plasmodium falciparum*, remains a significant global health burden affecting millions of individuals annually. Moreover, the emergence of drug resistance to most of the currently available antimalarials is an obstacle that continues undermining the efforts made to combat malaria. As such, there is an urgent call for new alternative strategies that can help in this regard. Medicinal plants are seen as appealing and promising, especially since chloroquine and artemisinin are plant derived. Moreover, targeting some of the molecular chaperones implicated in the survival and pathogenicity of the parasite with bioactive compounds from medicinal plants is seen as yet another promising approach. In this study, antimalarial evaluation and validation of *Xysmalobium undulatum* and *Ziziphus mucronata* were carried out. The plants were collected and sequentially extracted using Hexane (Hx), Ethylacetate (EA), Dichloromethane (DCM), and Methanol (Mt) after which the extracts were tested for their antimalarial activity against the *P. falciparum* chloroquine-sensitive strain (NF54) and their cytotoxicity was tested against the Chinese hamster ovary (CHO) cell line. The results showed that the Hx, EA, and DCM extracts had a promising antimalarial activity with an IC_{50} ranging from 4.98 – 19.25 $\mu\text{g/ml}$. However, Mt extracts of both plants exhibited minimal activity $IC_{50} > 20 \mu\text{g/ml}$. All the extracts showed minimal cytotoxicity against the CHO cell line except the DCM and EA extract of *Z. mucronata* ($IC_{50} = 10.01$ and $10.96 \mu\text{g/ml}$ respectively). Silica gel chromatography was used to isolate the compounds from *Z. mucronata* despite being toxic due to its high percentage yield and potent activity. The isolated compounds were elucidated using NMR techniques (^1H , ^{13}C , DEPT, FT-IR) and were found to be Betulinic acid and its derivative. Molecular docking using AutoDock Vina suggested the potential binding of BA and its derivative against PfHsp70-1 with docking scores of -6.5 and -6.8 kcal/mol. However, *in vitro* validation of this data using UV-VIS spectroscopy, Malate dehydrogenase, and ATPase assay remains to be done.

Mass spectral molecular networking to profile the phytochemical space of *Cissampelos* species

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Abstract: The genus *Cissampelos* belongs to the Menispermaceae family and is used to treat a wide variety of ailments. South Africa harbours four indigenous species, namely *Cissampelos capensis* L.f., *C. hirta* Klotzsch, *C. mucronata* A.Rich. and *C. torulosa* E.Mey. ex Harv. & Sond. Comprehensive phytochemical studies revealed the presence of a rich diversity of biologically active bisbenzylisoquinoline alkaloids. Previous studies have also reported that the chemical profiles of these four *Cissampelos* species are influenced by the geographical origin. The knowledge of this variation would assist in the commercialisation of chemotypes with a favourable profile. A molecular network is an *in silico* tool to summarise the most predominant chemical classes retrieved through library matching and structure annotation. This study aimed to identify secondary metabolites in four *Cissampelos* species by using an untargeted metabolomics approach. Ultra-performance liquid chromatography (UPLC) hyphenated with mass spectrometry (MS) was used to analyse 271 acid-base extracts of the *Cissampelos* species collected from various locations in South Africa. The molecular network was used to explore the chemical profiles of the leaves, stems and roots. The classes of compounds in the *Cissampelos* species revealed varying levels of organic heterocyclic compounds including alkaloids, indoles, quinolines, benzopyrans, benzimidazoles and imidazopyridines across the different species. The putatively annotated metabolites also varied in the leaves, stems and roots. This approach demonstrates the ability of *in silico* tools such as molecular networking to profile the phytochemical space of *Cissampelos* species and determine signature markers relevant to chemotaxonomy.

Criteria for selecting the most appropriate indigenous medicinal plants for potential use in primary health care in South Africa

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Abstract: Traditional medical practices of the African continent, despite their ancient origins, were largely ignored or even actively discouraged by colonial authorities. Traditional practitioners, although highly respected members of their communities, played almost no role in the establishment of formal health-care systems in Africa. In recent times, efforts have been made to comprehensively record the ethnobotany of South African traditional medicinal plants and practices. To investigate which South African traditional medicinal plants might be most relevant to use in primary healthcare in South Africa, a literature review of 29 papers and comparative analysis of four published studies were done. A list of 26 species with high frequencies of citation was compared with priority species identified in relevant publications such as Van Wyk (2008) and Moteetee and Van Wyk (2011). Specific criteria were developed to assess each plant species mentioned, namely i) ease of cultivation, ii) proven or probable efficacy, iii) long track record of safe use; iv) sustainable wild harvesting (if need be). Based on these criteria, the most promising indigenous species for use in primary health care in South Africa are *Artemisia afra*, *Aloe ferox*, *Bulbine frutescens*, *Carpobrotus edulis*, *Lessertia* (*Sutherlandia*) *frutescens* and *Lippia javanica*. These species are easily cultivated and may be used in their crude form as cheap (free) traditional medicine against all the most common self-terminating and chronic ailments.

Phenolic content, antioxidant activity, and spectroscopic characteristics of *Moringa oleifera* growing in the Eastern Cape province of South Africa

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Abstract: *Moringa oleifera*, commonly known as the horseradish tree, belongs to the Moringaceae family, and is a small, fast, growing, evergreen, deciduous tree. It is a preferred medicinal plant globally because its plant parts contribute significantly to people's health because of its nutritional, antidiabetic, and pharmacological properties, owing to its high antioxidant and phytochemical properties. However, temperature, altitude, and geographical location are known to affect the phytochemical content of a plant. Therefore, the study aimed to investigate the phenolic content and antioxidant properties of aqueous, acetone, ethanolic, and methanolic leaf extracts of *M. oleifera* that grow in Burnshill village, Eastern Cape. Further characterization of the extracts was conducted using proton nuclear magnetic resonance (¹HNMR) spectroscopy. The total phenolic content of *M. oleifera* extracts was estimated and measured spectrophotometrically. The 2,2-diphenyl picrylhydrazyl (DPPH), ferric reducing antioxidant power (FRAP), and ABTS was used to investigate the extract's antioxidant content. Results revealed that methanolic extract had significantly high TPC (68 GAE/g), whereas phenolic compounds in other extracts were slightly lower, with acetone having (51 GAE/g), ethanol (41 GAE/g), and water (34 GAE/g). The antioxidant activities of extracts varied among extracts. They were concentration-dependent, with methanol having higher activity, followed by acetone, ethanol, and aqueous. The nuclear magnetic resonance spectroscopy spectra indicated compounds present in the *M. oleifera* leaf extracts. This study has demonstrated that phenolics contributed to antioxidant activities. Findings from this study indicate that *M. oleifera* growing in Burnshill village, could be used for developing natural antioxidants and bioactive agents.

Phytochemical analysis and antimicrobial activity of medicinal plants commonly used in the treatment of tuberculosis in the eastern Free State, South Africa

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Abstract: Tuberculosis (TB), an airborne infectious disease that mainly infects lungs, caused by *Mycobacterium tuberculosis*. South Africa is one of the countries with the highest TB and multi-drug resistant TB burden. This study was aimed at screening eight medicinal plants that are frequently used by herbalists and traditional healers of the eastern Free State for the treatment of TB. Thirty-two plant extracts were screened for the presence of phytochemicals, antibacterial, antifungal and antimycobacterial activities using standard methods. All plants displayed the presence of tannins and saponins and the absence of alkaloids, anthraquinones and steroids. *Hermannia depressa* and *Senecio harveianus* extracts had the best antibacterial activity against all test microorganisms, ranging from 0.098 to 0.781 mg/ml, while *Drimys depressa* and *Lotononis lanceolata* extracts had the best antifungal activity, ranging from 0.049 to 0.781 mg/ml. Organic extracts of *Dicoma anomala*, *H. depressa*, *L. lanceolata*, and *S. harveianus* exhibited good antimycobacterial activity between 0.195 and 0.781 mg/ml. The presence of phytochemicals and significant antimicrobial activities in selected medicinal plants used in the treatment of tuberculosis and related respiratory ailments in the eastern Free State explains and justifies their frequent use by traditional healers. These findings provided a starting point for further research in order to develop new pharmaceutical drugs derived from plants.

