



UNIVERSITEIT VAN PRETORIA  
UNIVERSITY OF PRETORIA  
YUNIBESITHI YA PRETORIA

# University of Pretoria

## Department of Plant Science

### Medicinal Plant Science



# University of Pretoria

## Natural and Agricultural Sciences

### Message from the Dean

**Prof Jean Lubuma**

Have you ever wondered who is responsible for the quality of the chocolates, canned beverages or pancake mixtures you buy in the shops? What is the science behind a cricket ball or pitch? What is nanotechnology? How do specialists treat cancer with nuclear technology, or tuberculosis with phytomedicine? Why are actuaries the highest paid professionals in the world?

The Faculty of Natural and Agricultural Sciences offers graduate programmes that are not only at the forefront of the various disciplines, but also equip graduates to be leaders and problem-solvers in their chosen professions. The key to the Faculty's success is the high premium it places on quality education, research and innovation. This is embodied in the Faculty's approach to training and research—and above all, in the problem-solving mindsets it nurtures in students.

The University of Pretoria aims to be internationally competitive, while being locally relevant at the same time. Its disciplines of plant and animal sciences are currently ranked the highest of all South African universities, based on citations (i.e. the number of times that an author's work has been referred to in academic publications) and the number of research papers produced by academics in the Faculty (according to the essential science indicators of the ISI Web of Knowledge).

Local relevance is assured through close cooperation with industry. In this field, the University has deployed a number of innovations. Its strategic alliance with the Council for Scientific and Industrial Research (CSIR), known as the Southern Education and Research Alliance (SERA), creates unequalled training and research opportunities for students and staff. The Innovation Hub right next to the University's experimental farm is a project of SERA and the Gauteng Provincial Government. Some of the world's foremost high-technology firms are establishing research and development laboratories at the Innovation Hub.

National and international accreditation is the norm for both graduate programmes and research laboratories. The Faculty is serious about ensuring that the market value of the degrees it awards will always give its students a competitive advantage. The Faculty adds value to its degrees, and has a good reputation in the market, which makes its students sought after.

The study programmes of the Faculty of Natural and Agricultural Sciences are accessible to everybody who meets the Faculty's academic standards. All undergraduate study programmes with adequate student numbers are presented in both English and Afrikaans (except in certain instances, such as Actuarial Sciences, where programmes are only presented in English). The University has various financial aid schemes to assist deserving students with bursaries and loans.

The Faculty is involved in several outreach programmes, such as the well-known UP with Science Programme and the BSc (Four-year programme). Learners with a love for the unknown, a curious mind and a will to work hard are welcome to apply.



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**A view from the rooftop of the Plant Science Complex**

Produced by Anna-Mari Reid

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# Message from the Head of Department

**Prof. N. Barker**



South Africa boasts of more than 20 000 plant species; we have spectacular landscapes, and a scientific community committed to conserving our environment for current and future generations. Our botanical wealth is a rich source of medicines, and together with a strong agricultural sector, research in these fields has an exciting future.

The Department of Plant and Soil Sciences is a newly formed entity arising out of the recent merger of the Departments of Plant Science, Plant Production and Soil Science. With over 30 academic staff, the department now has a committed team of staff who aim to provide the very best undergraduate and postgraduate education in the broad arena of Plant Sciences, including plant taxonomy, ecology, medicinal plant science, biotechnology, agronomy, plant pathology, horticulture and soil science. In addition, staff carry out locally relevant but internationally competitive research in these fields, and several staff are leaders in these fields.

The department co-hosts the DST-NRF Centre of Excellence in Food Security, the DST-NRF SARCHI Plant Health Products from IKS as well as the SAFCOL Forest Chair and Director of the Forest Programme. In addition, several staff are affiliated with the Forestry and Agricultural Biotechnology Institute (FABI)

We are housed in two buildings on the Hatfield Campus; the recently constructed building called, the “Plant Sciences Complex” which is built with pioneering “green” architecture and state-of-the-art research facilities, and the Agricultural Building with associated labs and greenhouse facilities. The Department also has substantial plant growth and field trial facilities on the Hatfield Experimental Farm.

The Department has a rich botanical history stretching back to the founding years of the University of Pretoria in the early 1900s. Part of this legacy is the “H.G.W.J. Schweickerdt Herbarium”, which houses more than 110 000 botanical specimens, a rich resource used by local and international botanical scientists. The “Manie van der Schijff Botanical Garden” is the “living laboratory” of the Department with more than 4000 indigenous species in the Hatfield campus. It is world famous for its cycad collection, and plays a critical role in the conservation of rare species of this South African icon. We invite you to leaf through our web pages, to discover our world of plants and what it can do for you, whether you are an aspiring student, a fellow scientist, or a curious visitor.



The new Plant Science Complex.

## History of the Department

The first lectures in Botany and Zoology at the University of Pretoria, then known as the "Transvaal Universiteitskollege" (TUK), commenced in March 1909. The only lecturer at that time was a well-known entomologist Dr. A. J. T. Janse. In 1910, Prof. H. A. Wager became the first permanently-appointed lecturer in the Department of Plant Science and was later assisted by Dr. B. Elbrecht and Prof. J. M. Hector. Prof. H. A. Wager resigned in 1923. Prof. C. E. B. Bremekamp became the new Head of the Department of Botany in 1924. He was succeeded by Prof. B. Elbrecht as Head of the Department following his resignation in 1931. At this time the Department was housed in the old Agriculture building. In 1940, the Department moved to a newly-built Plant Science building, designed by Gerard Moerdyk, in the northwest corner of our modern day UP main campus.

Prof. B. Elbrecht retired in 1944 and was succeeded by Prof. Margaretha G. Mes as Head of Department in April 1944. She was known for her exceptional research in the field of plant physiology and was the second woman to be appointed as professor at the University of Pretoria. In 1949, the Bateman laboratory was erected and is one of the very first phytotrons in the world to be built. Two more buildings, the Vetman building (after Veterans of WWII) and the Bertha Stoneman building were also erected and together with the Bateman laboratory became the unofficial "Plant Physiological Research Institute" in 1954.

