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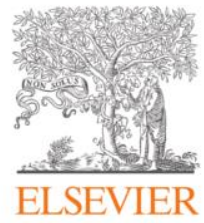
We are very grateful to all our sponsors for helping realise the objectives of this conference.



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Foreword - Chair 2018 WISWB *Indaba*

The 2nd International Women in Science Without Borders (WISWB) Indaba brings the WISWB series from the north of the African continent where the inaugural chapter was held in Egypt in 2017, to the very south of the African continent, Johannesburg, in 2018. The WISWB conference series is strategic and topical in that it aims to highlight and emphasise the contribution of women researchers within the science, technology, engineering and mathematics (STEM) ecosystem to effect positive outcomes. Is this important to continuously explore why and how women STEM researchers are an indispensable asset, and to understand the values and richness they bring to a research environment. WISWB-Indaba is a gender-inclusive conference as researchers more often than not work in a multi-gender workplace. The overarching theme of our conference in 2018 is: "Resilience in Diversity".

Themes for technical talks at the conference are inherently trans-disciplinary in nature, and also cutting across a number of South Africa's national priorities such as, though not limited to: Clean energy, Climate change, Digital revolution, Disaster management, Education and outreach, Food security, Gender studies, Health, Industrialisation, Science diplomacy, Smart cities and Water. Accepted peer-reviewed submissions will be published (electronically) after the conference under the title "Proceedings of the 2018 International Women in Science Without Borders (WISWB) - Indaba" with ISBN 978-0-620-78656-0. The 2018 WISWB-Indaba has also partnered with the South African Journal of Science (SAJS) to commemorate the hosting of the WISWB-Indaba in South Africa and selected full-length papers from the conference will be published in a future issue. We extend our deep gratitude to our sponsors without whom we would not have been able to achieve our vision. Our special gratitude is also reserved for our co-host, the University of Johannesburg for partnering with us.

I take this opportunity to thank the advisory committee and the local organising committee of the 2018 WISWB conference and all our mentors who helped us in realising the task we set for ourselves. On behalf of the organising committee, we wish you very enriching 3-days at the conference.

Prof Sonali Das
Principal Researcher (Statistics), Council for Scientific and Industrial Research, Pretoria, South Africa
Research Associate, Nelson Mandela University,
Port Elizabeth, South Africa
Visiting Associate Professor, University of the Witwatersrand,
Johannesburg, South Africa

Foreword - Founding Chair

Women in science without borders (WISWB) is a new potential initiative to empower women in science whether young or seniors with encouraging excellence and impact. Generally, encouraging excellence and impact will hopefully attract the attention to the achievements and concerns of females working or studying sciences. WISWB was essentially launched for establishing new healthy relation between males and females in scientific communities as main partners taking science as common template and language for mutual understanding. Consequently, that will increase the cooperation between them in order to enhance the work environment for both and strengthen the impact of scientific process whether with respect to education or research. That will strongly lead to gender diversity in favour of sustainable development. WISWB initiative includes encouraging the young female researchers and girls studying science. Also, empowering leadership for female scientists is an important aspect to enhance their action in their workplaces which will be useful for the whole scientific community on local and international levels. All these targets can be accomplished by increasing capacity building and training programs in addition to highlighting the success stories and the share of role models. That will help to some extent in fixing the suspended problems related to case of women in science. Additionally, WISWB is a good opportunity to involve scientists, policy makers, practitioners, journalists, entrepreneurs and young generations in fruitful interactive discussions in order to reach future action related to several concerns for development and societal interests. WISWB first copy was held at Cairo under auspices of the Egyptian academy for scientific research and technology and co-organized with the Egyptian young academy. WISWB was supported by several organizations concerned in the case of women in science such as Wellcome trust, Elsevier, ICSU, EU, UNESCO, L`Oreal, AAS, GYA and other reputable organizations. The current second copy of WISWB will be held in South Africa under auspices of several reputable national and international scientific bodies. In this context, I would like to express my great gratitude and appreciation for the efforts exerted by the organizers of WISWB-South Africa specifically my friend Prof Sonali Das and her colleagues and I wish them all the best. Their efforts in transferring the idea of WISWB to South Africa will help spreading it worldwide. Also, I would like to thank all participants whether females or males who responded to and shared in this initiative eagerly from the beginning till now. Really, all contributors and supporters for WISWB initiative make its success a reality. Finally and always, my deep thanks go to my family who is always supporting me.

Dr Amal Amin
National research Centre - Cairo, Egypt
Advisory board member of Egyptian young academy
Founding Chair of WISWB

Foreword - University of Johannesburg

On behalf of our esteemed Vice Chancellor, Prof Tshilidzi Marwala, the Management Executive team and the entire UJ community, I would like to welcome you to UJ for the 2018 edition of the International Women in Science Without Borders Indaba. The number of registered attendees participating and the thought provoking titles of presentations with a wide range of topics of concern is very encouraging and a testament of the urgency in the need to meet and interact as an interest group, most especially in providing a platform for networking, panel discussions and opportunities for knowledge sharing.

The University of Johannesburg is a vibrant, multicultural and a dynamic university of choice on the African continent. Proudly South African, the university is alive down to its African roots, and well-prepared for its role in actualising the potential that higher education holds for the continent's development. The vision of the UJ is to be "an international University of choice, anchored in Africa, dynamically shaping the future". The mission is aimed at "inspiring its community to transform and serve humanity through innovation and the collaborative pursuit of knowledge" and these are underpinned by the four values of the University of Johannesburg: imagination, conversation, regeneration and ethical foundation. As a University we also believe that we are well positioned for the Fourth Industrial Revolution and cutting edge research in all relevant fields, UJ has transformed itself into a diverse, inclusive, transformational and a collegial institution and has promoted women through various initiatives such as the Women Leadership Development Programme aimed to equipping women to become outstanding leaders and contribute towards achieving the UJ Global Excellence Stature.

I hereby enjoin you all to please enjoy the conference and looking forward to many more editions to come. You are all warmly welcome to the University of Johannesburg.

Prof Esther Akinlabi
Vice-Dean: Teaching and Learning
Faculty of Engineering and the Built Environment
University of Johannesburg

Keynote Speech

Minister Naledi Pandor's speech opening the International Women in Science Without Borders conference, Wednesday, 21 March 2018

South Africa applauds the hosting of this conference by women in science in a range of institutions. Our country is fortunate to have a well developed research sector – still too small yet extremely capable. We have twenty five universities and seven of them have credible research record. There are also a number of national research institutes that support and promote research in a wide variety of disciplines.
Recent reports on research indicators point to credible achievements in biotechnology, environment sciences, TB and HIV and AIDS research, astronomy science and space science. One of the challenges that confronts us in the midst of these matters for celebration is the fact that we rely primarily on institutions that are same number as the small exclusive apartheid designed institutional architecture that democratic South Africa inherited in 1994.

A second is that we still to need to develop programmes that support the emergence of a stronger research profile in our rural based universities that still tend to be largely focused on undergraduate teaching and inadequate publishing, innovation and research focused on complex socio-economic problems in South Africa, Africa and the broader African continent.

A third objective is to ensure increased participation by women in research and innovation. I regard this meeting of women in science which is dedicated to building research partnerships across borders as an innovative contribution to interventions we have created as South Africa to expand and support women's empowerment through science and technology. I think we have programmes that could be considered by our partners and I wish to reflect on some of them today.

Our National Research Foundation has a number of incentive programmes aimed at the advancement of women. The Thuthuka programme has 3 fast tracks for women academics: PhD, Post-PhD and Rating, and has been in existence since 2001. The Centres of Excellence have multiple objectives including building research excellence focusing on programmes and issues of national strategic importance. The South African Research Chairs Initiative (SARChI) targets the development of postgraduate students and emerging researchers. In 2015 there were 157 research chairs and, while half the doctoral students were men and half were women, only one in five SARChI professors was a woman. That changed in 2016 when 42 women professors were appointed. Now, nearly half of our 198 research professors are women. The SARCHi 42, as we call them, is a radical intervention that has the potential to reshape the future character of the South African professoriate. The SARCHi 42 are beginning to change the statistic that only one in three published scientists is a woman, and that she is younger and less qualified than her male colleagues. We need to expand such an initiative beyond our borders. Much more can be done. We need more incentives to support and recognise women in teaching and research, as without them significant change is unlikely to take place. Visible success for women scientists will ensure women play a role in key emerging sectors of research, such as renewable energy and innovation, health, and the bio-economy. Universities have also benefited from research incentives and more attention is being given to publishing and innovation. Universities are undertaking more R&D than before. Barely ten years ago universities undertook 20% of South Africa's research. Now it's over 30%, and growing. Investing in SARCHi is an investment in the future. Our intention is to achieve two important outcomes - more women professors and more PhDs including more women PhDs.

We have made some progress in creating an enabling environment for the progression of girls and women in the science, technology and innovation sector in South Africa but much more needs to be done. Supporting science capacity development in Africa is one of our science diplomacy priorities. We hope this meeting will encourage a similar focus in other regions of the world.

Africa has a billion people and is one of the fastest growing regions in the world. We are working to achieve greater economic integration and diversify the range of goods and services that we export.

The most important instrument to achieve this is faster job creation. In our situation, where some sectors of the economy already provide decent jobs, we need to combine mass absorption into the labour market with a determination to protect and expand access to these decent jobs.

We have to promote and grow industries that are labour absorbing, such as mining, agriculture, construction, hospitality and small businesses. We also have to grow the more advanced sectors of the economy, such as manufacturing, financial services, tele-communications and businesses services. For that we need high skills, science and innovation. And we need African women and must ensure their optimal participation in our economy and contribution to the growth of the African knowledge economy.

The challenge for Africa is to ensure that the gender imbalance in the practice of science, technology and innovation activities is addressed. We don't underestimate the importance of science, technology, and innovation for socio-economic development in both the developed and developing world. The involvement of women in STI activities is critical in contributing to the development of nations should not be limited to research but include business formation in STI sectors.

In closing, it is my belief that Africa’s capacity for innovation will shape the future of not only Africans but Asians, Americans and Europeans as well.

The most important new innovation driver is highly skilled human capital. We all compete in a global market for scientists and entrepreneurs. We are determined to encourage women scientists to work in Africa. But there must be work for them in frontier science. In South Africa we tried "to pick winners" with an electric car and a small-scale nuclear reactor project. We then turned to astronomy and "picked a winner" in radio astronomy where we had a comparative advantage in knowledge and geography.