Cannabidiol and *Cannabis sativa* as a potential treatment *in vitro* prostate cancer cells silenced with RBBp6 and PC3 xenograft

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Abstract: Prostate cancer is the second most frequently occurring carcinoma in males worldwide and one of the leading causes of death in men around the world. Recent studies estimate that over 1.4 million males are diagnosed with prostate cancer on an annual basis, with approximately 375,000 succumbing to the disease annually. With current treatments continuing to show severe side effects, there is a need for new treatments. In this study we looked at the effect of *Cannabis sativa* extract, cannabidiol and cisplatin on prostate cancer cells, PC3. In addressing the above questions, we employed the MTT assay to measure the antiproliferative effect on PC3 cells following treatment with varying concentrations of *Cannabis sativa* extract, cisplatin and cannabidiol. xCELLigence was also used to confirm the IC50 activity in which cells were grown in a 16 well plate coated with gold and monitor cell attachment. Caspase 3/7 activity was also measured using 96 well-plate following treatment. Western-blot and qRT-PCR was also used to measure the gene expression of tumour suppressor genes, p53, Bax and Bcl2. Animal studies were employed to measure the growth of PC3-mouse derived cancer to evaluate the effect of compounds *in vivo*. From the treatment with varying concentrations of *Cannabis sativa* extract, cannabidiol and cisplatin, we have observed that the three compounds induced antiproliferation of PC3 cancer cell lines through the activation of caspase 3/7 activity. We also observed induction of apoptosis in these cells following silencing of retinoblastoma binding protein 6 (RBBP6), with upregulation of p53 and bax mRNA expression, and a reduction in Bcl2 gene expression. The growth of tumours in the mouse models were reduced following treatment with cisplatin and cannabidiol. We demonstrated that cannabidiol is a viable therapy to treat prostate cancer cells, in combination with silencing of RBBP6. This suggests that cannabidiol rather *Cannabis sativa* extract may play an important role in reducing cancer progression.

Phytochemical screening and cytotoxic effects of *Drimia calcarata* plant extracts against cervical cancer cells

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Abstract: Cervical cancer is the fourth most common female malignancy, worldwide; and it is mostly prevalent in low-income and middle-income countries where mortality is 18 times higher than that in developed countries. Medicinal plants have gained more attention in treatment of cancer due to their multiple chemical compounds for discovering new active material against cancer. Therefore, this study focused on investigating the cytotoxic effect of *D. calcarata* bulb methanol and water extracts on cervical cancer cells. The phytochemical analysis and antioxidant activity were analysed using the Standard phytochemical tests, DPPH, and FRAP. The inhibitory effects and IC₅₀ values of *D. calcarata* extracts were determined using the MTT assay. Induction of cellular apoptosis and cell cycle progression were assessed using fluorescence microscopy and the Muse® Cell Analyser, respectively. Both *D. calcarata* extracts revealed the presence of tannins, phenols, steroids, terpenoids and cardiac glycosides. The flavanols, xanthenes, flavones and anthraquinones were only present in the water extract (WE), while carbohydrates and proteins were only present in methanol extracts (ME). WE demonstrated high phenolic, tannin, and flavonoid contents than the ME. Moreover, WE showed the best antioxidant activity than ME. Both extracts exhibited strong anticancer activity against HeLa, while the WE had no significant (*P* value) effect on the Ca-Ski cells. Both ME and WE mediated G2/M arrest and apoptosis induction in HeLa cells. These findings suggested that the *D. calcarata* plant extracts could be useful for therapeutic use against the human HPV-18 positive gynaecologic cancer disease.

Nutrient uptake of cowpea subjected to seaweed extract application under simulated drought stress

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Abstract: Cowpea is an African indigenous legume crop with nutritional advantages and plays a role in alleviating food and nutrition insecurities in the African rural communities. However, due to climate change which result in periods of drought, cowpea's grain yield and quality have been negatively impacted. Therefore, incorporating sustainable agro-inputs with a potential of combating drought effects on crops is necessary. Seaweed extracts such as Kelpak (*Ecklonia maxima*) have gained popularity in recent years due to their potential to improve crop's performance under drought stress. This study's objective was to evaluate the effects of seaweed extract on cowpea's nutrient uptake under drought simulated stress. The experiment was laid out in a complete randomised 5 x 3 CRD design under greenhouse conditions at the University of South Africa, Horticulture Centre. The treatments included three drought levels and five levels with four replicates. The nutritional composition of mature cowpea grains and leaves was analysed using inductively coupled plasma mass spectrometry. Cowpea's nutrients in the leaves and grain were significantly increased by seaweed extract when drought and treatment interacted. Na, Mn, B, and Ai in the leaves and P and Mg in the grain increased concentration when exposed to extreme dryness and higher doses of seaweed extract (15 ml and 20 ml, respectively). The K leaves and Na grain performed best under moderate level (50% pot capacity) with higher dosages (15 ml and 20 ml). This study suggests that the inclusion of Kelpak as a biostimulant can improve absorption of minerals by crops under periods of limited water supply.

Antimalarial activity of selected indigenous plants used in South African traditional medicine

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Abstract: The increasing resistance of *Plasmodium* parasites to currently available antimalarial therapy poses a great challenge in treating malaria. Plants have been used as a primary source of novel pharmacologically active compounds to make drugs since ancient times. More than 80% of the rural population relies on traditional medicine for their primary healthcare needs. Therefore, this study aims to explore the antimalarial properties of three South African plants used in traditional medicine to treat malaria. The medicinal plants, *Ximenia caffra*, *Ziziphus mucronata*, and *Ricinus communis* claimed traditionally to treat malaria, were explored for their antimalarial potentials through sequential extraction using hexane, ethyl acetate, dichloromethane, and methanol. Plant crude extracts were screened for asexual antiplasmodial activity using the SYBR Green I malaria assay on chloroquine-sensitive strain NF54 strain of *P. falciparum* parasites. Dichloromethane and ethyl acetate extracts of the bark of *Z. mucronata* displayed promising antimalarial activities and were further subjected to column chromatography for the isolation of pure compound(s), which were later characterised to be betulinic acid, methyl betulinate, and lupeol. *In silico* evaluation of the isolated compounds was conducted by molecular docking and further validated with *in vitro* experiments against a purified protein target, *Plasmodium falciparum* hypoxanthine-guanine-xanthine phosphoribosyltransferase (PfHGXPRT). Taken together, the antimalarial activity of the crude extracts and the isolated compounds confirm that these medicinal plants could serve as effective agents for treating malaria.

Phytochemical characterization and antioxidant activity of selected medicinal plant leaf extracts with anticancer properties

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Abstract: Plants have been vastly used, and exploring their pharmacological activities can be helpful for the prevention and treatment of various diseases. The current study reports on the qualitative phytochemical screening and antioxidant activity of *Annona senegalensis*, *Sutherlandia frutescens* and *Withania somnifera* leaf extracts. Different extracts were obtained using different solvents. Standard methods were used for the phytochemical screening of the extracts. Thin Layer Chromatography (TLC) was used to test the presence of potential secondary metabolites and antioxidants. The 0.2% 2,2-diphenyl-2-picrylhydrazyl (DPPH) assay was conducted for quantitative antioxidant activity analysis. The GC-MS technique was carried out to identify the compounds present in the crude leaf extracts. The screening analysis revealed the presence of quinones, steroids, cardiac glycosides, coumarins, cardiac glycosides and terpenoids in all selected plant extracts. However, glycosides were absent in all selected plants. The extracts had significant antioxidant activity, with the methanolic with IC₅₀ values of 12,63 µg/ml for *A. senegalensis*, 5,41 µg/ml for *S. frutescens* and 6,43 µg/ml for *W. somnifera*. The Gas Chromatography-Mass Spectrometry (GC-MS) chromatograms revealed different chemical compounds whose known bioactivities and applications are important in the management of life-threatening diseases like cancer and diabetes. Therefore, the current study has shown that the leaf extracts of selected medicinal plants bear a variety of chemical compounds and functional groups. These suggests their efficacy in traditional medicine may be attributed to their antioxidant agents thought to have disease-preventing properties.