When Prof. Mes passed away on 25th July 1959, the unofficial institute officially became the "Margaretha Mes Institute for Plant Physiology". In 1959, Prof. N. Grobbelaar succeeded Prof. Mes as Head of the Department of Plant Physiology, while Prof. H. G. W. J. Schweickerdt acted as Head of the Department of Botany. When Prof. Schweickerdt retired in 1963, Prof. H. P. van der Schijff succeeded him as Head of the Department of Botany. The two Plant Science departments merged in 1975 when Prof. Van der Schijff was promoted to become the Dean of the Faculty of Mathematical and Natural Sciences. Prof. Grobbelaar acted as Head of the merged Department of Plant Science. Prof. Grobbelaar remained a professor in the Department after he stepped down in 1986.

Prof. Albert Eicker became the new Head of the Department in October 1986. Prof. J. J. M. (Marion) Meyer succeeded Prof. Eicker as Head of the Department of Botany when he retired in 2000. The Department of Botany was renamed as the Department of Plant Science in January 2008. Staff members from several buildings in the campus were reunited in the new Plant Sciences Complex in 2011. A new specialized postgraduate course, known as, "Medicinal Plant Science", started at the University of Pretoria on 1st January 2007.

## Medicinal Plant Science Specialization

The “Medicinal Plant Science Specialization” programme focuses on application of plants and phyto-therapeutically important molecules for pharmaceutical and cosmeceutical purposes. The principles and applications of metabolomics and the biosynthesis of secondary compounds from indigenous plants are also included. Further research activities involve the screening of plant extracts as potential biopesticides against agriculturally important plant pathogens and mycotoxigenic fungi.



Student working at the laboratory, Plant Science Department



Speed extractor machinery at the laboratory of the Plant Science Department



## Academic Staff: Medicinal Plant Science

### Head of Department



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### Staff



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## Manie van der Schijff Botanical Garden

A botanical garden is a collection of living plants that is scientifically managed for the purposes of education, research, conservation and community service. The Manie van der Schijff Botanical Garden currently has about 4 000 plant species that covers approximately 3.5 hectares of the University's West campus. The primary aim of the garden is to raise awareness of southern Africa's indigenous flora through the dissemination and acquisition of botanical knowledge. This includes the provision of plant material for education and research purposes, the collection and propagation of rare and endangered species, as well as research into indigenous plant species with horticultural potential. The dissemination of this knowledge to the broader community is also considered to be very important and the Garden Route was developed to help meet this need.

The Garden had its beginnings as far back as 1924 when *Pavetta* species were planted on the campus for research purposes. The real impetus came in the 1930s with Berend Elbrecht, a man with passion and enthusiasm for the southern African flora that lives on in the many large trees and cycad specimens that were planted during his time in the University. In 1986 the garden was named after Manie van der Schijff to honour the contributions that he made towards the development of the Garden. The Garden is run by a Garden Committee which is responsible for formulating and implementing policies.

### CURATOR

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Rain water garden recently constructed within the Manie Van Der Schijff Botanical Gardens

## **H.G.W.J. Schweickerdt Herbarium (PRU)**

Founded in 1925, the H.G.W.J. Schweickerdt Herbarium (PRU) today houses not just more than 110 000 plant specimens, mostly vascular plants, but also macrofungi. It is the third largest university herbarium in South Africa. In addition to the dry collection, it also houses a large collection of liquid-preserved plant material. Collections are mainly from the forests, Succulent Karoo, grassland and Savanna biomes of southern Africa, including focal areas of the Kalahari region, Pondoland, Maputaland and Sekhukhuneland. New accessions are mostly from staff and postgraduate students involved in ecological and taxonomic research. Numerous plant identification queries from students, University staff members and even from people outside the university are attended to. The herbarium also serves as a repository for voucher specimens of plants used in research. The National Herbarium (PRE) and KwaZulu-Natal Herbarium (NH) and Herbarium of the Royal Botanic Gardens, Kew, amongst others, assist with plant identifications. The herbarium is partly computerized and currently uses the BRAHMS herbarium management programme. A library containing plant identification literature and an extensive collection of maps is available.

### **Training/Research**

Herbarium projects form part of several second and third year, as well as honours practicals in Plant Science and Zoology & Entomology (ZEN 364). The students are given specific projects to do in the herbarium. Herbarium specimens of selected taxa are examined to demonstrate the information value of such material. Students should know how to use a herbarium and how to prepare and submit herbarium specimens for identification. The herbarium is also used by post graduate students, particularly those in phytosociology, taxonomy, phytomedicine and wildlife management programmes. Students should attempt to identify material collected during fieldwork themselves. Herbarium specimens are regularly requested on loan by taxonomic researchers working at institutions from all parts of the world. The herbarium provides active support for a large number of research projects/themes.

UP Departments/Units other than Plant Science that frequently make use of the herbarium are as follows:

Forestry and Agricultural Biotechnology Institute (FABI)  
Department of Paraclinical Sciences (Onderstepoort)  
Department of Zoology and Entomology  
Department of Microbiology and Plant Pathology  
Department of Plant Production and Soil Science  
Department of Animal and Wildlife Science  
Department of Architecture (Landscape Architecture)

E-mail: [herbarium@up.ac.za](mailto:herbarium@up.ac.za)  
Tel: +27(0)12 420 4044/4784





Students at leisure at the Plant Science Department's End year function and during excursions to various institutions



Preparation of a herbarium specimen



The Monocot Garden at the University of Pretoria's Main campus

## Academic Programmes

### Honours programme

#### GENERAL INFORMATION

##### *1. Background and Objectives of the Honours programme*

Studying the Plant Sciences in South Africa today will open a wealth of discoveries for Honours students. Our country boasts of more than 20 000 plant species; we have spectacular landscapes, and a scientific community is committed to conserving our environment for current and future generations. Our botanical wealth is a rich source of medicines and together with a strong agricultural sector, research in these fields has an exciting future, exemplified by the 2014 Bio-innovation Strategy announced by the Department of Science and Technology.

The Department prefers Honours students to register full-time and be present in the Department on a full-time basis to complete the Honours course in one year; however the course is designed to accommodate part-time students who may be employed and who are expected to complete in two years. Most of the modules are presented through the Internet, using web-based interactions, complemented by comprehensive campus based practical sessions in specific blocks.

##### *2. Job Opportunities*

Careers range from working in a laboratory to studying plants in their natural environment. Employment could be at biotechnology and pharmaceutical firms, South African National Parks, private ecological companies, research institutions such as the CSIR, the ARC and the South African National Biodiversity Institute.



### **3. Closing date**

All applications for admission to the BSc Honours degree must preferably reach the course co-coordinator **BEFORE, OR ON THE 31st of OCTOBER** of the year preceding the year when students intend to study.