South Africa was selected in 2012 to co-host the global Square Kilometre Array (SKA) global radio telescope project. The SKA has reversed the loss of skilled scientists, but is also critical to achieving our objective of making science and technology work for Africa.

A luta continua – the struggle continues – the battle cry of the anti-apartheid resistance movements and freedom fighters in Southern Africa most certainly still applies.

Plenary Speakers

Day 1 (21 March 2018)

Name: Jennifer Thomson
Affiliation: University of Cape Town
Bio: Jennifer Thomson (PhD Rhodes) is Emeritus Professor in the Department of Molecular and Cell Biology at the University of Cape Town. She held a post-doctoral fellowship at Harvard, was Associate Professor in Genetics at the University of the Witwatersrand, visiting scientist at MIT, and Director of the Laboratory for Molecular and Cell Biology for the CSIR, before becoming Head of the Department of Microbiology at UCT in 1988. She won the L'Oreal/UNESCO prize for Women in Science for Africa in 2004 and has an Honorary Doctorate from the Sorbonne University. Her research field is the development of genetically modified maize resistant to the African endemic maize streak virus and tolerant to drought. She has published three books on Genetically Modified Organisms: enes for Africa, Seeds for the Future, and Food for Africa, and is a frequent speaker at international meetings, including the World Economic Forum and the United Nations. She is a member of the board (previously Chair) of the African Agricultural Technology Foundation (AATF), based in Nairobi and Vice-Chair of ISAAA (International Service for the Acquisition of AgriBiotech Applications). She serves on the National Advisory Council on Innovation of the South African Minister of Science and Technology. She is the President of the Organisation for Women in Science for the Developing World (OWSD) and chairs the South African chapter. She is a newly elected fellow of TWAS.

Talk Title: The role of OWSD (Organization for Women in Science for the Developing World) and GenderInSITE in helping more women succeed in science.

Day 2 (22 March 2018)

Name: Roseanne Diab
Affiliation: Executive officer,Academy of Science of South Africa(ASSAf)
Bio: Roseanne Diab is the Executive Officer of the Academy of Science of South Africa and Professor Emeritus in the School of Environmental Sciences,University of KwaZulu-Natal.She is a Fellow of the university, the South African Geographical Society,The World Academy of Sciences (TWAS) and the African Academy of Sciences (AAS).She has served on numerous international committees such as the International Ozone Commission (IOC),the Commission on Atmospheric Chemistry and Global Pollution (CACGP)and the SPARC

(Stratospheric Processes and their Role in Climate)Steering Group.She is active in the Organisation for Women Scientists in the Developing World (OWSD) and co-chairs the Gender Advisory Board to TWAS.

Talk Title: Gender and Innovation

Day 2 (22 March 2018)

Name: Sithembile Bhengu
Affiliation: Council for Scientific and Industrial Research, South Africa
Bio: Sithembile Bhengu is a Group Executive at CSIR responsible for Human Capital. Sithembile's career spans over 17 years with a wealth of experience in strategic Human Capital leadership, training, leadership development, talent management and transformation from high-tech and knowledge intensive organisations. She has worked in industries such as aeronautics, chemicals and gas, financial services, management consulting and pharmaceuticals. Sithembile holds a Bachelor of Social Sciences (Honours) and a Postgraduate Diploma in Human Resources Management, both from the University of South Africa (UNISA), a Leadership Development Programme qualification from Development Dimensions International (DDI) and she just completed a Master's degree in Business Leadership through the UNISA Graduate School of Business Leadership.

Talk Title: A human capital perspective: challenges for female scientist's careers in South Africa.

Day 3 (23 March 2018)

Name: Glenda Gray
Affiliation: South African Medical Research Council
Bio: Professor Glenda E. Gray - MBBCH, FCPaeds (SA), DSc (honoris causa), an NRF A rated scientist, is the President of the South African Medical Research Council. Gray, who trained as a Medical Doctor and Paediatrician at the University of the Witwatersrand, co-founded and led the Internationally renowned Perinatal HIV Research Unit, based at the Chris Hani Baragwanath Hospital in Soweto. She has expertise in mother to child transmission of HIV, HIV vaccines and microbicides. She is

the Co-PI of the HIV Vaccine Trials Network and Director of the HVTN International Programs. In 2002, she was awarded the Nelson Mandela Health and Human Rights Award for pioneering work done in the field of Mother-to-Child Transmission of HIV-1. She is a member of the Academy of Science in South Africa, and chairs their standing committee on health. She is a member of the Institute of Medicine, of the National Academies, and serves on their Global Health Board. She has also been confirmed as the Chair for the Global Alliance for Chronic Diseases (GACD).Gray has also been awarded the IAPAC "Hero of Medicine" award for work done in the field of HIV treatment in children and adults. In 2009, James McIntyre and Gray received the N'Galy-Mann lectureship in recognition of their HIV research contribution in South Africa. In June 2012 she received a DSc (honoris causa) from the Simon Fraser University, Vancouver for her work in the field of mother to child transmission of HIV. She has also been admitted into the American Academy of Microbiology in 2012. In 2013 she received the country's highest honour, the Order of Mapungubwe, granted by the president of SA for achievements in the international area which have served South Africa's interest as well as the EDCTP's outstanding Africa scientist award. In 2017, she was listed amongst the Times 100 influential people in the world.

Talk Title: Building research capacity & transformation in health research.

Elsevier Workshop

Day 2 (22 March 2018)

Name: Charon Duermeijer
Affiliation: Elsevier Amsterdam
Bio: Charon Duermeijer, PhD, joined the Elsevier Publishing group in 2000. Since then she has had various roles within Publishing. In her most recent Publishing role as Publishing Director, she was responsible for the global strategic direction and development of the Physics journal business unit with 13 global FTE reports and >80 journals. She currently holds the position of Senior Director Academic Customer Engagement where she is responsible for Outreach and Networking with key Academic stakeholders around the world to understand their needs and ambitions and explore how Elsevier can help achieve those ambitions.

Before joining Elsevier, she has worked for SpringerNature. In 1999, she finished her PhD in Geophysics at the Utrecht University in the Netherlands. Earlier she worked as a Geologist for Goldfields of South Africa.

She has a strong interest in science communication and a passion for education and knowledge sharing. In 2015, she was a volunteer for "Publishers Without Borders" in Tanzania (2015) supporting Tanzania to become a nation where science and scientific publishing are embedded in the universities and research institutions.

Talk Title: Addressing Gender in Scientific Publishing

As a leading scientific information solutions provider, Elsevier has a responsibility to apply a gender lens to our core business. We strive to serve as an industry leader by helping to establish best gender practices in editorial policies, board recruitment and researcher capacity building around the world.

We strongly feel that as Publishers we have a responsibility to produce the most robust research possible in the most equitable and inclusive way for both men and women from all nations around the globe.

In this talk, we will discuss the various global initiatives Elsevier is undertaking around the topic of gender and inclusivity. We will also provide a powerful insight and guidance on gender research and gender equality policy for governments, funders and institutions worldwide.

Invited Speakers: Day 1 (21 March 2018)

Name: Igle Gledhill
Affiliation: University of the Witwatersrand
Bio: Igle Gledhill holds a PhD in plasma physics, and completed the Executive National Security Programme in 2001. At UCLA and Stanford University, she wrote simulations for use in plasma fusion and space shuttle physics. She is Visiting Adjunct Professor in Flow Physics at Wits, and works on the aerodynamics of sharp manoeuvre. As an applied computational physicist, she has worked in collaboration with teams within the biosciences, in infrastructure engineering, and in non-linear optics.
She is a Past President of the SA Institute of Physics and immediate past chair of the IUPAP Working Group on Women in Physics.

Talk Title: A Global Approach to the Gender Gap in Mathematical and Natural Sciences: How to Measure It, How to Reduce it?

Name: Ismail Akhalwaya
Affiliation: IBM Research - Africa
Bio: Ismail obtained his B.Sc. Mathematics, Physics and Computer Science (2003) and his B.Sc. Honours Mathematics of Computer Science with Physics (2004) from UCT on the beautiful foothills of Table Mountain. He then joined the Quantum Research Group (QRG) at the balmy UKZN for his M.Sc. Theoretical Physics (Quantum Computation & Information, 2006, awarded cum laude with the S2A3 Bronze Medal). Ismail was then fortunate to be awarded a Canon Collins-Mamphela Rampele Scholarship for a one year studentship (non-credit course work & intensive research) at the Centre for Quantum Computation, Department of Applied Mathematics and Theoretical Physics, University of Cambridge in the perpetually overcast UK. After much soul-searching, Ismail completed his Ph.D. Theoretical Physics (Classical Noise in Quantum Systems, 2014) at the QRG, UKZN. At IBM Research Ismail is engaged with three primary tasks: engage in fundamental SKA physics/astronomy research especially through a machine-learning lens, explore quantum information research and supervise/co-supervise Wits postgraduate students. To facilitate the latter the University of the Witwatersrand has appointed Ismail as a Visiting Lecturer in the School of Computer Science and Applied Mathematics.
On the SKA front, Ismail has forged ties with a number of SKA researchers and is currently working on Bayesian Interferometry and Unsupervised Machine Learning.

Talk title: Artificial Intelligence and Quantum Computing in Africa

Name: Jesika Singh

Affiliation: University of Limpopo

Bio: Prof Rachael Jesika Singh works at the University of Limpopo as the Deputy Vice-Chancellor: Research, Innovation and Partnerships. Her focus area is on Research Development of staff and postgraduate students. She has a doctorate in teacher education from the University of Johannesburg. Her career in education spans over 26 years. In basic education, she has worked as a teacher, head of department, deputy principal and principal. In higher education and training, she has worked as a senior lecturer in Geography Education; a head of department in languages and social sciences, research developer and Director of Research. Her publications are in the field of teacher education. She is widely published and is a supervisor of masters and PhD students. She is particularly dedicated to promoting women in research and management. In this regard, she participates in the activities of ULWASA (University of Limpopo Women's Academic Solidarity Association) and HERS-SA (for women in management in higher education).

Talk Title: Women in Management: Our role in advancing and sustaining the STEM ecosystem.