Isolation and characterisation of compounds with antioxidant, anti-inflammatory and antimycobacterial effects against *Mycobacterium smegmatis* from the leaves of *Artemisia afra*

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Abstract: The resistant of *Mycobacterium tuberculosis* to the current treatment regimens is a huge challenge for the health care system and the economy. The aim of the study was to isolate and characterise compounds from the leaves of *Artemisia afra* with antioxidant, antimycobacterial, and anti-inflammatory activities. Extraction was done using solvents of varying polarity, namely hexane, chloroform, dichloromethane, ethyl acetate, acetone, ethanol, methanol, butanol, and water. Thin layer chromatography (TLC) was used to determine qualitative antioxidant activity using 2, 2-diphenyl-1- picrylhydrazyl (DPPH) assay and antimycobacterial activity of the *Artemisia afra* extracts against *Mycobacterium smegmatis*. Quantitative antioxidant activity and ferric reducing antioxidant power of the plant extracts were also evaluated. Bioautographic and MIC (minimum inhibitory concentration) assays were used to determine the antimycobacterial activity of the extracts. After screening for different phytoconstituents, it was observed that *Artemisia afra* possesses saponins, steroids, tannins, cardiac glycosides, terpenes, and flavonoids. Quantification of phytoconstituents indicated that the methanol extract had the highest amount of total phenolics (190.31 ± 5.81 mgGAE/g) as well as high tannin (339.92 ± 11.28 mgGAE/g) and flavonoid contents (1333.07 ± 12.97 mgQE/g). Antioxidant activity was observed on the plate developed in CEF (intermediate polarity) and EMW (polar) mobile phases. Most of the extracts showed high percentage inhibition. They were also observed to have low ferric reducing antioxidant power. There is significant potent antimycobacterial activity of the extracts observed against *Mycobacterium smegmatis* and the MIC values ranges between 1.25 mg/ml and 2.5 mg/ml. In conclusion, isolation and characterisation of the active compounds is needed to validate their individual activities.

The ameliorative effects of curcumin on key enzymes that play a role in hepatic glucose output

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Abstract: Diabetes mellitus (DM) is a prevalent and consequential disorder. Currently, it affects more than 463 million people globally with the numbers expected to rise, owing to the growing consumption of high-fructose diet. DM is characterised by high levels of glucose in the blood. The most common type of diabetes is type-2 diabetes (T2D), making up 90% of all diabetes cases. The hallmark of T2D diabetes is insulin resistance, affecting tissues like the liver, muscle, and adipose tissue. The liver is responsible for 60% of glucose released into the blood. During glucose metabolism, two critical mechanisms occur in the liver: gluconeogenesis and glycogenolysis. In a diabetic state, these mechanisms release excessive glucose into the bloodstream, promoting hyperglycaemia, a symptom of DM. In this study, natural polyphenol curcumin was administered to T2D-induced rats to observe the ameliorative effects of curcumin on crucial enzymes involved in hepatic glucose output. Forty male Sprague Dawley rats were fed a high-fructose diet to induce metabolic syndrome model. The rats were treated with curcumin. After 116 days the experiment was terminated, and hepatic tissues were collected for molecular analysis. Firstly, RT-qPCR was conducted to analyse the gene expression of the four rate-limiting enzymes, PEPCK, G6Pase, GP, and FBPase, which play a significant role in hepatic glucose output. Additionally, western blot analysis was conducted to determine the protein expression of these enzymes. Lastly, an enzyme activity assay was performed to analyse the activity of the PEPCK enzyme. The results indicated increased PEPCK gene expression in the high-fructose diet group compared to the control (CON) group. However, it was downregulated in the group treated with curcumin alone and in the HFD group treated with curcumin. Additionally, when checking the activity of PEPCK, the CON group showed increased activity, and the CU group showed reduced PEPCK activity compared to CON. HFD shows elevated levels of PEPCK enzyme activity compared to the group treated with HFD+CU. These findings indicate that curcumin can be a potential treatment for T2D and reduces excessive hepatic glucose output by downregulating the activity and gene expression of key enzymes involved in gluconeogenesis and glycogenolysis.

***In vitro* antibiofilm and antibacterial activities of selected South African plants against *Streptococcus agalactiae* isolated from bovine milk samples**

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Abstract: The emergence of drug-resistant, biofilm forming *Streptococcus agalactiae* poses a threat to effectiveness of antibiotic treatment in bovine mastitis. Antibacterial and anti-biofilm activities of selected South African plants were investigated against *S. agalactiae* (SAG) strains isolated from milk samples of bovine mastitis cases. Acetone and ethanol extracts of *Searsia lancea*, *Indigofera frutescens*, *Erythrina caffra* and *Antidesma venosum* were tested using the serial microdilution assay, resulting in minimum inhibitory concentration (MIC) ranging from 0.02 to 1.25 mg/mL. Cytotoxicity was investigated using the methyl tetrazolium bromide assay, and the ethanol extract of *S. lancea* had the highest mean selectivity index (SI) of 20.81. The strong antibacterial activity of *S. lancea*, coupled with its lack of cellular toxicity, makes it a potential candidate for further investigation and herbal formulation. The SAG isolates all demonstrated biofilm forming ability, while three isolates were drug resistant. Interestingly, the most susceptible SAG isolate to most of the extracts was the strongest biofilm former. Biofilm inhibition of the extract was studied on this biofilm forming strain, and all the extracts completely inhibited formation of biofilm at varying sub-MIC concentrations (0.004 – 0.016 mg/mL). Only the acetone extract of *Antidesma venosum* and ethanol extract of *Erythrina caffra* were able to completely disrupt 24h and 48h preformed biofilms. The selected plants have promising potential for further development as treatments for anti-infective management of *Streptococcus agalactiae*-induced bovine mastitis.

Antibacterial, antioxidant and anti-inflammatory activity and cytotoxicity of three plant species with potential to combat pathogenic mastitis-causing bacteria

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Abstract: Bovine mastitis is an inflammatory disease in cows caused by various bacterial species, some with high levels of antibiotic resistance. The disease results in severe economic consequences in the dairy industry. Different extracts (methanol, acetone ethanol, dichloromethane:methanol, cold and hot water) of three plant species (*Leonotis leonurus*, *Leonotis nepetifolia* and the invasive alien *Tithonia rotundifolia*) were investigated against six strains of *Staphylococcus* species isolated from clinical cases of mastitis, and ATCC reference strains. Antibacterial susceptibility was done using the serial microdilution assay, while antibiofilm efficacy was investigated using crystal violet and [2-(4-iodophenyl)-3-(4-nitrophenyl)-5-phenyl-2H-tetrazolium] assays to determine the anti-adhesion activity and viability of the bacterial cells after treatment with plant extracts. Anti-quorum sensing activity was assessed by violacein inhibition in *Chromobacterium violaceum*. Antioxidant activity was determined using *in vitro* chemical assays. Inhibition of 15-lipoxygenase enzyme and tetrazolium-based colorimetric reduction assays were used to determine anti-inflammatory activity and cytotoxicity of extracts respectively. Extracts had minimum inhibitory concentration values of 0.02 - 2.5 mg/mL. The extracts had varying abilities to inhibit biofilm formation and metabolic activity of bacteria at different times, with the most active $\geq 50\%$. Eight extracts had excellent anti-quorum sensing ability with violacein inhibition $\geq 50\%$ at all concentrations. *Leonotis nepetifolia* methanol extract had the highest anti-inflammatory activity in the 15-LOX assay and all extracts were non-cytotoxic to Vero kidney and bovine dermis cells. The different extracts had good efficacy against drug-resistant mastitis bacteria with little to no cytotoxicity and can be recommended for further development into formulations to prevent and treat mastitis.

