

Centre for Biomedical and Biomaterials Research University of Mauritius

No 7

Newsletter

December 2019



Foreword

The Times Higher Education University Impact Rankings are the only global performance ranking that assess universities against the United Nations' Sustainable Development Goals (SDGs).

Of particular interest to us is SDG 9 (industry, innovation and infrastructure) which includes more than 300 universities from 63 countries. It is worthy to note that in the top 10 institutions 5 are from South Korea, 1 from Japan and 2 from the Nordic countries.

South Korea is one of the countries which has successfully moved from an upper middle income to high income economy through massive investment in Research, Development and Innovation. It took the country 23 years for this transition.

We firmly believe that Mauritius has started its journey towards being a sustainable island through investment in novel technologies.

CBBR has sustained its Research & Innovation progression over the decade through SDG 17 (partnerships for the goals). It has built partnerships to support its students and researchers in the quest of making CBBR a reference in the region with unique home grown science and expertise.

Both Units at CBBR fully support the University of Mauritius SDG endeavor which aims at mapping UoM strengths and achievements and guiding us for a sustainable future.

Archana Bhaw-Luximon

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At its creation in 2011, the vision was to develop CBBR into a premier research Centre in Mauritius. The institution of the National Research Chair positions has been certainly instrumental in driving forward this vision. The infrastructure and equipment-building was thus guaranteed at least for the initial phase. CBBR also benefitted from the support of the private sector and, in particular that of the Mauritius Commercial Bank in 2012, to set up a state-of-the-art bio-lab to carry out *in-vitro* testing in house. In 2016, the Govt. through the Ministry of TCI injected funding for the purchase of a Scanning Electron Microscope, a unique one in the region. It was already recognized that partnership with the Public and Private sectors was a key element for progress.

This enabling environment boosted the researchers – staff and students- to work harder for CBBR to reach greater heights. Over and above the material aspect, the human factor is most important. Eight years down the line, CBBR is a reference Centre in nanobiomaterials, drug delivery and biopharmaceuticals and is the pride of the University of Mauritius.

A few research projects such as the elaboration of polymeric nanoscaffolds and hydrogels for enhanced wound healing targeting the diabetic patients have reached *in vivo* stage and are proving to be very promising.

The uniqueness of this research is the use of locally available raw materials from land and marine resources and their blending with synthetic materials. A home grown solution to the wound healing problem would be certainly most innovative and above all be more accessible to local patients. We can measure impacts through publication output but if the research can help the community, that's even better.

The high level of science and training, the world-class research output, the range of sophisticated equipment facilities, the strong anchoring at national level, the good industry relationship and the excellent regional and international networking as well as service to the community make of CBBR a model for sustainable development as detailed in this newsletter.

The pursuing of the SDGs ratified in 2015 by the UN, should not be an obsession for achievement of a better and more sustainable future for all but rather be considered as a natural guide for development and progress. This is what this 7th edition of the CBBR Newsletter reminds us.

Prof Dhanjay Jhurry
Vice-Chancellor, UoM

Research & Innovation Highlight



**Biomaterials from Mauritius – sucrose
PhD thesis - Ms Itisha Chummun**

**Mauritius Research and Innovation Council funded
Supervisors: Dr Archana Bhaw-Luximon & Prof Dhanjay Jhurry**

2D and 3D polysucrose-based scaffolds engineering and their assessment for skin tissue engineering applications

The BDDN Unit at CBBR focuses on research and development in the area of biomaterials in the fabrication of nanoscaffolds for regenerative medicine. At present, there is a high rate of mortality due to prevalence of diabetic foot ulcers in Africa, thus the Unit is looking towards value added products in an attempt to provide innovative and affordable treatment to treat diabetic ulcers.