Name: Yoseph Getachew

Affiliation: Department of Economics, University of Pretoria

Bio: Yoseph Getachew has obtained a Ph.D. from UNU MERIT Maastricht University in October 2009. He had been a Research Fellow in Durham University, the UK, between August 2010 and December 2013. He is currently Associate Professor at the University of Pretoria, South Africa. His expertise lies in both theoretical and empirical development macroeconomics. His main research interests are Economic Growth, Public Policy, Inequality and Mobility. He has published peer-reviewed papers in reputed international journals including the Journal of Macroeconomics, Macroeconomic Dynamics, Research in Economics and Economics Letters.

Talk Title: Share the Love: Parental Bias, Women Empowerment and Intergenerational Mobility

Name: H Prozesky

Affiliation: DST-NRF Centre of Excellence in Scientometrics and Science, Technology and Innovation Policy, Centre for Research on Evaluation, Science and Technology

Bio: Heidi Prozesky holds a PhD in Sociology, on gender differences in the publication productivity of South African scientists, a research interest she has

pursued since 2003. Her other research interests and teaching specialisations include social research methodology and ethics, as well as environmental sociology. In 2015 she was appointed as research manager of the DST-NRF Centre of Excellence in Scientometrics and STI Studies, where she is also conducting her own research on women in science and other topics within the field of the sociology of science.

Talk Title: A gender perspective on career challenges experienced by African scientists

Name : S. Khuluse
Affiliation: CSIR (Council of Science and Industrial Research)
Contact: smakhanya@csir.co.za
Bio: Sibusisiwe Makhanya (maiden Khuluse) is a Senior Researcher in Statistics at the CSIR. She has been with the CSIR for 11 years, devoting a substantial portion of that time pursuing graduate studies. This iincludes being Harvard University Graduate School of Arts and Sciences student fellow in the 2010/11 academic year. She holds a doctoral degree in Spatial Statistics from the University of Twente. She is a registered Chartered Statistician with the Institute of Certified and Chartered Statisticians of South Africa; Graduate Statistician with the Royal Statistics Society (United Kingdom) and an ordinary member of the South African Statistical Association. She currently has ten peer-reviewed scientific papers published in journals and conference proceedings and over thirty technical reports and non-peer reviewed talks. Her core research interests are in statistical risk analysis including extreme events as well as general statistical applications involving the analysis spatiotemporal data. She has experience in consulting on projects that utilize statistical methods for decision support in industry and in scientific research where statistical evidence is required to further scientific enquiry. Applications at the interface of the environment and society are of interest to her.

Talk Title: Air Quality Exposure Analysis - Data Challenges, Findings And Recommendations From A Case Study In South Africa.

Panel Discussion: Day 1 (21 March 2018)

Title: Gender shouldn't matter because we are all scientists here: Discussing some of the challenges faced by female scientists

Panelists: Nova Ahmed, Department of Electrical Engineering and Computer Science, North South University, Bangladesh; Yoseph Getachew, Department of Economics, University of Pretoria, South Africa Igle Gledhill, Adjunct Professor, School of Mechanical, Industrial & Aeronautical Engineering, University of the Witwatersrand, South Africa; Maria Kanjere, Turfloop Graduate School of Leadership, University of Limpopo, South Africa; Sibusisiwe Khuluse-Makhanya, Council for Scientific and Industrial Research, South Africa





Moderator: Antoinique Van Staden, University of Pretoria



Invited Speakers: Day 2 (22 March 2018)

Name: Amal Amin

Affiliation: Ass. Prof. Dr. Amal Amin Ibrahim

Member of Advisory and steering committee of Egyptian young academy; Young Affiliate of the academy of sciences for the developing world (TWAS); Co-founder and Alumni for Global young academy (GYA); Coordinator of Arab materials science and nanotechnology network; President of Egyptian Society of Advanced Materials and Nanotechnology (ESAMNT); Nanostructured polymers-Center of Excellence- National research center - Cairo- Egypt.

Bio: Dr. Amal Amin is an associate professor for nanotechnology/ polymers at national research center at Cairo-Egypt with large number of publications, projects, awards and other research activities. She studied in, worked at and travelled to several countries including-but not limited to-Germany (PhD-DAAD), USA, France, etc. She was cofounder and executive committee member of the global and Egyptian young academies (GYA, EYAS). She was president and cofounder of the Egyptian society for advanced materials and nanotechnology (ESAMNT) and ex-coordinator of the Arab materials science and nanotechnology network (AMSN-ASTF). She was TWAS young affiliate and TWAS-AAAS science diplomacy alumni. She was invited to and actively participated at WEF (Summer Davos), IAP meetings, TWAS meetings including TWAS-TYAN, GYA meetings, WSF, AAAS, UNESCO meetings, INGSA-EU conference on science and policy making in Brussels, and other big scientific high level meetings. Now, she is advisory board member of Egyptian young academy, founding chair of women in science without boarders' initiative/conference (WISWB), founding fellow of the academy of engineering and technology for the developing world (AETDEW), member of TWAS-TYAN network and member of other reputable organizations. She is especially interested in science communication, increasing public awareness/literacy for science, science advice/diplomacy, innovation, science policy, etc.

Talk Title: Development of society with science-another aspect for science diplomacy (personal experience)

Name: D Reddy

Affiliation: University of Cape Town

Bio: Daya Reddy was born in Port Elizabeth, South Africa. He holds a bachelor's degree in civil engineering from the University of Cape Town and a Ph.D. from the University of Cambridge. He currently holds the South African Research Chair in Computational Mechanics in the Department of Mathematics and Applied Mathematics at UCT, and also serves as Director of the Centre for Research in Computational and Applied Mechanics.

Daya Reddy recently completed a term as President of the Academy of Science of South Africa. He is also an elected fellow of TWAS, and of the African Academy of Sciences. He serves as co-chair of IAP-Research, formerly the InterAcademy Council, a component of the InterAcademy Partnership that produces reports on scientific issues for governments and global organizations. He also serves on the executive board of the International Council for Science (ICSU).

Daya Reddy is a recipient of the Award for Research Distinction of the South African Mathematical Society, the Order of Mapungubwe, awarded by the President of South Africa for distinguished contributions to science, and of the Georg Forster Research Award from the Alexander von Humboldt Foundation in Germany.

Talk Title: Women (in Science) and the Sustainable Development Goals.

Name: Yusuf Baran

Affiliation: Abdullah Gul University, Kayseri, Turkey

Bio: Prof. Dr. Yusuf Baran has been working as a full professor and vice rector at Abdullah Gul University, Kayseri, Turkey since 2015. He is also a member of advisory board at Yunus Emre Institute, Department of Science Diplomacy.

After receiving his bachelor degree in Dicle University, Department of Biology between 1994-1998, he earned his M.Sc. and Ph.D. degrees in 2002 and 2006, respectively, in the Middle East Technical University. During his Ph.D. studies, he worked in the Medical University of South Carolina, for 6 months in 2005 and 2006. He worked as a Faculty at Izmir Institute of Technology, from 2007 to 2015. Dr. Yusuf Baran has been involved in more than 30 research projects, has authored or co-authored in more than 300 papers in peer-reviewed journals and abstracts and has been recognized and awarded for more than 100 awards. Prof. Dr. Yusuf Baran has been honored as "2013 Young Scientist" by World Economic Forum (WEF) in 2013 and earned “Outstanding Young Person of Turkey in Scientific Leadership Award", by International Young Leaders and Entrepreneurs in 2014, Dr. Baran also earned “Outstanding

Young Scientist Award" by Experimental Hematology Association in 2016, by Science Heroes Association in 2014, and by Turkish Academy of Sciences in 2010; and "2017 Science Encouragement Award" by Turkish Academy of Pharmacy. Prof. Dr. Yusuf Baran is a member of The Global Young Academy; an Executive Committee member of The World Academy of Sciences Young Affiliate Network; a founder member of the Academy of Engineering and Technology for the Developing World; a member of World Association of Young Scientists; a member of the World Economic Forum, Young Scientist Program. In his research, Dr. Baran focused on molecular biology of cancer, multidrug resistance mechanisms and reversal of resistance, science and technology policies.

Talk Title: Science diplomacy: Soft power to connect the world through science

Name: Sunita Facknath

Affiliation: University of Mauritius

Bio: Sunita Facknath, BSc, MSc, PhD (UK), PhD (Mauritius) is a Professor in Sustainable Agriculture and the Dean of the Faculty of Agriculture, University of Mauritius. She has expertise in the field of sustainable agroecosystems (including coastal ecosystems) and climate change, and has also worked in the areas of aquaculture and sustainable forestry. She has earned two doctorates, one from the University of Middlesex in UK and one from the University of Mauritius. She is an active researcher, heading several research teams, and supervising student research. Prof Facknath has completed several consultancies for regional and international bodies (EU, FAO, UNDP, UNEP, SADC FANRPAN, CTA), as well as for the Government of Mauritius and local private companies, and has been invited to a large number of international conferences/ symposia in many parts of the world to present her work and/or make keynote addresses. Prof Facknath is also very active in social projects: she was a founder member of the Rotary Club of Ebene Mauritius, and a former Chairperson of the Rotary Foundation Committee and member of the Project Services Committee.

Talk Title: Women and the SDGs

Name: H Mouri

Affiliation: Department of Geology, University of Johannesburg, Auckland Park Campus, South Africa

Bio: Hassina Mouri studied and graduated (Cum Laude) in Algeria in 1990. She completed her PhD (University Paris 7, France) (Cum Laude) in January 1995. Hassina joined the University of Helsinki, then the Geological Survey of Finland (1995- 1999) for a research position. In June 1999, she was awarded a 2 years NSF Research Grant for a Post Doctoral Associate at the University of Minnesota (USA). However in October 2000, Hassina decided to come back to Africa in order to contribute to the Research and Development of Earth Science Education in Africa. She accepted a tenured senior lectureship in the Department of Geology at the University of Pretoria until July 2008. She was the 1st female academic in geology to join the department.