### **4. Duration of the degree**

The degree extends over one academic year for FULL-TIME STUDENTS and over one and a half to two consecutive years for PART-TIME STUDENTS.

### **5. Nature of the Honours programme**

The theoretical component of most modules is web-based. All the study objectives and outcomes, literature references and assignment information for each module are available on the web modules' sites. These sites become accessible to the student once he/she has registered for the particular module. E-mail is used where students can communicate with fellow students and most importantly, with the lecturers. The practical component of each module is completed during block sessions (2 to 4 days per module) during the course of the year.

Apart from the compulsory and elective modules, a project, leading to a research report (60 credits), forms an essential part of the training programme. Two seminars must also be written and field excursions are undertaken.

In addition to the compulsory modules, electives are selected in consultation with the supervisor.



LC/MS machinery in the laboratories of the Plant Science Department

A specialized division named as, “Medicinal Plant Science”, is being offered at Honours, Masters and Doctorate levels.

## **BSc Hons: Medicinal Plant Science (Code 03241090)**

### ***Admission requirements***

A recommendation from the head of the department, if the candidate did not major in Plant Science. A minimum of 60% in Phytomedicine 365 (BOT 365), which is offered at third-year level in the Department of Plant Science.



Students busy with various projects within the Plant Science Department

### **Programme composition for BSc Hons: Medicinal Plant Science**

Code	Module	Sem.	Credits
<b>Compulsory modules:</b>			
BOT 761	Advanced phytomedicine	2	10
BOT 748	Phytopharmacology	1	10
BOT 749	Pharmacognosy/ Phytotherapy	2	10
BOT 782	Research report	Year	60
BOT 783	Seminar	2	15
<b>Elective modules (to the value of 30 credits):</b>			
BOT 712	Plant nomenclature	1	10
BOT 718	Introduction to plant biotechnology	1	10
BOT 714	Seed ecology	1	10
BOT 719	Primary plant metabolism	1	10
BOT 717	Plant morphology	1	10
BOT 722	General plant ecology	2	10
BOT 746	Applications in plant biotechnology	2	10
BOT 741	Plant taxonomy	2	10
BOT 742	Plant classification	2	20
BOT 784	Trends in Plant Science (elective)	1	10
BOT 786	Plant taxonomy	1	10
BOT 788	Spatial analysis in ecology	2	10
BOT 790	Plant ecology and conservation for Wildlife management	1	10

**Total credits required: 135**



An Honours degree enables students to subsequently register for a masters and eventually a doctorate degree, and so enhance their understanding and appreciation for the extraordinary world of plants. The Department offers the following MSc and PhD degrees with Medicinal Plant Science:

- MSc Medicinal Plant Science
- PhD Medicinal Plant Science



Equipment at the laboratory of the Plant Science Department

## **MSc Medicinal Plant Science (Code 03251090)**

### **Masters programme**

#### ***Admission requirements***

“BSc Hons Medicinal Plant Science” or a recommendation by the head of the department. A minimum of 60% will be necessary in the compulsory modules, BOT 761, BOT 748 and BOT 749, which are offered at honours level in the Department of Plant Science.

#### ***Programme composition***

MPS 890 Dissertation: Medicinal Plant Science 890 (240 credits)

***Total credits required: 240***

## PhD Medicinal Plant Science (Code: 032610909)

### *Admission requirements*

“MSc Medicinal Plant Science” or an MSc in Plant Science, or a recommendation from the head of the department. A minimum of 60% is required in the compulsory modules, BOT 761, BOT 748 and BOT 749, which are offered at honours level in the Department of Plant Science.

### *Programme composition*

MPS 900 Medicinal plant science 900

MPS 990 Thesis: Medicinal plant science

**Total credits required: 360**



Laboratory equipment and specialized machinery at the laboratories of Plant Science Department

## **Modules description:**

### **BOT 712 Plant nomenclature**

**Contact time:** 1 lpw 1 ppw

**Language of tuition:** English

**Module content:** The regulations of the International Code for Botanical Nomenclature. Principles of nomenclature. History of plant collecting. Type specimens.

### **BOT 714 Seed ecology**

**Contact time:** 1 web-based period per week 1 ppw 1lpw

**Language of tuition:** English

**Module content:** Basic terminology and background regarding additions and losses in the seed bank (predation, dormancy, germination mechanisms, seed dispersal). Seed bank. Role of seed bank in management, conservation and rehabilitation.

### **BOT 717 Plant morphology**

**Contact time:** 1 lpw 1 ppw

**Language of tuition:** English

**Module content:** Speciation in flowering plants; plant variation. Sex determination in flowering plants. Reproductive systems in flowering plants.

### **BOT 718 Introduction to plant biotechnology**

**Contact time:** 1 lpw 1 ppw

**Language of tuition:** English

**Module content:** Plant genome: Structure and composition of the plant genome (nuclear, mitochondrial and chloroplast); applications in plant biotechnology: plant tissue culture (Micropropagation, somatic embryogenesis and cell suspension cultures). Genetic manipulation and gene transfer technology (Agrobacterium-based and other) and DNA-marker technology.

### **BOT 719 Primary plant metabolism**

**Contact time:** 1 ppw 1 web-based period per week 1 dpw

**Language of tuition:** English

**Module content:** Regulation and interaction of primary plant metabolic pathways on the sub-cellular and whole plant level.

### **BOT 730 Plant ecology and conservation**

**Contact time:** 2 lpw 5 ppw

**Language of tuition:** English

**Module content:** Applications of plant ecology principles in plant conservation: species-distribution modelling, alien plant invasions, conservation planning, threatened ecosystems, South African environmental legislation. Experimental design and vegetation survey techniques. Discussion of relevant topics in plant ecology. This module includes a compulsory 5-day field component.

### **BOT 741 Plant taxonomy**

**Contact time:** 1 lpw 1 ppw

**Language of tuition:** English

**Module content:** Classification, identification and nomenclature, methodology of a revision study, analysis and presentation of taxonomic information, evolution, phylogeny and cladistics.

**BOT 742 Plant classification**

**Contact time:** 1 ppw 2 lpw

**Language of tuition:** English

**Module content:** Sources of taxonomic information; morphology, anatomy, chemotaxonomy, cytogenetics, reproductive biology, plant geography, palynology, ethnobotany and paleobotany. Importance of different characteristics, methods to obtain information and interpretation of observed patterns in variation.