Effect of plant extracts on bacterial motility, hydrophobicity, biofilm formation and quorum sensing of enterohemorrhagic *Escherichia coli* O157:H7

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Abstract: This study aimed to investigate the antibiofilm mechanism of methanol and acetone extracts of 16 selected plants against multidrug resistant enterohemorrhagic *E. coli* O157:H7. The antibacterial effects of 32 extracts were investigated using the microplate dilution method and *in vitro* toxicity was conducted on normal mammalian cells. Thereafter, effects of the sub-inhibitory concentration (0.156 mg/ml) of extracts on cell motility, cell surface properties and biofilm formation (0 h, 24 h and 48 h) on a polystyrene surface against *E. coli* O157:H7 were studied. Finally, the biosensor strain *Chromobacterium violaceum* ATCC 12472 was used to study anti-quorum sensing potential of extracts. Most extracts had poor antibacterial activity (MIC > 0.62 mg/ml) with relatively low cytotoxicity (LC > 20 µg/ml). The extracts were able to significantly ($p > 0.05$) decrease the swarming and twitching motility of *E. coli* O157:H7 after 72 h incubation. *E. coli* O157:H7 was observed to be hydrophobic and autoaggregating, but this cell property was significantly ($p > 0.05$) changed after exposure to plant extracts. The acetone extracts of *Salix babylonica* (81.21%) and *Leucaena leucocephala* (89.36%) were able to prevent cell attachment (0 h). Furthermore, a significant ($p > 0.05$) difference in inhibition of biofilm formation was observed after 48 h incubation. The concentration that inhibited 50% of violacein production (IC₅₀) ranged from 0.01 to 0.02 mg/ml. The study showed that selected plant extracts can reverse bacterial multidrug resistance (MDR) of *E. coli* O157:H7 by affecting virulence factors such as biofilm formation and quorum sensing.

Antifungal activity of selected medicinal plants against *Rhizoctonia solani*, root rot causing agent in maize

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Abstract: Medicinal plants have been reported to have active antimicrobial activities against a wide range of pathogens. They are known to induce antagonistic effects to pathogens through the presence of bioactive compounds that induce cell wall disruption and inhibition of enzyme activities of the pathogen. In this study, four selected medicinal plants: *Trichilia emetica*, *Cascabela thevetia*, *Arctotus arctotoides* and *Vernonia amygdalina* were selected and screened for antifungal activity against *Rhizoctonia solani*. Antifungal agar disc diffusion assay was employed to test the crude extracts of four medicinal plants extracted in acetone and ethanol. The medicinal plant extracts, except *T. emetica* extracts exhibited antifungal activity against the pathogen. The mean inhibition diameter of the pathogen ranged from 39.83 (*C. thevetia* ethanol extracts) to 121.85 mm (*A. arctotoides* acetone extracts). The extraction solvent that exhibited the highest inhibition is acetone with an average of 71.77 mm compared to ethanol that exhibited 55.99 mm inhibition diameter. The minimum inhibitory concentration (MIC) for the crude extracts that showed antifungal activity was then determined using a modified version of a microplate method. Based on the MIC results, acetone extracts from *A. arctotoides* exhibited the lowest minimum inhibitory concentration value (0.2 mg/ml) among the tested medicinal plant extracts, which supports the high antifungal activity of the plant observed in the agar diffusion assay of this study.

The antimicrobial activity and toxicity of *Moringa oleifera*, *Portulacaria afra* and *Bulbine frutescens* against dermatological pathogens

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Abstract: Many medicinal plants have an age-old tradition for their anti-infective properties. Three plant species (*Moringa oleifera* Lam., *Portulacaria afra* Jacq. and *Bulbine frutescens* (L.) Willd.) are known for their therapeutic effects on the skin and have been gaining popularity on the market, however, scientific evidence validating their antimicrobial activity and toxicity in combination, against skin pathogens was lacking. Thus, this study sought to investigate the antimicrobial activity and toxicity of these three plant species independently and in combination. The antimicrobial activity of the three plant extracts, alone and in combination, was investigated against the reference strains *Enterococcus faecalis* (ATCC 29212), *Klebsiella pneumoniae* (ATCC 13887), *Brevibacterium epidermidis* (ATCC 20660), *Candida albicans* (ATCC 10231), *Cutibacterium acnes* (ATCC 29212) and *Trichophyton mentagrophytes* (ATCC 9533) using the broth micro-dilution assay to determine the minimum inhibitory concentration (MIC). The interactive profiles of the combinations were analysed by calculating the fractional inhibitory concentration index (FICI). The toxicity was screened via the brine shrimp lethality assay (BSLA). The pathogens *C. acnes* and *T. mentagrophytes* were the most susceptible (MIC values 0.50-0.83 mg/ml and 0.19-0.25 mg/ml respectively). For the combinations, synergistic interactions were observed for seven of the aqueous extract combinations, and one organic extract combination (FICI 0.25-0.50). Most of the extracts displayed low toxicity (% mortality below 50) when tested independently and in combination. Based on the findings of this study, the selected plant extracts and combinations hold potential as low toxic agents with antimicrobial activity.

Yield and chemical composition of *Greyia radlkoferi* leaves exposed to different watering regimes

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Abstract: *Greyia radlkoferi* Szyszyl. is one of the southern African medicinal plants used in development of cosmeceutical products. *Greyia radlkoferi* leaves contain flavonoids reported to inhibit the production of melanin and therefore hyperpigmentation. Although the flavonoid content in plants is influenced by environmental factors such as rainfall and soil conditions, there is little research work done evaluating the growth and chemical composition of *G. radlkoferi* under various irrigation treatments. The study was aimed at investigating the effect of water stress on the yield and chemical composition of *G. radlkoferi*. Two-year-old plants were exposed to six different irrigation regimes. The treatments included irrigating to 100% of the depleted water from the pots once (T1), twice (T2), and three times (T3) every week, 75% once a week (T4), and 50% twice (T5), and three times (T6) a week. The average leaf yield per plant was significantly affected by the irrigation frequency (associated with water stress levels). Plants exposed to treatment T3 recorded a significantly higher leaf yield than T1, T2, T4 and T6. The stomatal conductance measurements taken before and after each watering session showed a significant effect of water stress on the parameter. The total phenolic content was significantly higher in T4 and T6, while the flavonoid content was significantly reduced in the two treatments. Clustering based on the nuclear magnetic resonance analysis grouped T1 to T4 together by the presence of catechin, epigallocatechin, galangin, gallocatechin, 2',4',6'-trihydroxychalcone, and 2',4',6'-trihydroxydihydrochalcone, while pinocembrin was responsible for the grouping together of T5 and T6. The study recommends growing *G. radlkoferi* under adequate irrigation regime (with reduced water stress) for improved yield without compromising its currently known active ingredients (2', 4', 6'-trihydroxydihydrochalcone) in cosmeceutical preparations.

Ocimum sanctum and *O. kilimandscharicum* plant extracts induce apoptosis in melanoma cells

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Abstract: Natural products have long been the preferred source of pharmacologically active compounds, particularly the Lamiaceae family, which includes various medicinal plants in the pharmaceutical industry. *Ocimum sanctum* and *O. kilimandscharicum*, which are from the Lamiaceae family, are medicinal plants that have shown promise against numerous diseases; however, only a limited number of studies have tested the anticancer activity of these plants in skin cancer. As such, this study aimed to investigate the *in vitro* cytotoxicity of both species on malignant melanoma A375 cells. From the two plants, eight extracts were obtained via sequential extraction using hexane, dichloromethane, ethyl acetate and methanol. The eight extracts were screened for their cytotoxicity against non-cancerous human embryonic kidney cells (HEK 293) and malignant melanoma cells (A375) by performing Almar blue assay to determine the IC₅₀ of each extract. In addition, light and fluorescence microscopy, Caspase 3/7, and flow cytometry were used to determine and confirm the mode of cell death induced by the extracts. Out of the eight plant extracts screened, the hexane, dichloromethane, and ethyl acetate extracts of the *Ocimum sanctum* as well as the hexane and dichloromethane extracts of the *Ocimum kilimandscharicum* all had high apoptotic effects with IC₅₀ of 36.71; 40.13; 34.79; 30.18 and 29.86 µg/mL, respectively. Interestingly, the extracts showed nontoxicity to the HEK 293 cells. The results were obtained from further analysis using light and fluorescence microscopy and caspase 3/7 and flow.