This project exploits the potential of a sugar-derived biocompatible polysaccharide, polysucrose, PSuc (Ficoll®) as novel hydrogels and electrospun mats for wound healing applications. We were the first to report on the electrospinning of PSuc blended with poly-L-lactide (PLLA) and polydioxanone (PDX). The physicochemical properties of these scaffolds such as porosity, hydrophilicity and stiffness were determined. Their biological performance was investigated via both *in vitro* studies using a multitude of cells which play key roles at different stages of the wound healing process and *in vivo* biocompatibility studies using Wistar rat model. All PSuc-based scaffolds were well-tolerated *in vivo* and reduced fibrosis while promoting new blood vessel formation in the vicinity of electrospun mats. Hydrogels lead to intensive cellular infiltration with absence of fibrous capsule inducing blood vessel formation within hydrogel scaffolds.

These encouraging results are now being validated *in vivo* on diabetic rats.

Itisha is the winner of the TEC National PhD competition 2019 and prize winner student oral presentation, BioTERM 2019, Biomaterial-based Therapeutic Engineering and Regenerative Medicine, IIT Kanpur, India.

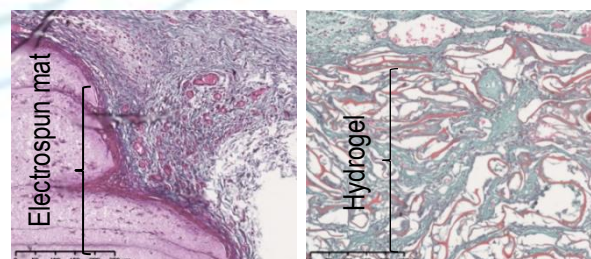
She has been offered life membership of the Society of Biomaterials and Artificial Organs, India.



Synthesis of PSuc-MA & PSuc-PolyX hydrogel



In vitro cell studies on PLLA-PSuc, PDX-PSuc electrospun mats and PSuc-MA & PSuc-PolyX hydrogels

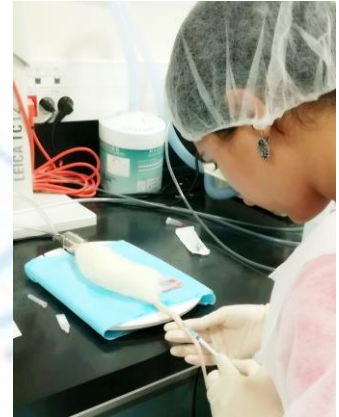


Masson Trichrome staining of tissues from in vivo biocompatibility test using Wistar rats

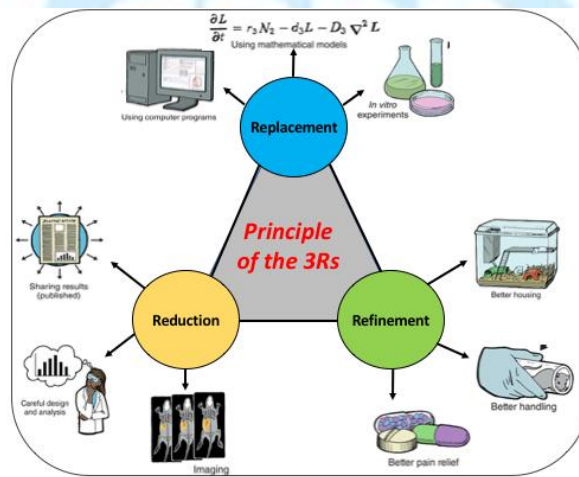
Advanced Training – SDG 4
EU-certified regulatory course
in Experimental Animal Science at GIP CYROI, Ile de La Réunion



Dr Nowsheen Goonoo successfully completed a two-week intensive EU-certified regulatory course in *Experimental Animal Science* at GIP CYROI, Ile de La Reunion funded by UoM Pole of Innovation in Health in April 2019 which now gives her the required competence to design experimental procedures on the use of small animals for scientific research purposes. Animal experiments are crucial to basic biological and medical advancements. Research using animals is controlled from a legislative and regulatory perspective. The first European directive regarding the protection of animals used for scientific purposes was adopted in 1986 (Directive 86/609/EEC) and later revised in 2010 (Directive 2010/63/EU) and transposed into French law in 2013 (Decree 2013-118). This regulation is firmly anchored on the principle of the 3 Rs (Replacement, Reduction, and Refinement), devised by Russell & Burch:



- Replace the use of animals with alternative techniques such as *in silico* (computer modelling), *in chemico* (chemical reactions) and *in vitro* (bacteria & cell culture) methods
- Reduce the number of animals used to a minimum
- Refine the way experiments are carried out, to ensure animals suffer as little as possible.



