

RESEARCH FOCUS AREA

PLANT BIOTECHNOLOGY

The concept of growing crops for health rather than for food or fibre is slowly changing plant biotechnology and medicine. Plant phytochemicals provide us with thousands of novel compounds that give us medicines, fragrances, flavourings, dyes, fibre, foods, beverages, building materials, heavy metal chelators important in bioremediation, biocides, and plant growth regulators. Traditional knowledge from parts of Africa indicates that some of these are used for diverse activities such as making beer, wine, composting, controlling parasites etc.

Plant biotechnology is a platform through which we aim to identify candidate plants and plant products from the range of local wild vegetables which are currently under cultivation or growing in the wild in areas of KwaZulu-Natal. Emphasis is on finding properties from local plants that will increase the commercialisation potential of local plants, which in turn would lead to agronomy development. Furthermore, through micro-propagation and bio-manipulation of the candidate plants the biotechnological potential will be exploited, which will lend the plant/product to be marketed on a large scale.

CURRENTLY, THE GROUP IS INVESTIGATING PLANTS FOR:

- Nutritional value which can improve the nutritional status of our people
- Bioactive compounds that can be used as pharmaceuticals or nutraceuticals
- Phytochemicals for therapeutic uses, and
- Value addition by producing novel food commodities.

Thus far, we have established a reference laboratory for nutritional/anti-nutritional evaluation of local plants; established standardised assays for plant compound evaluation and chemical characterisation; and established plant tissue micro-propagation techniques. Studies undertaken by the research group over the years have initiated a knowledge bank regarding the nutritional composition (carbohydrate, proteins, vitamins, mineral contents) of many locally grown leafy vegetables. Research has also been directed wherein some of these field plants have been used to produce novel commodities. Some plants have been shown to produce unique phytochemicals with unique biological properties – such as anti-microbial, anti-septic and anti-cancer properties.

The best prospect for market development of indigenously produced foods lies in the value added products and the export markets. In both cases, this research is a crucial and necessary step for the development of a knowledge base to support these new market developments. This research can make a significant contribution to the development of transforming wild vegetables into highly successful commercial farming. This will have a huge impact in that it will create entrepreneurial opportunities and also empower the local agronomy and marketing community.

LEAD RESEARCHERS

PROF. B. ODHAV & DR V MOHANLAL

The Plant Biotechnology Research Group consists of three main focus areas including Phytochemistry, Synthesis of Novel Metabolites and Nanotechnology. Biotechnology has opened the door to a wealth of possibilities in the pharmaceutical industry by making it possible to obtain various biopharmaceutical products, such as secondary metabolites. Phytochemistry of indigenous plants has resulted in the isolation and structural elucidation of novel secondary plant metabolites including anthraquinones, triterpenoids, alkaloids and steroids. Methods employed for qualitative and quantitative analysis of plant metabolites include UV-VIS and Fluorescent Spectroscopy, Gas Chromatography-Mass Spectrometry (GC-MS), Liquid Chromatography-Mass Spectrometry (LC-MS), Proton Nuclear Magnetic Resonance (¹H NMR) and Carbon Nuclear Magnetic Resonance Spectroscopy (¹³C NMR). Biological assays conducted on the isolated secondary metabolites include antibacterial, antifungal, antioxidant, anti-inflammatory, anti-HIV and anticancer. Anticancer activity is determined using two different approaches, namely mechanism-based apoptosis bioassays that are used to evaluate the ability of the extracts to induce apoptosis in human cancer cell cultures, and inhibition of the human a-topoisomerase II enzyme.

Dr Viresh Mohanlall
DTech

h-index	5
Masters students (complete)	2
Doctoral students (complete)	2
Masters students (current)	3

Prof. Bharti Odhav is a Full Professor in the Department of Biotechnology and Food Technology in the Faculty of Applied Sciences. She joined the University as a lecturer in 1988 and obtained her PhD in 1996. She is actively involved at all levels in the research fraternity and plays a significant role in nurturing the careers and minds of colleagues and young people through her previous role as Head of Department and now as a Lecturer and Professor. During her career she has taught and supervised numerous bachelors, honours, masters, doctoral and postdoctoral students.

She has initiated a strong research culture in the Faculty of Applied Sciences and plays a key role in sustaining research in Biotechnology and Food Technology. Her research interests are in the field of Plant Biotechnology and on application of Nanotechnology for drug delivery and drug discovery.