In August 2008, she joined UJ for a senior lecturer position, where she was also the only female academic (PhD) until recently. Since 2008, she has been very active at International level. In 2008, Hassina was elected Secretary General of the Geological Society of Africa (GSAf) for 4 years. During the same period, she was leading the organization of the 23rd Congress on African Geology (CAG23), which took place in January 2011 at the University of Johannesburg. In 2012, Hassina was elected Councillor for the International Union of Geological Science (IUGS) for 4 years. She was nominated for this position (IUGS Councillor) by the Geological Society of London (UK) and supported by the 4 adhering countries including France, USA, Canada, India and South Africa. In 2013, she was elected Councillor for the International Medical Geology Association for 2 years and in 2017, she was elected Chair of the South African National Committee for IUGS for 4 years. Hassina is a metamorphic geologist by training. However, in 2013, she started developing interest in the emerging field of Medical Geology and established the South African Medical Geology Chapter. In 2014, she organized the 1st International Symposium on Medical Geology in Africa at the university of Johannesburg and she is planning to organize the 2nd one in November 2018. Since the development of this emerging field, she has been actively involved in the training of Postgraduate students. For example, in 2014 the Council for Geoscience supported 2 part time students from SA; in 2015 and 2017, the University of Johannesburg supported 3 more students (2 from Kenya and 1 from Pakistan) through the Global Excellence and Stature (GES) Prestigious Program, and in 2016 she obtained bursaries to train up to 12 MSc students from South Africa, Namibia, Nigeria and Ghana to work under her supervision and co-supervision on projects related to Medical Geology. Hassina was invited to give keynote and public lectures on her work in Medical Geology at several International institutions and conferences including the University of Kashmir in 2014, the Chinese Academy of Science and the 35th International Congress of Geology in Cape Town in 2016 and the 6th International Conference in Medical Geology in Russia in 2017. She is currently leading a special session in this field to be held in Vienna at the European Geoscience Union Meeting in 2018. Hassina's works has been recognised at international level through a number of awards and distinctions, including the African & European Union Joint Prestigious Women in Science Regional Award (Earth and Life Science) in 2010, a Stimulus Chapter Award by the International Medical Geology Association in 2013 and a Dux Award by the University of Johannesburg Vice-Chancellor Executive Leadership Development Program Award in 2014.

Talk Title: Medical Geology and its relevance in Africa

Invited Speakers: Day 3 (23 March 2018)

Name: R Maphanga
Affiliation: Council for Scientific and Industrial Research, Pretoria
Bio: Regina Maphanga is a Researcher at the CSIR in South Africa. She completed her PhD in Physics from the University of Limpopo. In addition, she is appointed as a Junior Associate at the Abdus Salam International Centre for Theoretical Physics in Italy. Her research focuses on computational modelling of materials energy storage devices. She is a member of South African Young Academy of Science and Global Young Academy the voice of the young scientists around the world. She made continuous contributions to a number of programmes on promotion of public understanding of science, engineering and technology.

Talk Title: Li2O2/Graphene as a material for energy storage

Name: B Odhiambo
Affiliation: University of Venda, School of Environmental Sciences, Department of Geography & Geo-Information Science, South Africa
Bio: Professor of Applied Geomorphology and Environmental Studi. Doctor of Philosophy (Geography), University of Waterloo, Ontario, Canada, 1993; Master of Science (Geology), University of Nairobi, 1989; Postgraduate Diploma; (Geomorphology), I.T.C., the Netherlands, 1983; - Certificate of Achievement in Remote Sensing, G.D.T.A/C.N.E.S, Toulouse,
France, 1981; Bachelor of Science (Hons.), University of Nairobi, 1980; E.A.A.C.E, Kagumo High School, Kiganjo, Kenya.
PROFESSIONAL & TECHNICAL COMPETENCE:
1. Assessment of Natural Resources; including hydrogeological, hydrogeomorphological surveys and mapping, Climate Change, Land Capability Studies, Vegetation Mapping, and Animal Habitat Mapping, using Remote Sensing and GIS techniques.
2. Implementation of Integrated River Basin and Watershed Management practices.
3. Environmental Biogeochemistry (heavy metal analyses in hydrological, geological, geochemical, and biological materials with an emphasis on geomedical and toxicological implications).

4. Exploration of Economic Mineral Deposits, using Biogeochemical and Geobotanical Techniques.

AREAS OF ON GOING RESEARCH

1. Quantification of Soil Erosion and Siltation Rates into the Nandoni and Tzaneen Dams in Limpopo Province, South Africa from Sept 2015 to present.
2. Limpopo River Basin Curriculum Innovation Network. Task is to infuse aspects of climate change into curricula of Institutions of Higher Learning (IHL) that occur within the basin.
3. Acting Coordinator of The Univen/Mopani District Municipality Disaster Risk Reduction study within the Mopani District Municipality
4. Developed the Centre for Climate Change at Moi University in 2015; Sponsored by the International Social Science Research Council (ISSRC).
5. A collaboration research between Geography Department at IUPUI, USA and Department of Geography, Moi University, Kenya. 2013. Project title, 'Using High Resolution Imagery to Identify Cropping Signatures of Small Farms in Western Kenya'.
6. Swedish Secretariat for Environmental Earth System Sciences (SSEESS): 2013 to Present, collaborative project title,'Regional Centre for Hazards, Disaster Monitoring & Climate Change'.

Talk Title: Natural and Human-induced Hazards and Disasters in Africa and the Role of Women in Curriculum Development

Program at a Glance

Day 1		
Time		
07h30 - 08h30		Registration
08:45		Welcome song
09h00 - 09h30	Welcome	Program Director – Juanette John Sonali Das Amal Amin Esther Akinlabi
09h30 - 10h00	Keynote	Mrs Naledi Mandisa Pandor Minister of Higher Education and Training South Africa
10h00 - 10h30	Tea	
10h30 - 11h15	Plenary	Jennifer Thomson - *The role of OWSD (Organization for Women in Science for the Developing World) and GenderInSITE in helping more women succeed in science.*
11h10 - 11h30	Invited	Igle Gledhill - *A Global Approach to the Gender Gap in Mathematical and Natural Sciences: How to Measure It, How to Reduce it.*
12h00 - 13h00	Breakaway	
13h00 - 14h00	Lunch	
14h00 - 14h20	Invited	Ismail Akhalwaya – *Artificial Intelligence and Quantum Computing in Africa*
14h20 - 14h40	Invited	J. Singh - *Women in Management: Our role in advancing and sustaining the STEM ecosystem.*
14h40 - 15h00	Invited	Yoseph Getachew - *Share the Love: Parental Bias, Women Empowerment and Intergenerational Mobility.*
h00 - 15h20	Invited	Heidi Prozesky - *A gender perspective on career challenges experienced by African scientists*
15h20 - 16h30	Panel discussion	*Gender shouldn't matter because we are all scientists here: Discussing some of the challenges faced by female scientists.* Moderator: Antoinique Van Staden

Day 2		
Time		
08h30 - 08h50	Invited	Amal Amin - *Development of society with science-another aspect for science diplomacy (personal experience)*
08h50 - 09h10	Invited	Daya Reddy - *Women (in Science) and the Sustainable Development Goals*
09h10 - 09h30	Invited	Yusuf Baran - *Science diplomacy: Soft power to connect the world through science*
09h30 - 10h15	Plenary	Roseanne Diab - *Gender and Innovation*
10h15 - 10h35	Tea	
10h35 - 11h20	Plenary	Sithembile Bhengu - *A human capital perspective: challenges for female scientist's careers in South Africa*
11h20 - 11h40	Invited	Sunitha Facknath - *Women and the SDGs*
11h40 - 11h00	Invited	Hassina Mouri - *Medical Geology and its relevance in Africa*
12h00 - 13h00	Breakaway	
13h00 - 14h00	Lunch	
14h00 - 15h00	Workshop	Charon Duermeijer-*Addressing Gender in Scientific Publishing*
15h00 - 16h00	Breakaway	

Day 3		
Time		
08h30 - 08h50	Invited	Regina Maphanga - *Li2O2/Graphene as a material for energy storage*
8h50 - 09h10	Invited	Beneah Odhiambo - *Natural and Human-induced Hazards and Disasters in Africa and the Role of Women in Curriculum Development*
09h10 - 09h30	Invited	Ogunlade Davidson - *Women and Climate Change: Africa Perspectives*
09h30 – 10h15	Invited	Glenda Gray TBA
10h15 - 10h35	Tea	
10h35 – 12h05	Breakaway	
12h05 - 12h15	Closing	
12h15	Lunch	

WOMEN IN SCIENCE WITHOUT BORDERS 2018
RESILIENCE IN DIVERSITY

2018 International

Women in Science Without Borders (WISWB)-*Indaba*

School of Tourism and Hospitality, University of Johannesburg, South Africa

21-23 March 2018

A gender perspective on career challenges experienced by African scientists

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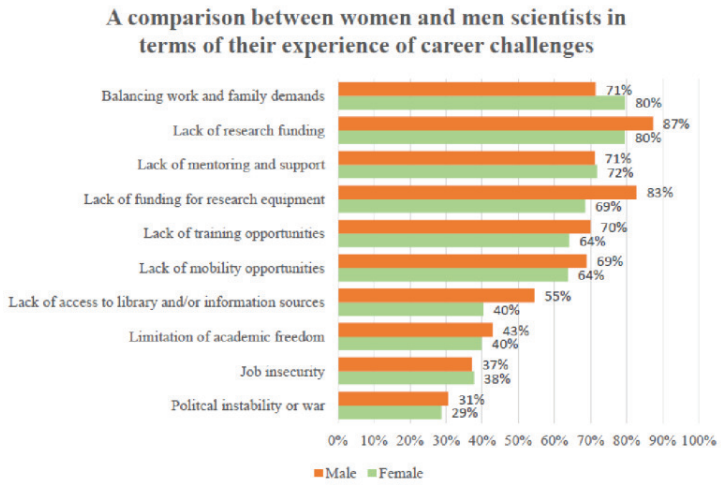

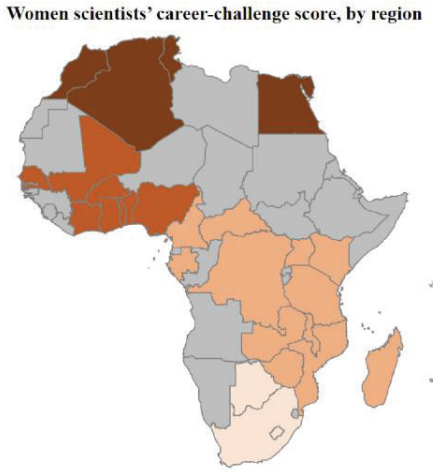

Abstract

The aim of this paper is to describe the career challenges that confront women scientists in Africa. Our analysis of questionnaire-survey data on approximately 5 000 African scientists shows that women are not more challenged than men by a variety of career-related issues, with the exception of balancing work and family, which the majority of women, regardless of age, region and field, experience. Contrary to expectations, women are not only less likely than men to report lack of funding as having impacted negatively on their careers. These results, as well as a comparison of women according to region and field, lead us to recommend priorities for future interventions aimed at effectively ensuring the equal and productive participation of women in the science systems of Africa.