Induction of apoptosis in cancer cell lines by nanomedicine prepared using medicine plants used for cancer treatment

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Abstract: Nanomedicine is the newest and most important research field of the 21st century due to the possibility of fabricating more efficient instruments for nanomaterial synthesis and characterisation. The purpose of nanomedicine is to detect, treat, and prevent any disease or other traumatic injury to improve human health. According to the International Agency for Research on Cancer (IARC) (2018), lung and female breast cancer are the leading types of cancer worldwide. Therefore, this current study was aimed to identify the active extract, isolate, and characterise its phytochemicals, further assess their biopharmaceutical capabilities using nano platforms against selected cancer cell model. Medicinal plants were identified through literature review. Plants were collected and extracted using acetone. TLC was used for phytochemical analysis of plant materials. Cell toxicity of the plant extracts, at varying concentrations, was studied against breast cancer cells using the 3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide (MTT) assay. The anti-metastatic was evaluated using the scratch assay. The results revealed the presence of active compounds with possible medicinal activity. Flavonoids, tannins, saponins and alkaloids were present in all plant materials. The TLC plates showed the stable phytochemical compounds. The acetone extract of *Agapanthus africanus* led to the loss of viability comparable to the results observed with the positive control. *A. africanus* had the best anti-proliferative activity with an IC₅₀ value of 15.9 µg/mL. The toxicity was time and concentration dependent.

Evaluation of anti-cancer, pro-apoptotic, and anti-metastatic effects of synthetic analogue compound 2-Imino-7-methoxy-4-(4-fluorophenyl)-2H-1,3-thiazino [3,2-a] benzimidazole (FDM27) on pancreatic and melanoma cancer cells

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Abstract: Cancer remains a life-threatening disease which greatly affects millions of people. Cancer is usually diagnosed in the advanced stage; hence, the prognosis remains poor. Synthetic small molecules are now used as potential drug discovery and development starting points due to their various pharmaceutical activities, including anticancer. Most chemotherapy drugs are designed to inhibit proliferation and induce apoptosis; however, they fail to deliver the expected outcomes. This study aims to explore *in vitro* antiproliferation, pro-apoptotic, and anti-metastatic effects of FDM27 against pancreatic and melanoma cancer cells. The study hypothesises that FDM27 will inhibit cell proliferation, induce apoptosis, and inhibit metastasis. To study anticancer effects, AlamarBlue assay was conducted to measure the cytotoxicity activity. Cell-viability percentage was reduced, which reveals that FDM27 may have antiproliferation properties. To study pro-apoptotic effects, a caspase 3/7 activity assay was conducted. Upregulation of caspase 3/7 was observed only in pancreatic cancer, indicating the late stage of apoptosis. melanoma showed non-caspase activity; however, there's evidence that cells may die due to over-expression of pro-apoptotic genes. Luminescent ATP detection assay revealed lower ATP production in cells exposed to treatment. Morphological effects were also studied using Hoechst staining, and cells with treatments showed nucleus fragmentation, one of the apoptotic features. To study antimetastatic effects, a wound healing cell-migration assay was conducted. cell-migration inhibition was observed, an important step of metastasis. However, to conclude if FDM27 induces apoptosis or inhibits metastasis, gene-expression qPCR will be conducted to confirm the upregulation or downregulation of related genes.

Conservation of rare, threatened, and endangered medicinal flora through cooperation

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Abstract: *Warburgia salutaris* was identified in 1926 as a target species for extinction due to unsustainable destructive harvesting. In 1996 the tree gained recognition as “Tree of the Year”. In 2014 the status and challenges of the tree were brought to the attention of Sappi Ltd by the South African National Parks, Kruger National Park management due to their remaining trees being under constant poaching threat and the demand for the bark from the surrounding traditional healers. Problems faced were seed supply, cuttings propagation, destructive harvesting, lack of plants available to traditional healers’ market and education on a more sustainable harvesting practice. Sappi tasked Outdoor Escapes to create and manage the project. A working group was formed with expertise to resolve the challenges. Through media attention, seeds were obtained from Precilavale Farms. Sappi Shaw Research Centre resolved the cuttings rooting challenge with a 77% rooting success rate resulting in 12 000 trees produced annually. Seeding challenges were resolved through cooperation with ARC and the community requirements for the Kruger National Park bordering areas were researched through the Kruger National Park Social Ecologists. Community and traditional healer workshops were undertaken on a changed and earlier sustainably through harvesting twigs and leaves that have proven potency as to roots and bark. The community and traditional healers were given trees at no cost. More than 65 000 trees have been provided to the Kruger National Park communities with an 83% survival rate, and in 2022, the first trees planted produced seeds. In 2019 the project was extended to KwaZulu Natal, with distribution undertaken through the Ezimvelo KZN Wildlife Social Ecologists. The simple framework template of the project, with the sponsorship of Sappi, partnerships, and cooperation with ARC, KNP and Ezemvelo and management of Outdoor Escapes, has resulted in the extension of the project to include *Prunus africana* and *Ocotea bullata*. The project's success is due to the simplicity of the framework template and the cooperative and catalytic approach of Outdoor Escapes and the working group.

Screening and comparison of *Lippia javanica* and *Mentha piperita* leaf extracts for antibacterial and antioxidant

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Abstract: Medicinal plants have been used from ancient history to treat numerous infections such as the respiratory tract infections and are now being evaluated as potential antimicrobial agents against antibiotic resistant microorganisms. The aim of the study was to evaluate the antioxidant and antibacterial activities of *Lippia javanica* and *Mentha piperita* leaf extracts to validate their use against respiratory tract infections. The plants were extracted using solvents of varying polarity. Thin layer chromatography was used to screen for the presence of phytochemical compounds. Standard tests were done to detect the presence of numerous phytoconstituents. Furthermore, major phytochemicals were quantified using the spectrophotometric methods. Qualitative and quantitative antioxidant activity was determined using 2,2-diphenyl-1-picrylhydrazyl radical (DPPH) assay. The antibacterial activity of the plant extracts was tested using micro dilution and bioautography assays. Most of the phytochemical compounds were separated on the non-polar mobile phase indicating the presence of mostly non-polar compounds. *Mentha piperita* contain many of the selected phytoconstituents as compared to the *Lippia javanica*. *M. piperita* had the highest phenolic and tannin content whereas *L. javanica* had the highest flavonoid content. Methanol extracts of both plants had the highest antioxidant activity. *Lippia javanica* (methanol) had the lowest MIC (0.020) against *P. aeruginosa* whereas *Mentha piperita* (acetone and methanol) had the lowest MIC (0.020) against *S. aureus*. The results obtained in this investigation confirmed high and antioxidant and antibacterial activity which validates the use of *Mentha piperita* and *Lippia javanica* as a medicinal herb and can be investigated further for drug discovery.

***In vitro* antidiabetic effect of wild and cultivated *Amaranthus* spp. and isolated compounds**

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Abstract: Previously, wild and cultivated *Amaranthus* spp. were investigated for antidiabetic activity *in vitro* using α -amylase and α -glucosidase enzyme assays. This study reports the antidiabetic effect of leaf extracts of cultivated *Amaranthus* spp. on glucose uptake in liver cells (HepG2) and muscle cells (L6 myotubes). Moreover, the antidiabetic effects of α -spinasterol and palmitic acid isolated from wild *A. cruentus* were determined. The extracts stimulated glucose uptake in HepG2 cells up to 19.6% and 17.0% in L6 myotubes, respectively, without toxicity to these cells. In addition, palmitic acid and α -spinasterol showed moderate glucose uptake in HepG2 and L6 myotubes cells.