**BOT 746 Applications in plant biotechnology**

**Contact time:** 1 lpw 1 ppw

**Language of tuition:** English

**Module content:** Creation of genetically modified plants and their impact on modern agriculture.

**BOT 782 Research report**

**Language of tuition:** English

**Module content:** Teaching and planning, execution and documentation of a research project

**BOT 783 Seminar**

**Language of tuition:** English

**Module content:** Literature study of a subject related to the main discipline.

**BOT 784 Trends in plant science**

**Language of tuition:** English

**Module content:** Literature study of a subject related to one of the elective disciplines.

**BOT 786 Plant taxonomy**

**Contact time:** 2lpw

**Language of tuition:** English

**Module content:** Plant taxonomy with special reference to identifying taxons. Variation in seed plants with reference to production systems, intra-specific variation and ecotypes.

**BOT 788 Spatial analysis in ecology**

**Contact time:** 2 lpw 2 ppw

**Language of tuition:** English

**Module content:** Mapping and analysing spatial data. Theory and basic techniques of analysing and manipulating spatial data using geographical information systems. Mapping of vegetation types, species distribution and diversity, species traits. Understanding the spatial drivers of biodiversity patterns. The influence of scale on biodiversity analyses. Relevance for conservation planning for mapping biodiversity risk and prioritising conservation, especially in a South African context.



The following three modules are compulsory for the students specializing in the Medicinal Plant Science programme:

### **BOT 748 Phytopharmacology**

**Contact time:** 1 ppw 1 dpw

**Language of tuition:** English

**Module content:** This module surveys the scientific underpinnings of Phytomedicine, the Chemistry and Pharmacology that may help clarify the mechanisms of its bioactivity and clinical efficacy. The practical therapeutics of the major body system and the pathologies that affect them, using plant-derived drugs form important components of the course. A student-centred approach is followed and co-operative learning and teaching methods are applied which are complemented by a number of discussion classes. Pharmacological action of low molecular plant constituents and high molecular weight compounds. Plant constituents as anticancer, antibacterial, antiviral, hypoglycaemic, free radical scavengers, hypotensive and as anti-inflammatory agents. Cell culturing, cell growth and apoptosis, cell mediated immune responses. Drug development in TB as models for research. Enzymes receptors and plant constituents. The unique challenges of plant-based medicines.

On completion of this subject a student should be able to:

- Discuss the nature of primary and secondary plant metabolites as a foundation for a review on the main categories of constituents considered to be of therapeutic importance.
- Give an overview of structure, botanical distribution and generalizations about pharmacology, followed by a discussion of representative molecules described in the literature.
- Understand the bioavailability of plant-drug and patient-outcomes, based on its physicochemical properties.
- Understand the principles of Pharmacology relevant to Phytomedicine, covering the broad principles of Pharmacokinetics.
- Know whether a drug-effect is due to a specific structural component of a molecule or is a result of a non-specific drug action.
- Understand the pharmacological actions of specific plant-based drugs including anti-inflammatory, anticancer, antiviral, hypotensive, hypoglycaemic, and anticancer agents. Define important groups such as sesquiterpene lactones, saponins and flavonoids in depth.
- Understand the problems associated with the manufacture of plant-based medicines. Understand the unique physiology of medicinal plants.

### **BOT 749 Pharmacognosy/Phytotherapy**

**Contact time:** 1 dpw 1 ppw

**Language of tuition:** English

**Module content:** This module surveys the scientific underpinnings of Phytomedicine, the Pharmacognosy and Phytotherapy that may help clarify the basic concepts of toxicology. Details on systemic, developmental, genetic and organ-specific toxicity studies form important components of the course. This module also deals with practical aspects related to the manufacture of good quality Plant-based medicines, Phyto-drug formulation, standardisation and stability of Phyto-derived drugs. A student-centred approach is followed and co-operative learning and teaching methods are applied which are complemented by a number of discussion classes. Basic concepts of toxicology. Systemic, developmental, genetic and organ-specific toxic effects. Hallucinogenic, allergenic, teratogenic and other toxic plants. Plant constituents, contradictions and interactions. Phytotoxicity unrelated to plant constituents. Safety and efficacy issues of commonly used Phyto-drugs with emphasis on pharmaceutical applications. Practical aspects related to the manufacture of good quality plant-based medicines. Phyto-drug formulation, standardizations and aspects concerning different dosage forms.

On completion of this subject a student should be able to:

- Explore the formulation and preparation of phyto-derived medicines.
- Give an overview of various pharmaceutical forms with examples from official pharmacopoeias as well as folk medicines.
- Understand the methods used for medicinal-extract standardization.
- Explore the basics of toxicology as they relate to issue concerning the safety and toxicity of medicinal plants.
- Discuss contradictions and dry-herb interactions.

- Review toxic plant-constituents.
- Understand the pharmacological effect of toxic plant species.
- Get an overview of poisoning of humans caused by hallucinogenic, allergenic and teratogenic plants.

### **BOT 761 Advanced phytomedicine**

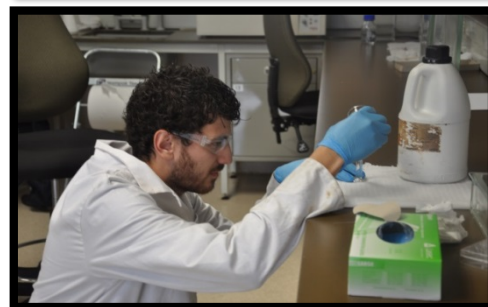
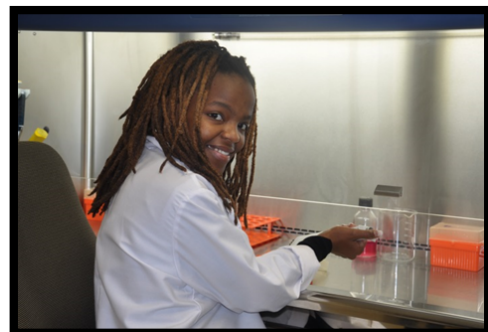
**Contact time:** 1 lpw 1 ppw

**Language of tuition:** English

**Module content:** This module involves the biosynthesis and function of plant secondary compounds like terpenoids, tannins, alkaloids, flavonoids and free amino acids are discussed. Do plants synthesise these compounds by accident or do they provide an evolutionary advantage to plants? How can humans benefit from the use of secondary compounds? We need to be able to isolate and identify bioactive compounds from medicinal plants if we want to use them as pharmaceuticals. What roles do ethnobotany, phytochemistry, metabolomics and bioprospecting play in this regard? A student-centered approach is followed and co-operative learning and teaching methods are applied and complemented by a number of discussion classes. Metabolism and functions of secondary compounds such as tannins, alkaloids, terpenoids, flavonoids and free amino acids. Importance of secondary defence mechanisms of plants. Isolation and identification of medicinal bioactive compounds from plants. Their current scope and potential applications in metabolomics. Strategies to discover new pharmaceuticals from ethnomedicine.