Theme— Gender studies.

1 Introduction

The focus of this paper on career challenges experienced by women African scientists is motivated by a general lack of empirical knowledge of scientists in Africa that needs to be addressed [1]. The challenges have the potential to negatively affect women scientists' research performance and their retention, to the detriment of the research system that trained them. The contribution of this paper is to suggest ways to address the most salient barriers, in order to nurture the full potential of African women scientists.

2 Method

A web-based survey was conducted between 2016 and 2017, which collected data on slightly more than 5 000 scientists born and working in an African country. To identify and contact African scientists, corresponding authors' email addresses were extracted from the Web of Science and Scopus databases, for each article published from 2005 to 2015 with an institutional address in Africa[1]. Data were collected via a self-administered, structured questionnaire, which included a section on the extent[2] to which 10 factors have impacted negatively on the scientists' careers. Data were analysed with IBM SPSS Statistics 24, primarily by drawing subgroup comparisons.

3 Results and discussion

This survey of African scientists does not support the hypothesis that women scientists are more career challenged than men are, with the notable exception of the challenge of balancing work and family demands, which is the only one women are proportionately more likely than men to have experienced. It is also the challenge most frequently experienced by women, regardless of age, region or field.

A number of scholars have highlighted the potential negative effects of particularly African women scientists' reproductive responsibilities and a traditional gendered division of labour within households [e.g., 2, 3]. It has often been noted that many women scientists globally are limited in their geographic mobility by family demands (for a review, see [4]). We find that almost two-thirds of women scientists have experienced lack of mobility as a career-related challenge. What is surprising, however, is that men are even more likely than women to report a lack of mobility as a challenge they have experienced.

The survey shows that women's greater likelihood to experience work–family role conflict is not a function of the number of dependents they have (which is greater for men). This corresponds well with the findings of previous research outside of Africa (and reviewed elsewhere – see Prozesky

[4]) that women who do enter scientific careers are more likely to postpone or avoid family responsibilities than men, but when they do have children, they take main responsibility for their care, while men tend to delegate these responsibilities to their (female) partners.

Contrary to the "deficit model", according to which men and women do not share equally in the means of scientific production [5], we find that African women scientists are much less likely than men to have experienced financial resources as a career challenge. However, among women, funding is highlighted by the second-largest majority as a career challenge. The need for funding for research equipment is most salient among North African women and among those in the natural and agricultural sciences. In terms of region, the "most career-challenged" women are found amongst North African nationals, but a more detailed analysis shows that West African women are particularly likely to lack material and other resources[3].

Finally, those qualified in fields where women are proportionately under-represented, i.e. engineering and applied technologies and the natural and agricultural sciences, are on average most likely to have experienced career-related challenges.

4 Conclusions

Our results seem to suggest that increasing funding for African women scientists should be less of a priority than addressing the work–family role conflict these women experience. While the challenge of balancing work and family is most salient amongst women scientists in the humanities, our results further suggest that women who are qualified in fields that still constitute a predominantly male milieu are in most need of interventions that address a variety of other career-related challenges. Job security among those in the health sciences, is also highlighted as an area of concern. Finally, from a regional perspective, efforts to address women scientists' career-related challenges should be directed first and foremost towards North African and Western African countries.

Endnotes

[1] For Zambia, we also used articles in journals not indexed in the Web of Science and Scopus databases. Other sources of emails included the South African Knowledgebase database, the Internet, as well as snowball sampling.

[2] Originally measured with three response options, "not at all"; "to some extent"; and "to a large extent", but recoded into a binary variable ("No" and "Yes", with the latter including at least to some extent) for ease of comparison.

[3] Library and/or information sources, funding for research equipment and training opportunities to develop professional skills.

Acknowledgments

Financial support by the IDRC (Canada), the Robert Bosch Stiftung, and the DST-NRF Centre of Excellence in Scientometrics and Science, Technology and Innovation Policy (SciSTIP) is hereby acknowledged.

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Development of Nanoemulsion as a Potential Medium for the Transdermal Delivery of Insulin and Chlorpromazine Drug

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Abstract
Nanoemulsions have gained importance in multiple industries including the chemical and pharmaceutical industries [1], since it is one of the few means of delivery of hydrophobic drugs. The aim of this research is to develop oil-in-water (O/W) nanoemulsion which can be adopted for transdermal delivery of Insulin and Chlorpromazine. The nanoemulsion was prepared by self-mild mechanical nano-emulsification method. The nanoemulsion formulation consisted of Castor oil as the oil phase, Polyethylene (20) sorbitanmonooleate (T 80) and Polyethylene (20) sorbitanmonolaurate (T 20) as the surfactants and Polyethylene glycol (PEG 400) as co-surfactant. The formulations were subjected to tests including Physical Appearance (colour, cloudiness and transparency), Stability test (phase separation), pH, Viscosity, Freeze-Thaw, Morphology Determination using Scanning Electron Microscope (SEM) and Determination of Cross-Linking of Drug with the Oil-Phase of the Nanoemulsion using Fourier Transform Infrared Spectroscopy.
The FTIR result shows that there's no cross-linking between insulin and the oil phase, but there was cross-linking between chlorpromazine and the oil phase. Therefore, insulin remains whole in the oil phase of the nanoemulsion but chlorpromazine does not remain whole in the nanoemulsion. The SEM images of drug-loaded nanoemulsion of insulin and chlorpromazine revealed an encapsulation with globule size diameter of 67 and 26nm respectively.
The findings of this work showed that insulin had better encapsulation than chlorpromazine and that T20 was a better surfactant, compared to T80.

Themes—health, drug, drug delivery, nanoemulsions, water, industrialisation

1 Introduction

Drug delivery is a long-age challenge, which is still present due to the lipophilic nature of recently produced drugs. This work is focused on the development of nanoemulsion, capable of entrapping drug in its oil phase and serving as a means of transdermal drug delivery. The major advantages of transdermal delivery of drugs include evading the first-pass liver metabolism of hydrophobic drugs in the system as well as increasing its bioavailability.

2 Method

The formulation consisted of Castor oil as the oil phase, Polyethylene (20) sorbitanmonooleate (T80) & Polyethylene (20) sorbitanmonolaurate (T 20) as the surfactants and Polyethylene glycol (PEG 400) as co-surfactant. The surfactants and co-surfactant were used in constant and varying ratio while distilled de-ionized water was used as the aqueous phase. The formulations were subjected to tests including Physical Appearance (colour, cloudiness and transparency), Stability test (phase separation), pH, Viscosity, Freeze-Thaw, Morphology Determination (using Scanning Electron Microscope (SEM)) and Determination of Cross-Linking of Drug with Nanoemulsion Fourier Transform Infrared Spectroscopy.

2.1 Drug Incorporation

Chlorpromazine and insulin (0.75g) were separately incorporated into the oil phase of the most stable nanoemulsion formulations prior to emulsification.

2.2 Characterization

The drug-free and drug-loaded nanoemulsion formulations were analyzed using Infra-Red Spectroscopy, Scanning Electron Microscopy and Transmission Electron Microscopy.

3 Results/ Discussion

The nanoemulsion formulations, containing 3% Castor oil, 14% T20, 14% PEG400, 69% water and 3% Castor oil, 16% T20, 8%PEG400, 73%water passed the pH test, Freeze -Thaw, Stability and Physical Appearance test. The FTIR result shows a prominent absorption band between 1090-1020cm^{-1} for primary amine present in insulin and 800-700cm^{-1} for C-Cl, 715-670cm^{-1} for C-S, 1360-1310cm^{-1} for aromatic tertiary amine and 1210-1150cm^{-1} for aliphatic tertiary amine present in chlorpromazine respectively. The prominent absorption band found in insulin was found in the insulin-loaded nanoemulsion but the prominent absorption bands found in chlorpromazine was not found in chlorpromazine-loaded nanoemulsion. The FTIR result shows that there's no cross-linking between insulin and the oil phase, but there was cross-linking between chlorpromazine and the oil phase. Therefore, insulin remains whole in the oil phase of the nanoemulsion but chlorpromazine does not remain whole in the nanoemulsion. The SEM images of the nanoemulsions revealed a uniform slurry liquid showing complete emulsification. The SEM images of three of the drug-loaded nanoemulsion revealed an encapsulation with globule size diameter of 78, 67 and 26nm respectively.

4 Conclusions

The findings of this work showed that insulin had better encapsulation than chlorpromazine and that T20 was a better surfactant, compared to T80 and the formulation containing ratio 2:1 and 1:1 has the highest potential for transdermal drug delivery in terms of entrapment globule size of the dispersed phase.

Acknowledgments

We acknowledge the financial support of Dr & Mrs. T. O. Adebowale and the immense support of Bamisaye Abayomi and Dr. (Mrs.) T. O. Akinhanmi all through this research work.

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Studies on Individual and Combined Antimicrobial Activities of Methanolic Extracts of *Allium sativum* bulbs and *Garcinia kola* seeds on some selected Bacterial Isolates

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Abstract
This study investigated the individual and combined antimicrobial activities of the methanolic extracts of *Allium sativum* bulbs and *Garcinia kola* seeds on some selected bacterial isolates, assessed the minimum inhibitory concentration of the crude extracts. This was with a view to determining if the crude extracts have synergistic effect.
The seeds of *Garcinia kola* and bulbs of *Allium sativum* were purchased from Central Market, Ile – Ife Southwest Nigeria, dried, and then ground into a fine powder. The powdered plant materials were extracted using 60% methanol separately, filtered, concentrated *in vacuo*, lyophilized and screened for phytochemicals and antibacterial activities individually and in combined form against some selected bacterial isolates. Minimum inhibitory concentrations (MIC) of the extracts were determined.
The extracts of the plant materials individually and in combined form exhibited different degrees of antimicrobial activities. Phytochemical screening revealed the presence of saponins, tannins, flavonoids, reducing sugar, alkaloids and steroids in *G. kola* while saponins, triterpenes and steroids were present in *A. sativum*.
The MIC of the methanolic extract of *G. kola* ranges between 0.313 mg/ml and 2.5 mg/ml, MIC exhibited by *A. sativum* was 2.5 mg/ml while MIC that ranged between 0.313 mg/ml and 1.25 mg/ml was observed when the extracts were combined at equal proportion.
The study concluded that the crude extracts of *G. kola* and *A. sativum* exhibited potentials of synergy against pathogenic bacteria.