Investigation of the anticancer activities of the novel compound 5-methoxyjamaicin isolated from *Erythrina abyssinica*

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Abstract: According to WHO, the rising cancer burden is putting a strain on the healthcare system, and people living with the disease experience mental, physical, and emotional distress. Conventional therapies have limitations such as non-selectivity, detrimental effects on healthy cells, secondary recurrence, metastasis, and cancer becoming resistant to treatment. Therefore, it has become critical to identify effective, bio-friendly, and affordable alternative cancer treatments. For many years, plants have played an important role in developing anticancer medications, and natural compounds derived from these plants have been a rich source of anticancer agents. This study aimed to isolate and characterise flavonoids found in *Erythrina abyssinica*, conjugate them to metallic nanoparticles, and test them for anticancer activity. The *in vitro* studies showed that non-conjugated 5-methoxyjamaicin had cytotoxic activity against pancreatic and cervical cancer and showed no cytotoxicity against normal cells. This cytotoxic activity was accompanied by intrinsic apoptosis induction that was characterised by high caspase activity, low ATP levels in cancer cells, changes in the cell and nucleus morphology, and inhibition of metastasis. Furthermore, the conjugation of the compound to silver nanoparticles resulted in the cytotoxic activity that was much higher than that of the non-conjugated compound. Despite the fact that conjugating this compound increased its cytotoxic activity against malignant cells tremendously, it proved damaging to healthy normal cells. Given that this is an ongoing study, further research is needed to identify and understand other biological processes and cancer-associated genes that the compound may impact and examine how to improve the delivery of this compound without eliciting adverse effects on normal cells.

Medicinal plants used to treat oral health infections at Mukula village, Thulamela local municipality, Limpopo province, South Africa

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Abstract: The majority of people living in rural areas still use traditional medicines to treat variety of infections including oral diseases. The purpose of this study was to document medicinal plants used to treat oral infections and to evaluate their antibacterial activity. Local people were interviewed about the medicinal plants they use to treat oral infections using semi-structured questionnaires. 28 plant species belonging to 19 families are used to treat oral infections. Amongst the 28 plant species recorded 50% were trees, herbs (25%), shrubs (18%) and climbers (13%). The most frequently used plant parts were roots (50%) and stem bark (20,6%). Commonly used preparation methods were decoction 35,29% and chewing 32,29%. *Senegalia ataxacantha* (DC.) Kyal. & Boatwr. was selected and collected due to its high frequency index (31,25%) and its availability. Ethyl acetate and aqueous extracts of stem bark and roots were tested for the presence of phytochemicals using standard procedures and antimicrobial activity against *Actinobacillus actinomycetemcomitans*, *Fusobacterium nucleatum* and *Streptococcus mutans* using agar well diffusion technique. *S. ataxacantha* contained flavonoids, alkaloids tannins, saponins, terpenes and steroids. Both aqueous and ethyl acetate extracts of stem bark and roots showed antibacterial activities against the selected microorganisms ranging from 6.4 to 14.3 mm zones of inhibition. The best activity was shown by stem bark ethyl acetate extract with zone of inhibition of 14.3 mm against *S. mutants* while positive control, chlorhexidine had 15.4 mm zone of inhibition. The antibacterial activities recorded showed that traditional use of *S. ataxacantha* to treat oral infections has been validated up to a certain extent.

Sustainable harvesting guidelines for *Pelargonium sidoides*

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Abstract: *Pelargonium sidoides* is not threatened overall by the current harvesting rates, but the species remains at risk of habitat loss, and unsustainable harvesting practices in certain areas could pose a risk to parts of the population. It is, therefore, important that the plant is harvested sustainably through best practice harvesting methods. The species should be managed to provide a sustainable yield where the harvesting rate does not exceed the regeneration rate. The *P. sidoides* economic, environmental, and social aspects have been considered through the development of these sustainable harvesting guidelines.

These sustainable harvesting guidelines have been developed to promote a sustainable approach to the wild harvesting of *P. sidoides*. These guidelines will provide interested stakeholders with background information on the species, species description, reproduction, cultivation, traditional and commercial values, threats, permitting requirements and sustainable harvesting practices. The key recommendations are to ensure that *P. sidoides* harvesters and industry practice and implement the sustainable harvesting guidelines.

Investigating antibacterial activity and biofilm disruption of South African medicinal plants on bacteria causing infectious diseases in livestock

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Abstract: Pathogens infecting farm animals are responsible for rising incidences of lethal veterinary diseases, leading to decrease in meat quality and profits. The use of medicinal plants has beneficial ingredients with potential usage in the development of new cost-effective drugs. The aim of the study was to screen the antibacterial potential of different plant species against selected bacteria causing infectious diseases in livestock. The selected pathogens were *Klebsiella pneumoniae*, *Pseudomonas aeruginosa*, *Staphylococcus aureus*, *Escherichia coli* and *Enterococcus faecalis*. TLC plates were loaded with 100 µg of each extract, developed in different mobile phases and used for bioautography. Duplicate TLC plates were visualized under UV light at 254 and 350 nm and sprayed with vanillin-sulphuric acid and served as reference plates. The broth microdilution assay (0, 2.5, 1.25, 0.63, 0.31, 0.16 mg/mL) was used to determine the effects of the extracts on the growth of the bacteria. The potential of the extract (0, 2.5, 1.25, 0.63, 0.31, & 0.16 mg/ml) to inhibit the formation of biofilm and mature biofilm of *Klebsiella pneumoniae*, *Pseudomonas aeruginosa*, *Staphylococcus aureus*, *Escherichia coli* and *Enterococcus faecalis* was investigated using crystal violet assay. Extracts of *Combretum mkyzeale*, *Gunnera perpensa*, *Spirostachys africana* leaves had no visible activity against *K. pneumoniae*, *P. aeruginosa*, *S. aureus*, and *E. coli* and *E. faecalis*, as evidenced by the absence of the clear zone on TLC bioautograms. Active compounds were observed in extracts of *Combretum zeyheri*, *Combretum petrophilum*, *Combretum imberbe*, *Annona senegalesis*, *Combretum elaeagnoides* and *Withania somnifera*. Plants extract of *C. elaeagnoides* and *W. somnifera* leaves had more visible clear zones against *K. pneumoniae*, *P. aeruginosa*, *S. aureus*, *E. coli* and *E. faecalis* compared to other extracts. *Combretum apiculatum*, *C. mkyzeale*, *C. zeyheri*, *C. petrophilum*, *C. imberbe*, *A. senegalensis*, *G. perpensa*, *C. elaeagnoides*, *W. somnifera* and *S. africana* extracts had significant ($p < 0.001$) inhibition against *K. pneumoniae*, *P. aeruginosa*, *S. aureus*, *E. coli* and *E. faecalis* with a minimum inhibitory concentration (MIC) of 100 µg/ml. Tested plant extracts did not have any effect on formation of biofilm and mature biofilm. In conclusion, some of the tested plant extracts significantly inhibited the growth of tested bacteria in a concentration dependent manner. Extracts of *C. elaeagnoides* and *W. somnifera* had more compounds that visibly inhibited the growth of the tested bacteria.