She has published in over 50 publications in peer-reviewed journals and has presented in National/Regional Conference Abstracts, as well as contributing 3 chapters in books. Her undergraduate and postgraduate supervision is evidence of her keen sense of promoting learning. She has supervised 6 doctorates, and 33 masters students and is currently supervising 4 doctoral students and 18 masters students. Many of her former BTech and masters students are now holding key positions at the Durban University of Technology, University of Cape Town, University of KwaZulu-Natal, the Medical Research Council, Technology Innovation Agency and the Council for Scientific and Industrial Research. Others have gone on to conduct industry-specific research or hold management positions in the growing Research & Development divisions in the industrial sector.

Prof. Odhav is nationally and internationally recognised in her field, and has made tremendous contributions to the University and scientific community through exposure and linkages with national institutions as well as international institutions in India, Brazil, China and the USA.

The multiplier effect of Prof. Odhav's efforts can be verified by her contributions to growing the ability and proficiency of young scientists. Being a pioneering, physically challenged, black female scientist in a developing institute, she has furthered the causes of higher education and transferred her skills, knowledge and understanding to the future researchers.

COLLABORATORS

- Savannah State University/TELP linkage Program.
- South African/Netherlands Research Program on Alternatives in Development (SANPAD).
- University of Georgia, Department of Food Science and Technology (FST), Griffin Campus.
- India Bilateral Project – University of Coimbatore.

Prof. Bharti Odhav
Retired Honorary Professor PhD

NRF Rating	C3
h-index	19

Masters students (complete)	33
Doctoral students (complete)	6
Masters students (current)	18
Doctoral students (current)	4
Collaborators	4

RESEARCH ASSOCIATES

Prof. Shode is former chemistry lecturer and organic chemistry researcher from the University of KwaZulu-Natal. Professor Francis Oluwole Shode completed his BSc Honours degree in Chemistry at the University of Ibadan, Ibadan, Nigeria in 1975; thereafter he completed his MSc & PhD in Organic Chemistry at Sheffield University, UK in 1981. He was a lecturer/researcher at the University of Port Harcourt, Port Harcourt, Nigeria (1981 – 1997), the University of KwaZulu-Natal (1997 – 2011), and the University of Zululand (2012 – 2013). He has published several research articles in international and local journals. He has created intellectual property in the form of patents from his research activities.

Professor Shode has trained over 20 MSc/PhD students in Nigeria and South Africa. He is currently supervising post-graduate students and researching the development and commercialisation of phytomedicines, nutraceuticals, and herbal cosmetics using African medicinal and food plants. He has created an active research partnership with pharmaceutical and food industries locally and internationally.

His passion for teaching chemistry and empowering youths has led to a partnership with the Masizi Kunene Foundation to run a Science Training & Community Development Centre in the Umdoni Municipality of KwaZulu-Natal.

Prof. Francis Shode
PhD (Organic Chemistry) (Sheffield University, UK)

Professor Himansu 'Snowy' Bajinath is an Honorary Research Professor in the School of Biological and Conservation Sciences at the University of KwaZulu-Natal. He has a passion for plants and conservation, which he enthusiastically shares with his students.

Many of the plants that Professor Bajinath has researched are endemic to the Durban area, such as the Durban Guava, which he discovered and named, and the Racecourse Lily, Durban's rarest indigenous plant, once thought to be extinct in the wild. He is responsible for the re-discovery, propagation and active protection of this beautiful lily.

He has also long been involved in projects focusing on the utilisation of plants, both as sources of nutrition and traditional medicinal preparations. He is also one of the only botanists who have had a wasp named after him.

Over the past 24 years at Pema Ridge Primary School he has taken it upon himself to plant trees that are totally unique to KwaZulu-Natal, exposing teachers and inspiring students to nurture their natural inheritance. At the DUT Biotechnology Department, he supervises and mentors postgraduate students for their higher degrees.

Professor Bajinath has for many years been planting the seeds of knowledge about the importance of caring for our natural world, and is a great inspiration for countless minds, young and old.

Prof. Himansu Bajinath
PhD (University of Reading, England), F.L.S.

RESEARCH OUTPUTS

2015/2016

NATIONAL CONFERENCES

Ally, F., Mohanlall, V and Odhav B, (2016) Analysis of tropane alkaloids in field grown, plant cell, and hairy root cultures of *Datura stramonium*. South African Society for Microbiology Congress, Coastlands, Umhlanga, Durban, January 2016.