Themes— Antimicrobials, food and water purification

1 Introduction

The emergence and spread of microbes which are resistant to cheap and effective first-choice drugs had become a common occurrence. The problem is even more evident in bacterial infections which contribute most to the global infectious disease burden such as diarrheal, respiratory tract infection, meningitis, sexually transmitted infections, and tuberculosis [10]. This incidence has necessitated alternative therapy with the aid of medicinal plants due to their ability to produce a wide variety of secondary metabolites many of which have been reported to be of therapeutic value and this had attracted many scientists in finding solutions to the problems of multiple resistances to the existing synthetic antibiotics[3]. Such plants include *Allium Sativum* and *Garcinia kola.*

2 Method/Experiment/Body

Microorganisms used in this study were obtained from the department of Microbiology O. A. U. Ile Ife which include both typed and locally isolated organisms. These organisms

were both Gram positive and Gram negative.

2.1 Extraction process and phytochemical screening

The seeds of *Garcinia kola* and bulbs of *Allium sativum* were purchased from Central Market Ile – Ife. Seeds of *Garcinia kola* were air dried while the bulbs of *Allium sativum* were peeled, cut into pieces and oven dried at 45^0C. Both the dried seeds and bulbs were then ground into a fine powder. About 550g of powdered plant materials were soaked using 60% methanol separately for four days after which they were filtered. The extracts obtained were concentrated *in vacuo* using rotary evaporator and lyophilized. The methanolic plant extracts were screened for phytochemical parameters individually and in combination as described by Trease and Evans (2002).

2.2 Antibacterial screening and Minimum inhibitory concentration (MIC)

The susceptibility of the bacterial isolates to the plants extracts was determined using agar-well diffusion method [6]. Mueller-Hinton agar were uniformly seeded with standardized (0.5 McFarland) 18 h inoculum suspension. Three wells were bored in the agar medium using a sterile cork borer (6 mm diameter). The wells were filled with plant extract solution (50 mg/ml) and streptomycin (1 mg/ml) as positive control and later incubated at 37^0Cfor24h.
The MIC of the plant extract was determined using the method described by Akinpelu and Kolawole, (2004).

2.3 Combination studies of methanolic extracts of *Garcinia kola* and *Allium sativum*

The extracts were combined at equal concentration to make up the active concentration (50 mg/ml) and subjected to antimicrobial screening as described earlier after which MIC were determined. The fractional inhibitory concentrations (FIC) were derived from the lowest concentration of extracts combination permitting no visible growth of the test organisms [13]. The FIC value for each agent was calculated using the formula;

$$\text{FIC (extract A)} = \frac{\text{MIC of extracts in combination}}{\text{MIC of extract A alone}}$$

$$\text{FIC (extract B)} = \frac{\text{MIC of extracts in combination}}{\text{MIC of extract B alone}}$$

The interaction between the two extracts was evaluated by the use of the FIC indices which was calculated using the formulae;

$$\text{FIC Index} = \Sigma\text{FIC} = \text{FIC (extract A)} + \text{FIC (extract B)}$$

Combinations was classified as synergistic, if the FIC indices is < 1, additive if the FIC indices = 1, indifferent if the FIC indices is between 1 and 2 and antagonistic if the FIC indices is > 2 [7].

3 Results/ Discussion

Phytochemical screening revealed the presence of saponins, tannins, flavonoids, reducing sugar, alkaloids and steroids in *G. kola* while saponins, triterpenes and steroids were present in *A. sativum*.

The extracts of the plant materials individually and in combined form exhibited different degrees of antimicrobial activities. *Garcinia kola* at 50 mg/ml exhibited a broad spectrum antimicrobial activities which agrees with results of other researchers [1] thus validating the traditional use of the seeds in treatment of oral and respiratory tract infections. Methanolic extract of *A. sativum* at 50 mg/ml exhibited antimicrobial activities against only four bacteria isolates out of fifteen used in this study which are Gram positive. Absence of flavonoids, exposure to heat[5], geographical location and variation in the strain of *A. sativum* species may be responsible for limited antibacterial activity observed with *A. sativum* used in this study. When the plant extracts were combined at equal concentration to make 50 mg/ml, broad spectrum activity was obtained with the exception of *M. luteus* and this compared favourably with the standard antibiotics (Streptomycin) used in this study because their zones of inhibition fall within the same range (10-30 mg/ml). The MIC of the methanolic extract of *G. kola* ranges between 0.313 mg/ml and 2.5 mg/ml, MIC exhibited by *A. sativum* was 2.5 mg/ml while MIC ranging between 0.313 mg/ml and 1.25 mg/ml was observed when the extracts were combined at equal proportion.

The combined study using FIC Index, revealed synergistic effect on two Gram positive (*B. cereus* and *B. subtilis*) and three Gram negative (E. coli, *Salmonella* sp. and *Shigella* sp.) bacteria. The synergistic effect observed in this study could be attributed to the presence of flavonoids and polyphenolic compounds which had been reported to possess resistance modifying potentials.[4][11] The synergistic effect observed against Gram-positive bacteria may be due to blockage of cell division by inhibiting DNA synthesis and macromolecular synthesis (due to damage to cell membrane) as in *Bacillus subtilis*[9]. Bacterial efflux pumps are responsible for a significant level of resistance to antibiotics in pathogenic bacteria [8]. This could be the mechanisms by which some of the organisms used in this study adopt in responding to the antibacterial activity of combined methanolic extract of *G. kola* and *A. sativum*.

4 Conclusions

In this study, methanolic extract of *G. kola* was found to exhibit antimicrobial activities against both Gram positive and Gram negative bacterial isolates used and this indicate a broad spectrum potential.

The synergy observed between the methanolic extracts of *Garcinia kola* and *Allium sativum* is a significant finding demonstrating the therapeutic potentials of these plants especially against pathogenic bacteria (Salmonella and Shigella) often posing problems of drug resistance demonstrated the potential of these plant materials as a source of antibiotic resistance modifying compounds. Considering these significant findings, this research therefore concludes by recommending the need to establish the molecular basis of these interactions.

A Appendix

Synergistic interaction of the combined methanolic extract of *Allium sativum* bulb and *Garcinia kola* seeds

Bacterial isolates	Mean FIC (*G. kola*)	Mean FIC (*A. sativum*)	FIC Index	Interaction
B. cereus (NCIB 6349)	0.06	0.13	0.19	Synergism
B. subtilis (NCIB 3610)	0.50	0.13	0.63	Synergism
E. coli (NCIB 86)	0.25	0.25	0.50	Synergism
Salmonella (LIO)	0.13	0.13	0.26	Synergism
Shigella (LIO)	0.50	0.25	0.75	Synergism

Key: LIO = Locally Isolated Organisms, NCIB = National Collection of Industrial Bacteria

Acknowledgments

I am grateful to my supervisor, Prof. Olu Odeyemi for his unflinching support and commitment to the attainment of this feat.

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Utilization of Bambara (*Vigna subterranea* (L) Verde) nuts for Tannase Production by a novel *Bacillus pumilus* strain AJ-2 MF083685

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Plate 1: Deteriorated Bambara Nuts

Abstract
Women form the largest percentage of bambara nuts sellers in the Nigerian markets. Bambara (*Vigna subterranea* (L) Verde) nuts also known as bambara beans have a lot of nutritional and health benefits to man. In addition to all the health benefits, deteriorated bambara nuts plays host to lots of microbial isolates which are useful for industries. The aim of this study is to investigate the untapped potentials of some Nigerian isolated bacterial species from Bambara nuts. Molecular identification of the tannase-producing bacteria isolate revealed *Bacillus pumilus* strain AJ-2. Tannase was produced extracellularly by submerged fermentation. The tannase produced by bacterial isolate Code G had a total activity of 2.340 Units, a specific activity of 3.21Units/mg protein for crude and a total activity of 1.770 Units and specific activity of 4.19Units/mg and a yield of 75.6% after ammonium sulphate precipitation at 48h of incubation. Optimum activity of the bacterial tannase was at a pH of 6.0, temperature of 35^{o}C and substrate concentration of 1.2% (w/v). This research established tannase production from a novel *Bacillus pumilus* strain AJ-2 obtained from deteriorated bambara (*Vigna subterranea* (L) Verde) nuts. The study contributes to the identification of microbial species producing tannase with potential application in biotechnology

Theme— Food security

1 Introduction

Bambara nut (*Vigna subterranea* (L.) Verde is indigenous to sub-Saharan Africa where it is widely cultivated. Bambara nut is known as izindlubu (Zulu, South Africa); Jugo beans (South Africa); Ntoyo cibemba (Zambia); Gurjiya or Kwaruru (Hausa, Nigeria); Okpa (Igbo, Nigeria); Epa- Roro (Yoruba, Nigeria); Nyimo beans (Zimbabwe). It is the third most important food legume after groundnut (*Arachis hypogea*) and cowpea (*Vigna unguiculata*) in Africa [1]. Tannase was discovered accidentally by Van Tieghem in 1867 [2]. Tannin acyl hydrolase EC 3.1.1.20 is an inducible and extracellular enzyme that catalyzes the cleavage of ester and depside bonds in hydrolysable tannins such as tannic acid to release glucose and gallic acid [3]. Tannase is solely responsible for the degradation of hydrolysable tannins and it suppresses its anti-nutritional activities [4]. Apart from nullifying tannin negatives, tannase has greater application in the feed, food and pharmaceutical industries [5]. In view of the growing demand of tannase and its potential applications in food, pharmaceutical and chemical industries, it is necessary to isolate new bacterial strains capable of producing high yields of the enzyme [6].