On completion of this subject the students should be able to:

- Have detailed knowledge of plant secondary metabolism, ethnobotany, phytochemistry, plant metabolomics and an awareness of the variety of contexts within which it applies.
- Classify the secondary compounds into functional groups.
- Give an overview of the non-medical applications of phytochemicals.
- Describe the role of ethnopharmacology in traditional medicine.
- Give an overview of a good strategy to discover new pharmaceuticals by using a metabolomic approach.
- Describe the importance of natural products in today's "Western" medicine.
- Know exactly what all the laboratory steps are to evaluate a plant extract for bioactivity.
- Know how to extract the different classes of secondary compounds (e.g. phenolic compounds, alkaloids, essential oils etc.).



Various research projects involving a number of students in the Department





Consultation with the traditional health practitioners

**Plants are selected based on their  
phytochemical constituents and in consultation  
with the traditional practitioners**

## **Research areas of the staff in the Medicinal Science Programme**

### **Prof. J. J. M. Meyer**

- Isolation, identification and mode of action of secondary compounds from medicinal plants.
- Identification of bioactive natural products by using a metabolomics approach.
- Isolation of several novel compounds with bioactivity on erectile dysfunction, malaria, HIV, and other pathogenic bacteria and viruses from traditionally used plants.

### **Prof. N. Lall**

- Cosmeceutical and Pharmaceutical product development from plants (Antityrosinase skin pigmentation, melasma, age spots, acne, oral care, skin cancer)
- Antituberculosis natural product leads from medicinal plants
- Cytotoxicities of plant extracts/compounds and anticancer activities of medicinal plants
- Isolation and purification of bioactive principles from plants

### **Dr. E. Tshikalange**

- Antimicrobial activity plant extracts and isolated compounds
- Anti-HIV activity plant extracts and isolated compounds
- Medicinal plants used traditionally in the treatment of STD's
- Cytotoxicity of plant extracts/compounds
- Isolation and purification of bioactive principles from plants.
- Ethnobotany

### **Dr. Q. Kritzing**

Integrates plant pathology and medicinal plant science into his main research focus areas of mycotoxins and natural (botanical) pesticides. The overarching aim of his research endeavours is to promote food security amongst smallholder and emerging farmers.

- Antifungal activity of plant extracts and isolated compounds thereof against various plant pathogens of crop plants.
- Investigating storage fungi and mycotoxins associated with indigenous African crops (including cowpea), with special emphasis on the phytotoxic nature of the mycotoxins on crops.

### **J. Bapela**

- Bioprospecting medicinal plant species for antiplasmodial, antitrypanosomal and antileishmanial chemotherapeutic agents
- Plant derived biopesticides

### **Dr. G. Stafford**

- Postharvest physiology, chemistry and biological activity of medicinal plants
- Ethnobotany, phytochemistry and pharmacology of psychoactive plants, plant derived smoke and incense
- Bioinformatics and meta-analysis of ethnobotanical and phytochemical data for drug discovery

## Recent publications

### Prof. J. J. M. Meyer

- Stanton, S. L., **Meyer, J. J. M.**, & Van der Merwe C. F. 2013. An evaluation of the endophytic colonies present in pathogenic and non-pathogenic Vanguerieae using electron microscopy. *South African Journal of Botany* 86, 41-45 (Impact factor 1.34).
- Komori, A., Suzuki, M., Seki, H., Nishizawa, T., **Meyer, J. J. M.**, Shimizu, H., Yokoyama, S., Muranaka, T. 2013. Comparative functional analysis of CYP71AV1 natural variants reveals an important residue for the successive oxidation of amorpho-4, 11-diene. *FEBS Letters* 587, 278-284. (Impact factor 3.34).
- Karkare, S., Chung, T. T. H., Collin, F., Mitchenall, L. A., McKay, A. R., Greive, S. J., **Meyer, J. J. M.**, Lall, N., Maxwell, A. 2013. The Naphthoquinone Diospyrin is an inhibitor of DNA Gyrase with a novel mechanism of action. *Journal of Biological Chemistry* 288, 5149-5156. (Impact factor 4.60).
- Kishore, N., Binneman, B., Mahapatra, A., van de Venter, M., du Plessis-Stoman, D., Boukes, G., Houghton, P., **Meyer, J. J. M.**, Lall, N. 2014. Cytotoxicity of 1, 4-naphthoquinone analogues on human cancer cell lines. *Bioorganic and Medicinal Chemistry*. 22, 5013-5019. (Impact factor 2.951).
- Bapela, J., **Meyer, J. J. M.**, Kaiser, M. 2014. *In vitro* antiplasmodial screening of ethnobotanically selected SA plant species used in the treatment of malaria. *Journal of Ethnopharmacology*. 156, 370-373. (Impact factor 2.9).
- **Meyer, J. J. M.**, Senejoux, F., Heyman, H. M., Meyer, N. L., Meyer, M. A. 2015. The occurrence of triterpenoids from *Euphorbia gummifera* inside the fairy circles of Garub in the southern Namibian pro-desert. *South African Journal of Botany*. 98, 10-15. (Impact factor 1.34)
- Heyman, H. M., Senejoux, F., Seibert, I., Klimkait, T., Maharaj, V. T., **Meyer, J. J. M.** 2015. Identification of anti-HIV active dicaffeoylquinic- and tricaffeoylquinic acids in *Helichrysum populifolium* by NMR-based metabolomic guided fractionation. *Fitoterapia*. 103,155-164. (Impact factor 2.35).
- Mohamed, E., Saeed, M., **Meyer, J. J. M.**, Hussein, A., Efferth, T. 2016. Cytotoxicity of South African medicinal plants towards sensitive and multidrug-resistant cancer cells. *Journal of Ethnopharmacology*. 186, 209-223. (Impact factor 2.9).
- Bapela, J., Kaiser, M., **Meyer, J. J. M.** 2017. The antileishmanial activity of selected South African plant species. *South African Journal of Botany*. 108, 342-345. (Impact factor 1.34).
- Swart, V., Crampton, B. G., Ridenour, J. B., Bluhm, B. H., Olivier, N. A., **Meyer, J. J. M.**, Berger, D. K. 2017. Complementation of CTB7 in the maize pathogen *Cercospora zeina* overcomes the lack of *in vitro* cercosporin production. *Molecular Plant-Microbe Interactions*. 30 (9), 710-724. (Impact factor 4.21)
- Tsukanovaa, K. A., Chebotara , V. K., **Meyer, J. J. M.**, Bibikova, T. N. 2017. Effect of Plant Growth-Promoting Rhizobacteria on Plant Hormone Homeostasis. *South African Journal of Botany*. 113, 91-102. (Impact factor 1.34).