Exploring the apoptosis-inducing potential of *Cannabis sativa* and cannabidiol in pancreatic cancer *in vitro*

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Abstract: Pancreatic cancer is a one of the most lethal and aggressive type of cancer that has limited treatment options. It is mainly caused by mutations in certain genes, including KRAS, CDKN2A, SMAD4, and p53, which play a role in the initiation and progression of the cancer. Recently, there has been great interest in studying *Cannabis sativa*, specifically its derivative cannabidiol (CBD), as a potential treatment for pancreatic cancer. CBD has anti-inflammatory and anti-tumour properties, making it a promising candidate for combating this deadly disease. Additionally, studies have shown that CBD can help alleviate pain, manage cancer symptoms, and reduce chemotherapy-induced effects. Studies have also shown that combined with existing treatments enhances their effectiveness. Restoring the normal functions of the "main drivers" of pancreatic cancer, namely KRAS, CDKN2A, SMAD4, and p53, holds immense potential in improving the current challenges associated with its treatment. However, there is limited scientific evidence on the direct effects of *Cannabis* and CBD on these genes. Therefore, this study aimed to address this gap by investigating the apoptosis-inducing potential of *Cannabis sativa* and CBD in pancreatic cancer cells *in vitro*. This was achieved by treating pancreatic cancer cells with *Cannabis* extract and CBD to assess their viability using the AlarmaBlue assay and xCELLigence. Induction of apoptosis was also analysed using Annexin V/propidium iodide staining, followed by flow cytometric analysis. Furthermore, the study intended to evaluate the expression levels of apoptosis-related genes and the "main drivers" (KRAS, CDKN2A, SMAD4, and p53) using quantitative real-time polymerase chain reaction (qPCR) and western blotting. It was revealed that the proposed treatment significantly reduced cell viability and induced apoptosis by upregulating pro-apoptotic genes and downregulating anti-apoptotic genes. The direct effects of CBD and *Cannabis* extracts on the expression levels of KRAS, CDKN2A, SMAD4, and p53 were also revealed.

Investigation of the underlying molecular mechanisms of anticancer properties of *Cotyledon orbiculata*, and *Salvia aurea* on breast and cervical cancer cell lines

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Abstract: Cancer is the unregulated growth of cells, that accounts for an estimated 20 million incidences and 10 million mortalities in 2020, globally. It is a major public health burden worldwide and it is the second most cause of death after cardiovascular diseases. Africa has the highest cancer incidences and mortalities of 5.7% and 7.1% and these numbers are set to increase particularly in less developed countries. To mitigate the rising number of cancer cases there's is a need of newer cancer therapeutics that have less to no side effects. It is believed that naturally occurring herbs have properties that can serve as an alternative approach to combating cancers and many other diseases as they possess biologically active chemicals that display strong antioxidant, anti-inflammatory, anti-bacterial, anti-diabetic and anticancer properties. *Cotyledon orbiculata*, and *Salvia aurea* (= *Salvia africana-lutea*) native to south Africa where it is used to treat minor illness. The cytotoxicity test MTT assay and xCELLigence have shown that the said plants have anti-cancer properties. Therefore, this study will investigate the anti-proliferative and antioxidant underlying molecular mechanisms of *C. orbiculata* and *S. aurea* methanol and hexane leaf extract on breast and cervical (HeLa, MCF-7) cancer cell lines.

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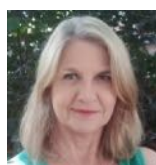
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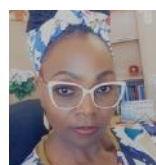
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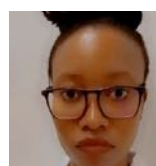
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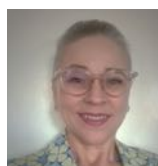
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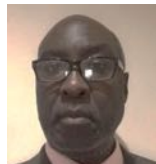
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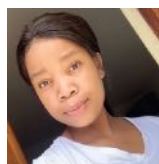
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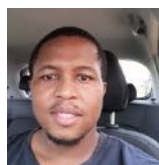
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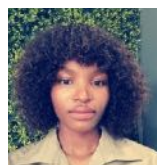
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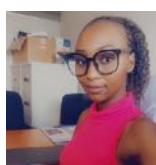
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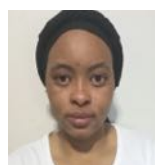
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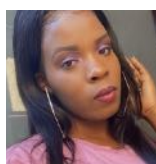
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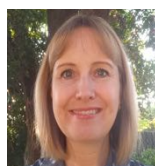
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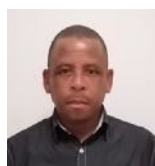
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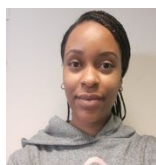
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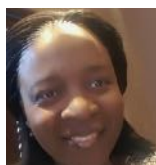
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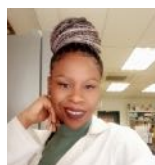
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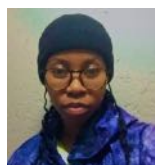
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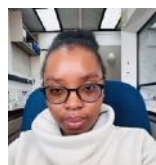
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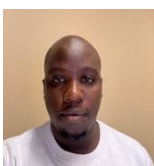
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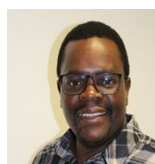
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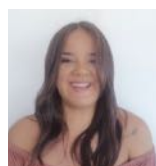
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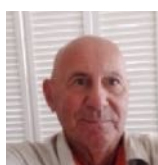
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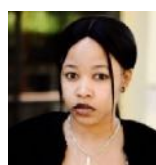
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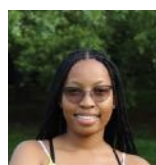
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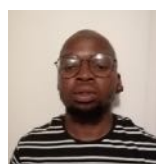
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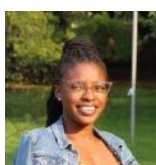
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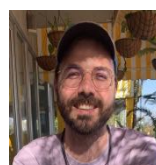
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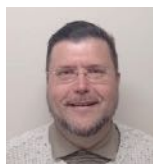
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Adjudication criteria and guidelines

Criteria	Points
5. Audibility and clarity	/10
6. Visual contact with audience	/10
7. Logical sequence of ideas	/10
8. Quality and use of visual aids	/10
9. Appropriate use of time	/10
10. Significance of the problem	/10
11. Experimental design	/10
12. Quality of results obtained	/10
13. Conclusion	/20
TOTAL	/100

Objective

The objective of these awards is to encourage a high standard of presentations at the annual Indigenous Plant Use Forum (IPUF) meeting by adjudicating and rewarding the best presentations (paper and/or poster) by a young scientist.

Criteria

The criteria for adjudication are:

1. Audibility and clarity (10 points)

This refers to the extent to which the entire audience can hear and understand what the presenter is saying. It includes the manner, tone, volume, speed and clarity of the speech, and their variation to capture and retain the interest and attention of the audience. Appropriate use of hand and body language must be included in judging this point.

2. Visual contact with audience (10 points)

This is adjudicated on the extent to which the manner and success of the presenter feature in the establishing and maintaining visual contact with the audience. The presenter must look at, and talk to the audience, and ensure that the audience's attention is focused on him/her.

3. Logical sequence of ideas (10 points)



This covers the logical sequence from the beginning to end. It also covers the flow of thought in the presentation and the extent to which this is logical and used to enhance the communication of the message to the audience.

4. Quality and use of visual aids (10 points)

In addition to the quality of the visual aids, of equal importance in adjudicating this point, is the proficiency of use of the aids and the extent to which they are used as an aid to support and enhance the presentation. The flashiness of the aids should not overpower or dominate the presentation to the detriment of communicating the message.

NB: A presentation must be remembered for what was communicated and not what aids were used.

In the case of a poster presentation is the candidate must not be penalized if all the text (with figures, tables, photos etc.) is not legible to the whole audience at the time he presentation, as the poster may be presented from the place where it is displayed.

NB: All the text and ideas on the poster must however be understood, legible and dear to any person who wants to look at the poster during his/her own time, without the presenter having to be present and explain.

5. Appropriate use of time (10 points)

This refers to the extent to which the presentation is delivered within the time limit and is not rushed, drawn out or truncated.

6. Significance of the problem (10 points)

This refers the significance or impact in either basic or applied research.

7. Experimental design (10 points)

This refers to the design of the experiments, if the stated objectives were addressed by the methods used, if the experiments were well planned and executed.