Principle of the 3Rs

All research projects involving the use of animals must receive prior authorization from Ethics Committees. Even though, the use of animals in experimental procedures are strictly controlled, the ideal situation would be one where the use of animals in scientific research could be prevented. However, because the human body is so complex, we cannot always extrapolate *in vitro* data to *in vivo* conditions. Thus, *in vitro* results have to be validated using animals. With new technological and scientific advancements, there is still hope that one day laboratory animals will be history.



Biopharmaceuticals

Nutraceutical development within the context of SDG 3 of 2030 Agenda for Sustainable Development. The definition of a nutraceutical “food or part of a food that provides medical or health benefits, including the prevention and/or treatment of a disease” lies within the areas of food, food supplements and pharmaceuticals. The field of nutraceuticals and functional foods appears varied and growing worldwide with a wide spectrum of products appearing on the market every year. This reflects a new reorganization of the market, resulting from new strategies, technologies and also the changes in the regulation applied to nutrition and to health claims. Over four billion people of the world’s population use herbal supplements/nutraceuticals/ functional foods and the growth of this sector is encouraged by greater consumer interest in improving physical and mental wellbeing and health status, often to compensate for an incorrect lifestyle. Currently, the rising costs and toxicity of some pharmaceuticals are driving populations around the world to move forward with less expensive nutraceuticals and functional foods. Furthermore agreed global sustainable development resolutions underscores the “primary health needs of the world's population” as “integral to the achievement of the goals of sustainable development and primary environmental care”, and identifies “preventive and curative health facilities, accessible to all” as a critical component of sustainable development and green economy advancement.

The main market drivers for the commercialization of functional foods and nutraceuticals include lifestyle, increasing health trend, ageing population with life expectancy having increased to 71.2 years and 77.9 years for men and women respectively, increasing income and epidemiological studies conducted. Current lifestyle is also increasing the risk of non-communicable diseases such as diabetes, cancer and CVDs. In Mauritius deaths due to endocrine, nutritional and metabolic diseases reached 23.9% in 2017, which adds to a high preponderance of pre diabetic subjects. Deaths due to diverse cancers and diseases of the circulatory system have reached the 13.8 % and 33.2 % marks respectively.

The functional food and nutraceutical industry in Mauritius is in its initial stage without a clear legal and activity framework. There have been a number of sporadic developments mainly from local entrepreneurs who have started SMEs with the background of general knowledge on a number of production lines comprising food items/plant biofactors/ functional foods/nutraceuticals.

There are so far no comprehensive documentation compiling the current status of the functional food industry in terms of (i) applied research work on products of economic importance (ii) specificities of production (iii) areas and the regions under cultivation for functional food/nutraceutical production (iv) specific regulations/legislations or regulatory framework governing the production, labelling or commercialization of nutraceuticals and monitoring the safety of nutraceuticals through pharmacovigilance. A dedicated team from the University of Mauritius including CBBR staff is currently addressing the above with aim to set up of a road map for a sustainable nutraceutical industry in Mauritius. This work endeavours to respond to the needs of a sector which is gradually growing to unleash the potential of setting up an economic pillar with the background of recent applied research and innovation on a number of potent local plant/marine biofactors with high prospects for commercial ventures.