2 Method/Experiment/Body

Cream coloured coats of Bambara nuts were purchased from Ota market, Nigeria and transported to the Microbiology laboratory of Covenant University, Ota Nigeria for analysis. Sample processing was done according to modified method [7].

2.1 Identification of Isolate

The bacterial isolates were subjected to various biochemical tests and molecular identification. The isolates were grown and screened for the production of tannase according to the method of [8]. PCR Amplification of the 16srRNA gene (27F and 1492R) was carried out and all PCR products sent to Epoch Life science (USA) for Sanger sequencing.

2.2 Tannase Production and Characterization

Tannase producing isolates were identified based on clear zones of hydrolysis around the colonies on the agar plates. DNA extraction was carried out on the isolate, the purity and concentration of the extracted DNA was evaluated using a Nanodrop (ND 1000) Spectrophotometer (Thermo Scientific, USA). Tannase assay was carried out according to the method of [9]. The enzyme was partially purified using Ammonium Sulphate Precipitation and the enzyme was characterized to obtain optimum temperature, optimum pH and substrate concentration

3 Results

The results of this investigation revealed seven pure bacterial isolates (A, B, C. D, E, F, G) from deteriorated Bambara nuts (Plate 1). Diameter of Zones of Hydrolysis of Tannase Producing Bacteria revealed isolate G as having the highest zone of hydrolysis. Optimum activity of the bacterial tannase was at a pH of 6.0, temperature of 35^{o}C and substrate concentration of 1.2 % (w/v). The tannase produced by bacterial isolate Code G had a total activity of 2.340 Units, a specific activity of 3.21Units/mg protein for crude tannase and a total activity of 1.770 Units, specific activity of 4.19Units/mg and a yield of 75.6% after ammonium sulphate precipitation after 48h of incubation. Molecular characterization revealed isolate code G as *Bacillus pumilus* strain AJ-2.

4 Conclusions

This study reports the isolation of tannase producing bacterium from Bambara nuts. The organism was identified as *Bacillus pumilus* strain AJ-2 with NCBI GeneBank Accession number MF083685. This study will give the women dealing directly with the buying and selling of bambara nuts in Nigeria, a different view of the different uses of bambara nuts as well as adding to existing reports on bacterial tannase.

A Appendix

Estimation of Proteins [10]

Acetylation of Cellophane Tubing [11]

Acknowledgment

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Effect of hydrocarbon pollution on microbial diversity and implication for bioremediation

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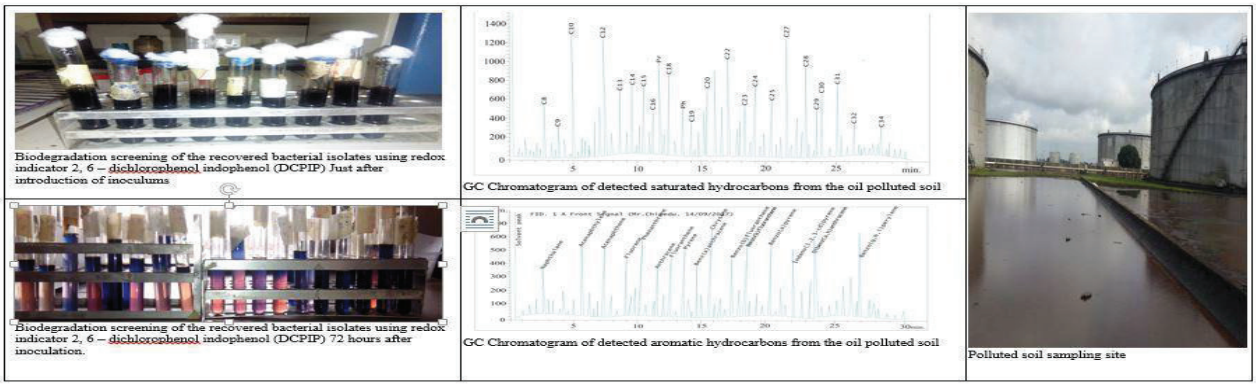

Abstract
Crude oil pollution threatens environmental sustainability, diversity and overall public health. The aim of this research was to determine the effect of hydrocarbons pollution on microbial diversity and richness and to investigate their role in eco-restoration. Hydrocarbons polluted soil samples was collected from the Port Harcourt Refining Company Limited, Nigeria. The microbial diversity of the polluted soil was compared to that of a pristine soil. Total Petroleum Hydrocarbons (TPH), Polycyclic Aromatic Hydrocarbons (PAH), pH, nitrate, phosphate, potassium and total carbon content were among the physicochemical parameters measured. The mean total heterotrophic bacterial and total fungal counts for the polluted soil was 1.3×10^5 cfu/g and 1.5×10^3 cfu/g respectively. The pristine soil mean bacterial count was 6.1×10^5 cfu/g. Seventy nine percent of the total bacteria in the polluted soil were able to utilize Okono medium crude oil. The indigenous microbiome adapted to the distinct prevailing environmental conditions, as T-test analysis of microbial richness between the polluted and pristine soil showed no statistical significant differences. The results obtained from this study will be useful in optimizing sustainable eco-restoration techniques.

Themes— Sustainability, Diversity, Remediation.

1 Introduction
Petroleum provides for most of the world's energy needs. Crude oil exploration, production, transport and processing to usable products carries with it negative impact on the environment. Operational spills, accidents, storage, sabotage and artisanal refining are some of the sources of hydrocarbons pollution. Hydrocarbon pollution has become a global environmental challenge because of the highly toxic nature of its chemical constituents. Some of its constituents have been shown to be mutagenic, carcinogenic and teratogenic [1].
Bioremediation is a technology that involves optimizing microbial processes and some physicochemical parameters. It is considered the most cost effective, efficient and environmentally friendly method for the recovery of hydrocarbons polluted sites [2]. Therefore, the development of suitable models and remediation procedures for *in situ* recovery of oil polluted sites will depend on understanding the class of hydrocarbons that constitute that particular spill and the microbial and functional diversity within the spill site.

2 Method/Experiment/Body
2.1 Site description/sample collection
Soil samples polluted with refining effluent were collected from 0 to 30 cm depth using soil auger from Port Harcourt Refining Company limited, Port Harcourt, Nigeria. Soil samples were also collected from a pristine soil approximately 200 metres away from the refinery.
2.2 Physicochemical analysis
TPH and PAHs fractions of the soil was determined using Gas chromatography. Total nitrogen, phosphate, potassium, total organic carbon, pH and electrical conductivity was analysed using the methods of APHA 4500 and ASTM D1691.
2.3 Microbial enumeration and characterization
One gram of crude oil polluted and pristine soil was diluted (tenfold) and plated out in duplicates on plate count Agar (PCA), Bushnell Haas agar and Malt Extract Agar (MEA) for determination of total heterotrophic bacteria, hydrocarbon
utilizing bacteria and total fungal counts respectively. Individual bacterial and fungal isolates were tentatively identified by biochemical and morphological methods.
2.4 Crude oil utilization screening using redox indicator

2, 6 – dichlorophenol indophenol (DCPIP)
The bacterial cultures from the polluted soil were screened for biodegradability of okono medium crude oil based on the redox indicator DCPIP. Test tubes containing 9 ml of Bushnell Haas broth, 500 µl of DCPIP and 1000 µl of okono medium crude oil was inoculated with 500 µl of the test organisms in duplicates and incubated at 30 ^{O}C. The hydrocarbon utilization screening was monitored at interval of 24 hour till 120 hours

3 Results/ Discussion
Analysis of total petroleum hydrocarbons in the polluted soil revealed the presence of C8 – C34 hydrocarbons with a TPH concentration of 16754.71 (mg/kg). The total PAHs concentration in the polluted soil was 7809.83 (mg/kg). Polycyclic aromatic constituents like Benzo(a)Pyrene known to be mutagenic and carcinogenic [1] were also detected. The variation in pH of the pristine and polluted soil was 0.36 units, thus would not have played an important role in determining microbial composition or richness.
The mean total heterotrophic bacterial and total fungal counts for the polluted soil was 1.3×10^5 cfu/g and 1.5×10^3 cfu/g respectively. The pristine soil mean bacterial count was 6.1×10^5 cfu/g while the total fungi was 1.9×10^3 cfu/g. Seventy nine percent of the total bacteria in the polluted soil were able to utilize Okono medium crude oil. Only 11 percent of the total bacteria in the pristine soil were potential crude oil degraders. T-test analysis of the microbial counts from the polluted and pristine soils was not significant at $P \leq 0.05$. This is an indication that the microorganisms in the two distinct communities adapted fairly well to the available substrate and prevailing physicochemical conditions. Several studies have shown that crude oil contamination triggers a microbial community shift and an enrichment of hydrocarbon degrading microbial species [3,4].
Crude oil degradation screening using redox indicator 2, 6 – dichlorophenol indophenol (DCPIP) showed 25 out of 33 isolates recovered from the polluted site could utilize crude oil at varying rates (Fig 2). Statistical analysis using One Way Anova and Turkey's Multiple Comparison Test revealed *Pseudomonas* sp. (Isolate UB 2) and *Achromobacter* spp. (Isolates UB4 and UB29) utilized okono medium crude oil at a significantly different rate. These organisms could be used to develop a specialised consortium for degradation of crude oil spills from oil processing facilities. While this study has enabled the screening of specialised hydrocarbon degrading organisms, developing a workable consortium and a remediation programme will require looking at the total picture of the microbial functional dynamics following changes in the chemistry of the polluted medium using both culture and predictive metagenomics approaches.

4 Conclusions
The high concentration of TPH and PAHs only affected microbial diversity but not the abundance of specialised organisms.
Three bacterial isolates showed significant differences in their crude oil utilization rates, these organisms could be used for the development of a viable hydrocarbon degradation consortium.
The findings from this study will be vital in optimizing bioremediation processes *in situ*.