8. Quality of results obtained (10 points)

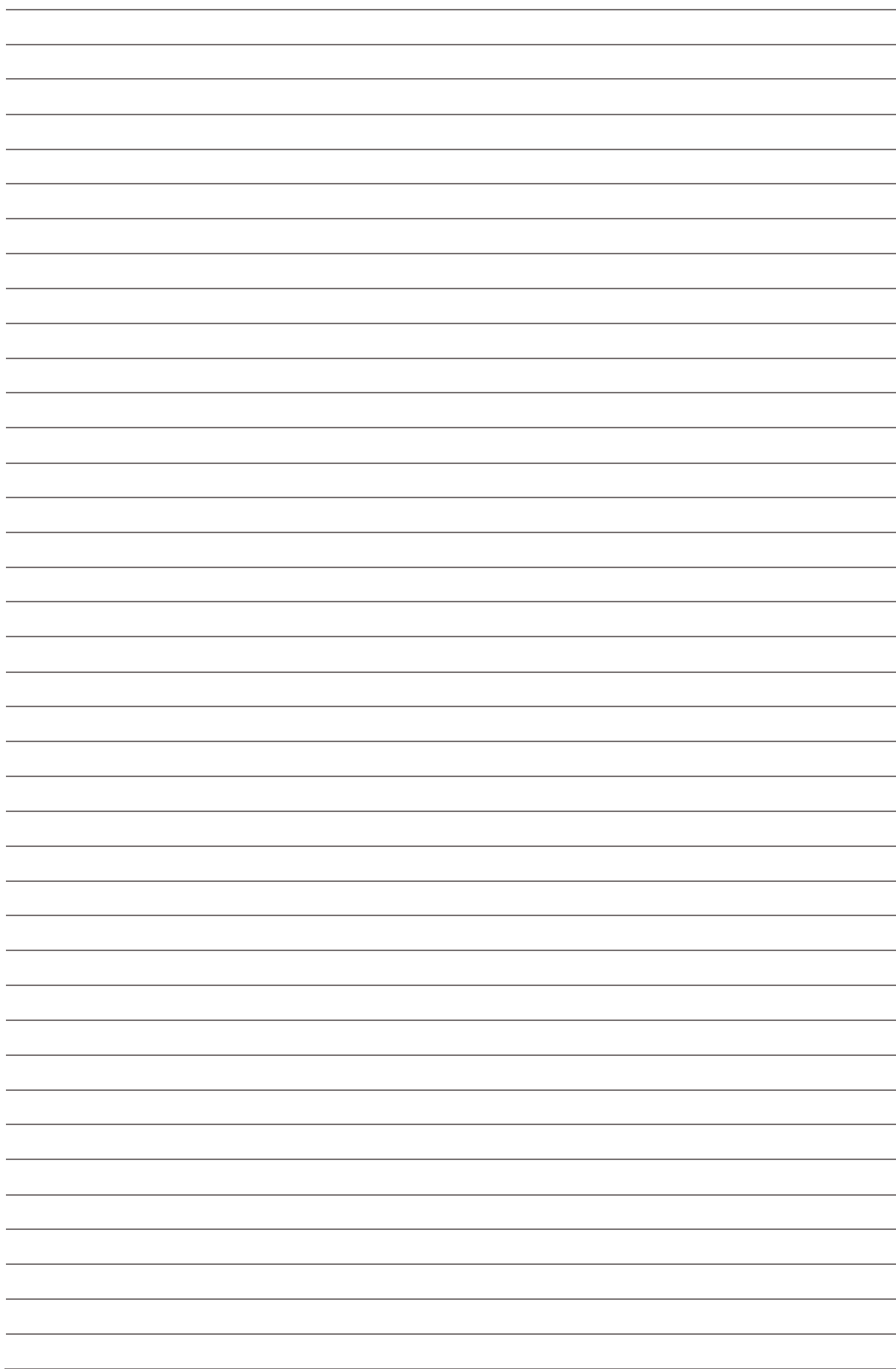
This refers to the significance, originality and quality of the results obtained.

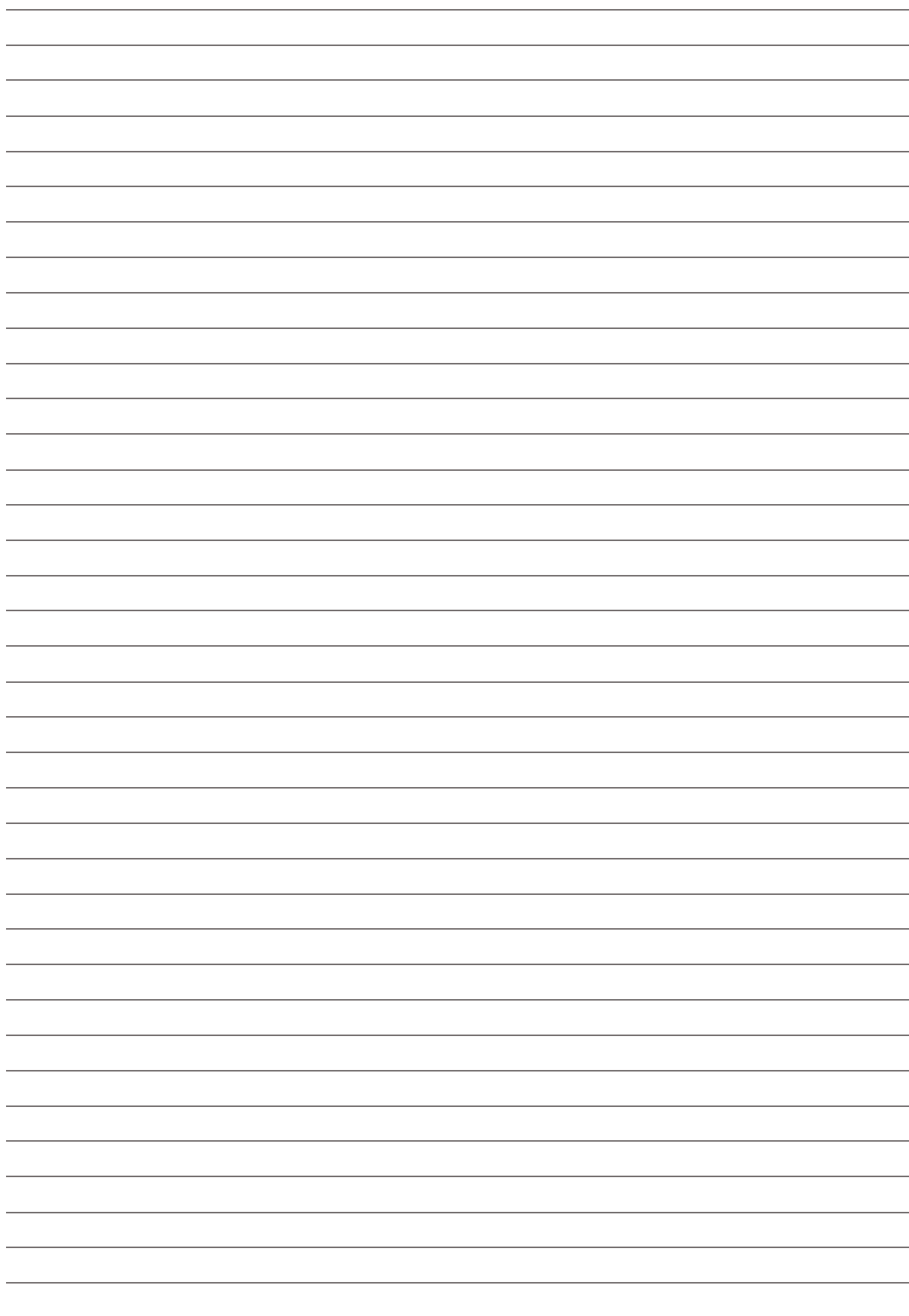
9. Conclusion (20 points)

This is adjudicated based on the interpretation and implications of the results, the correlation of the conclusions with the results presented, and suggestions for future areas to be investigated.

Notes

[illegible]







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Compiled by Ryan D. Rattray