### Prof. N. Lall:

- **Lall, N.**, Mogapi, E., Canha, M. N. D., Crampton, B., Nqephe, M., Hussein, A. A., Kumar, V. 2016. Insights into tyrosinase inhibition by compounds isolated from *Greyia radlkoferi* Syzsyl using biological activity, molecular docking and gene expression analysis. *Bioorganic and Medicinal Chemistry*. 24, 5953-5959. (Impact Factor 2.923).
- **Lall, N.**, Kumar, V., Meyer, D., Gasa, N., Hamilton, C., Matsabisa, M., Oosthuizen, C. 2016. *In vitro* and *In vivo* antimycobacterial, hepatoprotective and immunomodulatory activity of *Euclea*



*natalensis* and its mode of action. *Journal of Ethnopharmacology*. 194, 740-748 (Impact Factor 2.939).

- **Lall, N.**, Kishore, N., Momtaz, S., Hussein, A., Naidoo, S., Nqephe, M., Crampton, B. 2015. A clinical and experimental study on *Ceratonia siliqua* in search of plant-derived multifunctional actives for skin hyperpigmentation. *Phytotherapy Research*. (29), 1729-1736 (Impact Factor 2.397).
- Kishore, N., Mishra, B. B., Tiwari, V. K., Tripathi, V., **Lall, N.** 2014. Natural products as leads to potential mosquitocides. *Phytochemistry Reviews* (13) 587-627. (Impact Factor 2.894).
- Kishore, N., Binneman, B., Mahapatra, A., van de Venter, M., du Plessis-Stoman, D., Boukes, G., Houghton, P., Meyer, J. J. M., **Lall, N.** 2014. Cytotoxicity of 1,4-naphthoquinone analogues on human cancer cell lines, *Bioorganic and Medicinal Chemistry*. (Impact Factor 2.903).
- **Lall, N.**, Kishore, N., 2014. Are plants used for skin care in South Africa fully explored? *Journal of Ethnopharmacology* 153, 61-84, doi: 10.1016/j.jep.2014.02.021. (Impact Factor 2.939).
- Momtaz, S., Hussein, A. A., Ostad, S. N., Abdollahi, M., **Lall, N.** 2013. Growth inhibition and induction of apoptosis in human cancerous HeLa cells by *Maytenus procumbens*. *Food and Chemical Toxicology* 51, 38-45. (Impact Factor 2.61).
- **Lall, N.**, Henley-Smith, C. J., Canha, M. N. D., Oosthuizen, C. B., Berrington, D. 2013. Viability reagent, PrestoBlue, in comparison with other available reagents, utilized in cytotoxicity and antimicrobial assays. *International Journal of Microbiology*, Article ID 420601, <http://dx.doi.org/10.1155/2013/420601>.
- Karkare, S., Chung, T. T. H., Collin, F., Mitchenall, L. A., McKay, A. R., Grieve, S. J., Meyer, J. J. M., **Lall, N.**, Maxwell, A. 2013. The naphthoquinones Diospyrin is an inhibitor of DNA gyrase with a novel mechanism of action. *The Journal of Biological Chemistry* 288: 5149-5156. (Impact Factor 4.6).
- Ellithey, M. S., **Lall, N.**, Hussein, A. A., Meyer, D. 2013. Cytotoxic cytostatic and HIV-1 PR inhibitory activities of the soft coral *Litophyton arboretum*. *Marine Drugs*. 11, 4917-4936, doi: 10.3390/md11124917. (Impact Factor 3.512).
- Mapunya, M. B., Nikolova, R. V., **Lall, N.** 2012. Melanogenesis and antityrosinase activity of selected South African plants. *Evidence-Based Complementary and Alternative Medicine*, Article ID 374017, doi:10.1155/2012/374017. (Impact Factor 2.175).
- Mapunya, M. B., Hussein, A. A., **Lall, N.** 2011. Tyrosinase activity of *Greyia flanaganii* (Bolus) constituents. *Phytomedicine* 18, 1006-1012. (Impact Factor 2.877).
- Kuete, V., Ngameni, B., Mbaveng, A. T., Ngadjui, B. T., Meyer, J. J. M., **Lall, N.** 2010. Evaluation of flavonoids from *Dorstenia barteri* for their antimycobacterial, antigonorrheal and anti-reverse transcriptase activities. *Acta Tropica* 116: 100-104. (Impact Factor 2.519).
- Kuete, V., Tangmouo, J. G., Meyer, J. J. M., **Lall, N.** 2009. Diospyrone, crassiflorone, and plumbagin: three antimycobacterial and anti-gonorrheal naphthoquinones from two Diospyros species. *International Journal of Antimicrobial Agents* 34, 322-325. (Impact Factor 4.259).
- Mativandlela, S. P. N., **Lall, N.**, Muthivhi, T., van der Walt, M., Hussein, A. A. H., Haruhisa, K., Oshima, Y., Hamilton, C. J., Houghton, P. J. 2009. Antimycobacterial flavanoids from the leaf extracts of *Galenia Africana*. *Journal of Natural Product* 72, 2169-2171. (Impact Factor 3.947).