JOURNAL PUBLICATIONS

- Kabange Kasumbwe, Katharigatta N. Venugopala, Viresh Mohanlall and Bharti Odhav. (2016). Synthetic Mono/di-halogenated Coumarin Derivatives and Their Anticancer Properties. *Anti-Cancer Agents in Medicinal Chemistry*. Volume 16. PMID: 27671300
- Naicker L, Venugopala KN, Shode F, Odhav B. (2015) Antimicrobial and antioxidant activities of piperidine derivatives. *African Journal of Pharmacy and Pharmacology* 9(31); 783-792
- Mellem, J., Baijnath, H., Odhav, B. 2015. Antidiabetic potential of *Brachylaena discolor*. *African Journal of Traditional, Complementary and Alternative Medicines* 12 (1) 38-44
- Venugopala, K.N., Govender, R., Khedr, M. A., Venugopala, R., Aldhubiab, B. E., Harsha, S., Odhav, B (2015) Design, synthesis, and computational studies on dihydropyrimidine scaffolds as potential lipoxygenase inhibitors and cancer chemopreventive agents. *Drug Design, Development and Therapy*. 9: 911
- Chandrashekarappa, S., Padmashali, B., Venugopala, K. N., Kulkarni, R. S., Venugopala, R., Odhav, B. (2015). Synthesis and Characterisation of Ethyl 7-Acetyl-2-substituted 3-(substituted benzoyl) indolizine-1-carboxylates for in vitro Anticancer Activity. *Asian Journal of Chemistry*. 28 (5): 1043
- Chandrashekarappa, S., Venugopala, K. N., Venugopala, R., Odhav B. (2015). Silica-Sulfuric Acid: Novel, Simple, Efficient and Reusable Catalyst for Hydration of Nitrile to Amide. *Asian Journal of Chemistry*. 28 (10): 2177.
- Venugopala, K. N., Nayak, S. K., Gleiser, R. M., Sanchez-Borzone, M. E., Garcia, D. A., Odhav B. (2016). Synthesis, Polymorphism, and Insecticidal Activity of Methyl 4-(4-chlorophenyl)-8-iodo-2-methyl-6-oxo-1, 6-dihydro-4H-pyrimido [2, 1-b] quinazoline-3-Carboxylate Against *Anopheles arabiensis* Mosquito. *Chemical Biology & Drug Design*. 88 (1): 88-96
- Bairagi, K. M., Venugopala, K. N., Mondal, P. K., Odhav, B., Nayak S. K. (2016). Crystal structure of methyl 4-(4-hydroxyphenyl)-6-methyl-2-oxo-1, 2, 3, 4-tetrahydropyrimidine-5-carboxylate monohydrate. *Acta Crystallographica Section E: Crystallographic Communications*. 72 (9): 1335-1338
- Singh, A., Venugopala, K.N., Khedr, M. A., Pillay, M., Nwaeze, K. U., Coovadia, Y., Shode, F., Odhav, B. (2016). Antimycobacterial, docking and molecular dynamic studies of pentacyclic triterpenes from *Buddleja saligna* leaves. *Journal of Biomolecular Structure and Dynamics*. 1-11
- Chandrashekarappa S., Venugopala, K. N., Gleiser, R. M., Chetram, A., Padmashali, B., Kulkarni, R. S., Venugopala, R., Odhav, B. (2016). Greener synthesis of indolizine analogues using water as a base and solvent: study for larvicidal activity against *Anopheles arabiensis*. *Chemical Biology & Drug Design*. 88 (6): 899-904
- Sánchez-Borzone, M. E., Mariani, M. E., Miguel, V., Gleiser, R. M., Odhav, B., Venugopala, K. N., García D. A. (2016). Membrane effects of dihydropyrimidine analogues with larvicidal activity. *Colloids and Surfaces B: Biointerfaces*. 150: 106-113
- Naicker, L., Mohanlall, V., Odhav, B. 2016. Genetic transformation of *Ceratotheca triloba* for the production of anthraquinones from hairy root cultures. *African Journal of Traditional, Complementary and Alternative Medicine*. 13(3): 85-94
- Sipahli, S., Mohanlall, V., Mellem, J. 2016. Stability and degradation kinetics of crude anthocyanin extracts from *Hibiscus sabdariffa*. *Food Science and Technology* (Campinas). Accepted.