Prof Theeshan Bahorun, Biopharmaceuticals Unit

New Partnerships

Mauritius Oceanography Institute

CBBR and MOI have mounted a joint project funded by the Tertiary Education Commission. This project aims at screening specific species of marine sponges and seaweeds for bioactive molecules and biomaterials collected in Mauritius and Rodrigues. Marine sponges are known for their bioactive molecules with medicinal properties against human diseases such as cancer whereas seaweeds (brown) are important sources of polysaccharides such as alginates and fucoidans.

This project will bring together the competencies of three institutions namely the UoM, MOI and CYROI. The latter is providing its technical expertise in structural elucidation of biopolymers and bioactive molecules. We have also benefited from the expertise of Prof John Bolton from the University of Cape Town, South Africa in the preliminary identification of algae/seaweeds collected.



Padina sp.

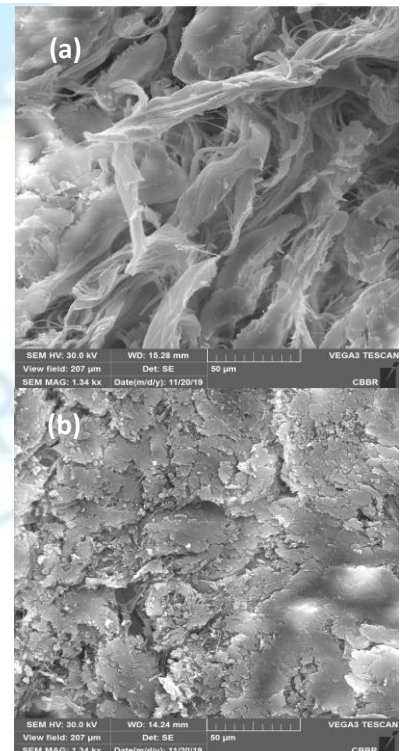
Centre International de Développement Pharmaceutique (CIDP)

CIDP is a private and independent CRO carrying out high performance research and clinical activities for pharmaceutical, medical device, nutrition and cosmetic industries. CIDP is ISO 9001:2015 certified. CIDP has centers in Brazil, India, Mauritius, Romania and Singapore which enable access to a wide panel of patients and allows multi-centric trials with a rapid recruitment process in a secured and adapted environment.

CBBR collaborates with Dr Véronique Newton (Head of Preclinical Operations, CIDP) on the microscopic imaging of skin and hair after various types of treatment. Dr Newton presented the results on 'Effects of environmental stressors on skin aging with a focus on the effect of blue light on skin' at the Symposium International de la SFC, Journées Jean-Paul Marty, on 3 December 2019 in Paris.

CIDP has developed monochromatic calibrated Blue light sources and a unique Controlled Pollution Exposure System (CPES) which allows the quantified administration of pollutants on the skin. These systems thus allow to mimic environmental stressors and to analyze their direct impact on skin ageing in an in vivo and ex vivo model.

Dr Archana Bhaw-Luximon, BDDN Unit



SEM images of collagen in skin (a) before & (b) after treatment with blue light



Long standing Partnership

Prof Theeshan Bahorun received the CV Raman Senior Fellowship for African researchers by the Government of India in 2010. This award was instrumental to set up a cancer research centre at the Chhatrapati Shahu Ji Maharaj University, Kanpur with exchange of students, technology transfer and publication of seminal cancer molecular nutrition data. Subsequent to this long standing partnership, Prof Theeshan Bahorun received the **Excellent Educationist** and **Outstanding Scientist** awards at the International Wellness Conference held in Kanpur from 8-10 Nov 2019 from the Vice Chancellor of CSJM Kanpur, Professor Nelima Gupta.

Dr Srishti Ramsaha from the Biopharmaceutical Unit has benefitted from this collaboration to complete *in vivo* studies on the effect of nutraceuticals on liver cancer during her PhD. This collaboration has generated 5 publications so far.