## Patents

- **International patent portfolio** entitled “Naphthoquinone derivatives and their use in the treatment and control of tuberculosis”. Inventors: **N Lall** and JJM Meyer. Patent No: **US 6,835,755 B1**. {Patent was granted in 9 countries including Switzerland, China, Germany, France, United Kingdom, The Netherlands, Russia, USA and South Africa}

### PCT applications:

- PCT Patent entitled, “Lall - Mysine Skin Care”. Patent No: **PA163604/PCT**. Inventor: N. Lall
- PCT Patent entitled “Novel South African plant for oral care”. Patent No: **PCT/IB2013/058016**. Inventors: C.J. Henley-Smith, **N Lall**, F.S. Botha and A. Hussein.
- PCT Patent entitled “Probability of inhibition prediction”. Patent No: **PCT/IB2014/064177**. Inventors: C.J. Henley-Smith, F.E. Steffens, F.S. Botha, **N Lall**.
- PCT Patent: Plant extract and use thereof. Patent No: **PCT/IB2013/0**. Inventors: M.D. Canha, E. Mogapi, A.A. Hussein, I. Moodley and **N Lall**.
- PCT Patent: Skin care composition containing *Leucosidea sericea* extract for the treatment of *Propionibacterium acnes*. Patent No: **PCT/IB2013/056343**. Inventors: R. Sharma, **N Lall**, A. Hussein, N. Kishore, I. Moodley.

### **The following patent applications have been filed/granted in South Africa:**

- SA patent: "Plant extracts having anti-tyrosinase activity" (Granted on 26 May 2010 claiming priority from 15 October 2008). South African Patent No: **ZA2009/06638**. Inventors: **N Lall**, S. Momtaz and A.A. Hussein.
- SA patent: Skin Lightening. South African Patent No: **ZA2012/05718**. Inventors: S. Singh and **N Lall**. Granted on 29<sup>th</sup> October 2014.
- SA patent: “Extract and compositions of *Helichrysum odoratissimum* for preventing and treating skin cancer”. South African Patent No: **2013/07414**. Inventors: D. Berrington and **N Lall**.
- SA patent: “Shoot extract and composition of *Euclea natalensis* for immune modulation and hepato-protection”. South African Patent No: 2013/07324. Inventors: C. Oosthuizen and **N. Lall**.

### Product development:

- Eleven cosmeceutical products from Plants have been developed.
- Two pharmaceutical products, for periodontal disease and for Tuberculosis with immunomodulatory and hepatoprotective effects have been developed.

One product for skin-hyperpigmentation problem is currently being commercialized by national and international companies.

## Books and/or chapters in books

### Book:

- Lall, N. 2017, Elsevier publisher, Medicinal Plants for Holistic Health and well-being. ISBN: 978-0-12-812475-8

### Chapters in books

- Binneman B and **Lall N**, 2011. Phytopharmacological research for the treatment of cancer. Page number: 34-60, In " Herbal Drugs, Publisher: New central book agency, Kolkata; ISBN: 978-81-7381-653-6.
- Mapunya MB and **Lall N**, 2011. Melanin and its role in Hyper-Pigmentation-Current knowledge and future trends in Research Chapter 11, pages 217-234: In Breakthroughs in Melanoma Research, Publisher; Janeza Trdine 9, 51000 Rijeka, Croatia; ISBN: 978-953-307-291-3, [www.intechopen.com](http://www.intechopen.com).
- Mativandlela P and **Lall N**, 2011. The antiquity and history of medicinal plants and tuberculosis. Page number: 62-90, In Herbal Drugs, Publisher: New central book agency, Kolkata, ISBN: 978-81-7381-653-6.
- Sharma R and **Lall N**, 2012. Acne, a review on epidemiology, pathogenesis and treatment options. Page number 1-14. In: Acne, etiology, treatment options and social effects. Nova Science Publishers, New York, ISBN: 978-1-62618-358-2.
- Henley Smith CJ, Botha F, **Lall N**, 2013. The use of plants against oral pathogens. Page Number: 1375-1384. In: Microbial pathogens and strategies for combating them: science, technology and education. Formatex Research Centre, Spain, ISBN: 978-84-942134-0-3.
- De Canha MN, Singh S and **Lall N**, 2014. The Host Innate Immune Response to *Propionibacterium acnes* and the Potential of Natural Products as Cosmeceutical Agents. Page number: , In Novel Plant Bioresources: Applications in Food, Medicine and Cosmetics, 1st Edition John Wiley & Sons, Ltd. (The Atrium, Southern Gate, Chichester, West Sussex PO19 8SQ, UK), ISBN: 978 -1-118-46061-0.
- Twilley D and **Lall N**, 2014. Toxicological Survey of African Medicinal Plants. Page Number: 493-509. In: African plants with Dermatological and Ocular relevance. Elsevier, Waltham, MA 02451, USA, ISBN: 978-0-12-800018-2.
- Sharma R, **Lall N** and Kishore N, Role of Protein Interleukin 8 (IL-8) in Human Life, 2015, Chapter 7, In Biomedical Applications of Natural Proteins Editors: D Kumar and R Kundapur, Book ID: 332173-1-En, ISBN: 978-81-322-2491-4, Springer publisher, Heidelberg Germany.
- Twilley D, **Lall N**, 2017. The role of natural products from plants in the development of anticancer agents. In: Natural Products and Drug Discovery. Elsevier