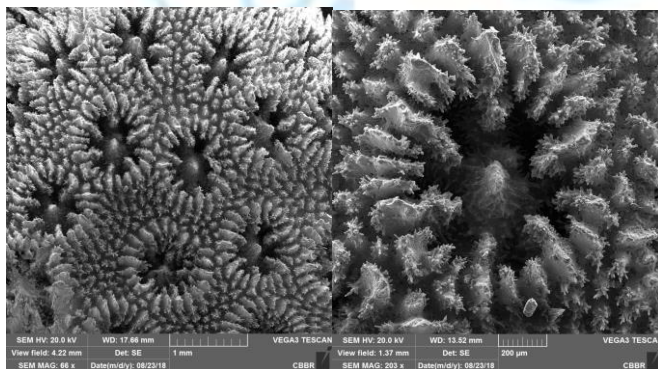


Award Ceremony Nov 2019

Prof Nelima Gupta, VC, CSJM Kanpur, India and Prof Theeshan Bahorun

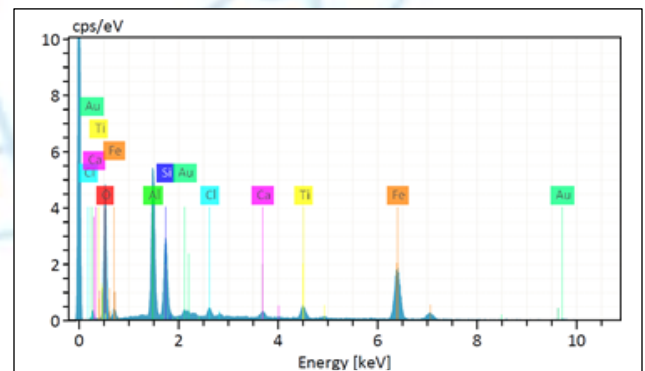
Analytical Services for Research, Innovation and Industry

At CBBR, we provide analytical services for high-end techniques such as Scanning Transmission Electron Microscopy (STEM), Energy Dispersive X-Ray spectroscopy (EDX) and mechanical testing of materials. We have a fully PC-controlled STEM which has the ability to operate in five modes; resolution, depth, field, wide field and channeling. STEM imaging is used for morphological and topographical analysis of different types of materials ranging from inorganic to biological (soil, metal, corals, algae, fibers etc.). The imaging of samples is conducted in a chamber pumped within a pressure range of 0.009-2000 Pa operating under N₂ environment. The microscope allows imaging at both low ($\leq 4\text{kx}$) and high ($\leq 10\text{kx}$) magnifications depending on the sample and we can measure nanometer size objects. The STEM is equipped with an EDX detector which is used for elemental analysis or chemical characterization of samples. The BDDN Unit performs analyses and devises new methods for a number of companies.



SEM images of corals

Dr Honita Ramphul, BDDN Unit



Soil sample analyzed for elemental composition

Awards

Dr Newsheen Goonoo, PostDoc Award, L'Oréal UNESCO Foundation

Newsheen was among the 5 Postdoctoral researchers who received the 2019 Young Talent Award for Sub-Saharan Africa from the L'Oréal UNESCO Foundation as part of the 10th edition of L'Oréal's regional program For Women in Science (FWIS), November 2019. This award carries a research grant of 15 000 Euros to be spent on research work at the BDDN Unit, CBBR.

Created in 1998, the For Women in Science programme, led by the Fondation L'Oréal in partnership with UNESCO, aims to promote women in the field of scientific research, where the glass ceiling remains a reality. Over the past 21 years, more than 3,400 women researchers from 118 countries have been highlighted.

<https://bit.ly/2tybMdu>



Dr Srishti Ramsaha, Winner Famelab 2019 National Finals May 2019



Srishti presented her several years of research in cancer chemoprevention using Mauritian edible mushrooms. She represented Mauritius in the International Famelab competition during the Cheltenham Festivals 2019 in UK.

FameLab is a communication competition for scientists, mathematicians, engineers and technologists to talk about an aspect of their science in 3 minutes in front of a live audience.

She completed her PhD at the Biopharmaceuticals Unit, CBBR in April 2019. Srishti was also one of the finalists of the TEC National PhD competition. She is currently working at CIDP and is still active in research and development.

Ms Itisha Chummun, Bajpai Saha Award, BioTERM 2019, IIT Kanpur, India, 28 Nov – 1 Dec 2019, & Winner TEC National PhD competition, May 2019

In May 2019, Itisha won the 1st Edition of TEC National PhD competition. Amongst the 10 finalists, there were 8 PhDs from the University of Mauritius out of which 4 were from CBBR. She was recently selected to participate in the Bajpai Saha Student Award at IIT Kanpur where she was competing with numerous students from various IITs in India. She presented her PhD work on 3D hydrogels with the self-healing potential for tissue engineering. She won the 3rd prize and has been made life member of the Society for Biomaterials and Artificial Organs, India. Itisha has successfully submitted her PhD and is pursuing her research career at the BDDN Unit, CBBR.



Highlights Community Outreach and Talks

The younger generation of researchers at CBBR (PostDocs, PhDs, RAs) are fully involved in community outreach activities and act as role models contributing towards our science capital.

Visit of HE Shri Tanmaya Lal, Indian High Commissioner, 4 June 2019



Association of Commonwealth Universities, Summer School, July 2019



Educational Visit, Lycée Saint-Paul final year students, La Réunion, 15 November 2019



National Science Week, 9 – 12 May 2019, Rajiv Gandhi Science Center



- T. Bahorun, Distinguished speaker at the International Wellness Conference, CSJM Kanpur University, 7-10 November, 2019, India.
T. Bahorun, Invited Speaker, Conference on Diabetes and Associated Diseases, Intercontinental Mauritius Resort Balaclava Fort, Mauritius, 21-23 October 2019
- A. Bhaw-Luximon, Keynote Lecture, BioTERM 2019: Biomaterial-based therapeutic engineering and regenerative medicine, 28 Nov-1 Dec 2019, IIT Kanpur, India
A. Bhaw-Luximon, Invited Lecture, deuxième édition de la Journée des soins de plaies, CHU de la Réunion, 5 Dec 2019, La Réunion
N. Goonoo, Oral Lecture, African Materials Research Society Conference, 10-13 Dec 2019, Arusha, Tanzania

Selected Recent Publications

- N. Rummun, R. E Hughes, R. Beesoo, W.W Li, O. Aldulaimi, K. G Macleod, T. Bahorun, N.O Carragher, A. Kagansky, and V.S Neergheen-Bhujun. Mauritian endemic medicinal plant extracts induced AMPK activation, G2/M Phase cell cycle arrest and growth inhibition of oesophageal squamous cell carcinoma in-vitro. *Acta Naturae* 11(1) (40) 81-90 (2019) (IF 2)
- T. Bahorun, O. I. Aruoma and V. S. Neergheen-Bhujun. Phytomedicines, nutraceuticals and functional foods regulatory framework: the African context. In *Nutraceutical and Functional Food Regulations in the United States and around the world*. Third Edition. Editor Debasis Bagchi, Academic Press, Elsevier, pp 509-519, 2019.
- N. Goonoo and A. Bhaw-Luximon, Mimicking growth factors: role of small molecule scaffold additives in promoting tissue regeneration and repair. *RSC Advances*, 2019, 9, 18124-18146. (IF 3.05)
- N. Goonoo and A. Bhaw-Luximon, Nanomaterials combination for wound healing and skin regeneration, Chapter 7 in *Advanced Nanosystems and 3D-printed systems from drug delivery and tissue engineering*, L. Du Toit, P. Kumar, V. Pillay (Eds), Elsevier, 2019.

Researchers

BDDN Unit

Dr Archana Bhaw-Luximon
Dr Nowsheen Goonoo
Dr Honita Ramphul
Ms Itisha Chummun (PhD completed/RA)
Mr Devesh Bekah (PhD completed/RA)
Ms Koushanee Madub (MPhil/PhD)
Mr Ajmal Boodhun (MPhil/PhD)
Dr Abha Jodheea-Jutton (MPhil/PhD)
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