**Dr. Q. Kritzinger**

- de Bruin, W., van der Merwe, C.F., **Kritzinger, Q.**, Bornman, R. & Korsten, L. (2017) Morphological characterisation of lettuce plasma membrane ultrastructure and vesicle formation caused by nonylphenol: A scanning electron microscopy study. *South African Journal of Botany*, 111, 176-181. (Impact factor 1.34).
- de Bruin, W., van der Merwe, C.F., **Kritzinger, Q.**, Bornman, R. & Korsten, L. (2017) Ultrastructural and developmental evidence of phytotoxicity on cos lettuce (*Lactuca sativa*) associated with nonylphenol exposure. *Chemosphere*, 169, 428-436. (Impact factor 3.14).
- Kotze, R.G., Crampton, B.G. & **Kritzinger, Q.** (2017) Effect of fumonisin B<sub>1</sub> on the emergence, growth and ceramide synthase gene expression of cowpea (*Vigna unguiculata* (L.) Walp). *European Journal of Plant Pathology*, 148, 295-306. (Impact factor 1.54).
- Masangwa, J.I.G., **Kritzinger, Q.**, & Aveling, T.A.S. (2017) Germination and seedling emergence responses of common bean and cowpea to plant extract seed treatments. *Journal of Agricultural Science*, 155, 18–31. (Impact factor 1.08).
- Mandiriza-Mukwirimba, G., **Kritzinger, Q.** & Aveling, T.A.S. (2016) A survey of brassica vegetable smallholder farmers in the Gauteng and Limpopo provinces of South Africa. *Journal of Agriculture and Rural Development in the Tropics and Subtropics*, 117(1), 35-44. (Impact factor 0.67).
- de Bruin, W., **Kritzinger, Q.**, Bornman, M.S. & Korsten, L. (2016) Nonylphenol, an industrial endocrine disrupter chemical, affects root hair growth, shoot length and root length of germinating Cos lettuce (*Lactuca sativa*). *Seed Science and Technology*, 44(1), 1-10. (Impact factor 0.54).
- Potgieter, M., Harding, A., **Kritzinger, Q.**, Somo, C. & Engelbrecht, J. (2015) Reflections of science students on their experience of an academic development programme in South Africa *South African Journal of Higher Education*, 29(1), 109–132. (Impact factor 1.54).
- Masangwa, J.I.G., Aveling, T.A.S. & **Kritzinger, Q.** (2013) Screening of plant extracts for antifungal activities against *Colletotrichum* species of common bean (*Phaseolus vulgaris* L.) and cowpea (*Vigna unguiculata* (L.) Walp). *Journal of Agricultural Science*, 151, 482–491. (Impact factor 1.08).
- Aveling, T. A. S., Govender, V., Kandolo, D.S. & **Kritzinger, Q.** (2013) The effects of treatments with selected pesticides on viability and vigour of maize (*Zea mays*) seeds and seedling emergence in the presence of *Fusarium graminearum*. *Journal of Agricultural Science*, 151, 474–481. (Impact factor 1.08).
- Mofokeng, M., Prinsloo, G. & **Kritzinger, Q.** (2012) Germination response of four South African medicinal plants to a range of temperatures and treatments. *Seed Science and Technology*, 40, 123– 128. (Impact factor 0.54).

#### **Dr. E. Tshikalange**

- Tshivhandekano, I., Ntushelo, K., Ngezimana, W., **Tshikalange, T. E.**, Mudau, F. N. 2014. Chemical compositions and antimicrobial activities of *Athrixia phylicoides* DC. (bush tea), *Monsonia burkeana* (special tea) and synergistic effects of both combined herbal teas. *Asian Pacific Journal of Tropical Biomedicine*. 4(1): Accepted for publication.
- Razwinani, M., **Tshikalange, T. E.**, Shirley C. K. M. Motaung, S, C, K, M., 2014. Antimicrobial and anti-inflammatory activities of *Pleurostylia capensis* Turcz (Loes) (Celastraceae). *African Journal of Traditional, Complementary and Alternative Medicines*. 11(2). (Impact factor 0.926)

#### **Books and/or chapters in books**

- Wansi, J. D., Devkota, K. P., **Tshikalange, E.**, Kuete, V. 2013. Alkaloids from the Medicinal Plants of Africa, *Medicinal Plant Research in Africa: Pharmacology and Chemistry*, Elsevier.
- Dzoyem, J. P., **Tshikalange, E.**, Kuete, V. 2013. Medicinal Plants Market and Industry in Africa. *Medicinal Plant Research in Africa: Pharmacology and Chemistry*, Elsevier.

### J. Bapela:

- **Bapela, M. J.**, Meyer, J. J. M., Kaiser, M. 2014. *In vitro* antiplasmodial screening of ethnopharmacologically selected South African plant species used for the treatment of malaria. *Journal of Ethnopharmacology*. 156, 370-373. (Impact factor 2.939).

### Dr. G. Stafford:

- Leonti, M., Stafford, G. I. Dal Cero, M., Cabras, S., Castellanos, M. E., Casu, L., Weckerle, C. S. 2017. Reverse Ethnopharmacology and Drug Discovery. *Journal of Ethnopharmacology*. 198, 417- 431 (Impact factor 2.939).
- **Stafford, G.I.**, Wikkelsø, M.J., Nancke, L., Jäger, A.K., Möller, M., Rønsted, N. 2016. The first phylogenetic hypothesis for the southern African endemic genus *Tulbaghia* L. (Amaryllidaceae, Alliioideae) based on plastid and nuclear DNA sequences. *Botanical Journal of the Linnean Society*. 181, 156-170. (Impact factor 2.277)
- Krejčová, P., Kučerová, P., **Stafford, G.I.**, Jäger, A.K., Kubec, R. 2014. Antiinflammatory and neurological activity of pyrithione and related sulfur-containing pyridine N-oxides from Persian shallot (*Allium stipitatum*). *Journal of Ethnopharmacology*. 154, 176-182. (Impact factor 2.939)
- **Stafford, G.I.**, Birer, C., Brodin, B., Christensen, S.B., Eriksson, A.H., Jäger, A.K., Rønsted, N. 2013. Serotonin transporter protein (SERT) and P-glycoprotein (P-gp) binding activity of montanine and coccinine from three species of *Haemanthus* L. (Amaryllidaceae). *South African Journal of Botany*. 88, 101-106. (Impact factor 1.34 )
- Rønsted, N., Symonds, M.R.E., Birkholm, T., Christensen, S.B., Meerow, A.W., Molander, M., Mølgaard, P., Petersen, G., Rasmussen, N., van Staden, J., **Stafford, G.I.**, Jäger, A.K. 2012. Can phylogeny predict chemical diversity and potential medicinal activity of plants? A case study of Amaryllidaceae. *BMC Evolutionary Biology*. 12, 182. (Impact factor 3.407)

## Collaborations (local and international)



Meeting with the Chiefs from the Ndakabazi community of the Eastern

Benefit Sharing Agreement for a possible cosmeceutical product



Collaboration with J.S.S.  
College of Pharmacy, Ooty,  
India

Collaboration with the Green Chem  
Research and Development MOU







Collaboration with CEPHYR,  
Mauritius

Collaboration with Department of Plant  
Science, University of Missouri



Collaboration with Emory University

Collaboration with University of Mauritius

Department of Chemistry

Department of Biochemistry



Collaboration with the University of Cyprus



Collaboration with Mercer University

Collaboration with Medical University of Lublin



Collaboration with Plants for Human Health Institute

Collaboration with University of Albany



UNIVERSITY OF  
EASTERN FINLAND

Collaboration with University  
of Eastern Finland