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Oil Price Uncertainty and Economic Activities in South Africa

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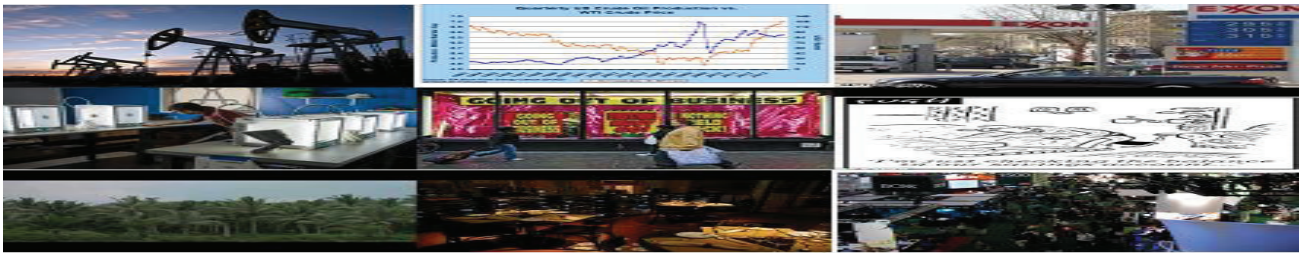

Abstract
This paper investigates the link between oil price uncertainty shocks and key macroeconomic indicators of a net oil importing country, South Africa. Monthly data covering the period 1990:01 to 2015:12 is used. The Structural Vector Auto-regressive (SVAR) methodology is applied incorporating realized volatility as an indicator of oil price uncertainty to investigate the short run effects of oil price uncertainty. The results reveal the significant role of exogenous oil prices on the economy of South Africa when price uncertainty shocks exist. These findings have policy and practical implications.

Themes—Disaster management, Clean energy

1 Introduction

The biggest risk facing companies in the oil and gas sector is uncertainty about energy prices. This makes it difficult to calculate the economic benefit of investments over a project's life cycle and may hence impact on economic activities. The characteristic relationship between oil price and macroeconomic activity remains one of the key, debatable and inconclusive subjects in energy economics [1]. Incidences of low growth, high inflation and unemployment, occurred in most developed economies in the early and late 1970s making oil price changes a significant cause of concern for policymakers [2]. Sharp oil price changes affect various economic activities depending on the degree of uncertainty created by oil price volatility, and the attitudes of economic agents towards uncertainty [3, 4]. We analyse the effect of oil price uncertainty by looking at the overall performance of the economy focusing on several macroeconomic variables. This is lacking in most previous studies including the South African ones which focus on bivariate relationship [4, 5, 6, 7, 8, 9]. We also extend [2] by using a theoretical based model: Structural Vector Auto-regressive (SVAR) model.

2 Method

This section presents the data used and the empirical model for analysis.

2.1 Data

The study uses monthly frequency data spanning from January 1990 to December 2015. Industrial production index (IP_t) obtained from OECD Statistics was used as a proxy for output. Inflation $(INFL_t)$ is calculated from consumer price index (CPI) thus multiplied by 100, where CPI is acquired IFS. Also Money $(M2_t)$ and Trade balance (TB_t), found by subtracting the aggregate imports from the aggregate exports are from IFS. Real effective exchange rate (ER_t), short term interest rate (IR_t)were from Quantec. WTI daily crude oil prices are
from EIA. The proxy for oil price uncertainty is the realised volatility (RV_t) built from daily crude oil future prices.

2.2 Empirical Model

Structural Vector Autoregressive (SVAR) approach is used. The ordering is: realised volatility, industrial production, trade balance, M2, interest rate, exchange rate, and inflation. However, to avoid the problems that may come with ordering of variables the mean of Generalised Impulse Response Functions (GIRF) and Generalised Forecast Error Variance Decompositions (GFEVDs) are used in the analysis.

3 Results/ Discussion

The preliminary results of the VAR estimates indicate that the residuals are stationary and also not serially correlated[1]. The impulse response function shows that output responds negatively to the oil price uncertainty shock This may imply that when uncertainty exist around oil prices a decline in output is likely to occur due to discouraged investments. As expected inflation is seen to shoot immediately after the oil price uncertainty shock attaining the peak level in the third month and then declined. This suggests that the oil price uncertainty shock may cause inflationary pressure on the South African economy. The Money balances (m2) response to oil price uncertainty shock observed is at first

[1] These results are available from the authors upon request.

positive thus rising above levels of oil price shocks. After a 2 months lag the money balances returns its tendency.

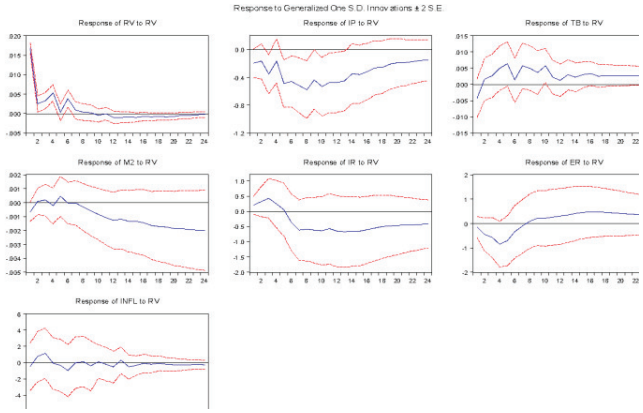

Figure 1: Generalised Impulse Response Functions

The immediate response of trade balance to a shock in oil price uncertainty is positive which may be due to a temporary postponement of energy imports. On the other hand, the response of short term interest rate indicates an immediate increase after the oil price uncertainty shock reaching a peak in month 3. The real effective exchange rate appreciates instantaneously subsequent the shocks to realised volatility up to the fourth month. After the fifth month it declines slowly and revert its tendency in the 7 month and depreciating over the next 24 months.

The results of the GFEVDs over a 24 months forecast horizon shocks 1 show that oil price uncertainty shock explains between 0.33 and 5.04 percent variations in domestic output over the 24 months horizon. The same pattern is also observed for the all the variables.[2]

4 Conclusions

The study empirically examines the short run effects of oil price uncertainty shock on the macroeconomic variables of South Africa from January 1990 to December 2015. The SVAR methodology is applied incorporating realized volatility as an indicator of oil price uncertainty. The results reveal that South African economy still remains greatly affected by the international oil price uncertainty shocks with significant adverse effects on output. This suggest that policy makers should always be alert on matters linked to oil price uncertainties so that they can be able to manage expectations of economic agents in order to steer expected outcomes of the South African economy.

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[2] Results are available from authors upon request.

The perceived benefits of attending a leadership development programme for women engineering students at a South African university

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Abstract
There is a global awareness of the shortage of women in STEM fields. The university, where this study is situated, responded to this global situation by establishing the Women in Engineering Leadership Association in 2011. In 2013, WELA registered a two-year leadership development (LDP) programme for women engineering students belonging to WELA. This paper will explore the perceived obstacles to entering the engineering field as listed by first year female engineering students. These will be compared to the benefits reported by WELA members based on data obtained from feedback questionnaires on conclusion of each year of the WELA LDP. This study can contribute to the development of interventions to retain, support and develop women in traditionally male dominated fields.

Themes— Education and outreach, Gender studies

1 Introduction

Many organisations make gender diversity a priority by designing training and development programmes and interventions. Often large amounts of money and time is spent on building a robust pipeline of upwardly mobile women without great success [1]. Ibarra et al., (2013) proposed that traditional high potential, mentoring and leadership education has a very important and necessary role, it is however not enough. They suggest three additional actions to improve the chances "that women will gain a sense of themselves as leaders, be recognised as such and ultimately succeed" [1]. The three actions are to, firstly, internalise a leadership identity and develop a sense of purpose. This is an iterative process and develops as a person asserts leadership and others affirm or resist the action. Secondly, people must be educated about second-generation bias, as women are often unaware of being victims of gender discrimination. Second-generation gender bias is often embedded in stereotypes and organisational policies and practices which can make it hard to detect. However, if men and women are aware of it, there are possibilities for change [1]. Thirdly, a safe space for learning, experimenting and community are important issues in ensuring a successful leadership development programme for women. A safe setting is an important factor in developing a strong leadership identity. Company support and development is important to retain women engineers, as is estimated that at least 70% of women engineering graduates reportedly felt isolated in their workplaces and consequently left the sector [2]. To prepare WES for the workplace and in an effort to retain, support, develop and grow women in engineering, WELA designed a two year LDP for women engineering students (WES) studying at the university.

The underlying premise of the WELA programme is to developing feelings of self-efficacy to assist WELA members to cope with the challenges of being employed in a traditionally male dominated field [3]. When WES were asked at the beginning of their academic studies what they perceived as obstacles or challenges to entering the engineering field, their greatest concerns related to a perception that they might not be taken seriously in the workplace, that they might be underestimated and undermined. Other concerns are sexism, not seen as equal but weak, being made to feel inferior and being judged in terms of their abilities and actions for being women.

The WELA programme aims to address and minimise the fears and concerns of WES and to develop coping strategies for dealing with the gender related issues that can potentially face them in the world of work. Achieving this, can contribute greatly to retention of women in this scare skills area. More women in the field will lead to more role models that can encourage young girls to consider engineering as a career. To reach these objectives, the WELA LDP consist of several developmental, personal growth, and engineering related short courses and workshops. Senior WELA members are trained as mentors to junior WELA members and WELA members take part in several community projects. Yearly feedback is obtained from WELA members to establish if WELA is meeting its goals and addressing the fears and concerns listed in their first year.

2 Method

At the end of every year, WELA members are asked to complete a feedback form. The paper feedback form is completed at the end of the last WELA activity scheduled for the academic year. They are asked to rate every workshop and activity, asked to name the personal benefits they experienced by joining WELA, to make suggestions for improvement, and to answer various questions regarding the mentorship programme. This research reports on perceived personal benefits derived by WELA members and on their overall rating of the WELA programme. The questionnaire was presented to both senior and junior WELA members at the end of the academic year. At this stage they could have completed either one, or two years of the LDP. Questions were structured around each activity of the WELA programme, and the aim was to establish the success of each activity. The 2014 and 2015 cohort of WELA members, totalling 56 respondents, completed the

questionnaires reported on in this study.

3 Results and Discussion

WELA members were asked to list the personal benefits they felt that they have gained from attending the WELA programme. Students were allowed to list more than one benefit. Thirty one percent of respondents indicated that they experienced personal growth, greater self-knowledge, and an improved sense of maturity because they were able to acknowledge and address their personal shortcomings. Twenty percent of respondents experienced a perceived increase in self-confidence, assertiveness and acceptance of who and what they are, 16 percent felt that they acquired new leadership skills and other skills such as time and conflict management skills. They also reported that the support from WELA members and management benefitted them and they were able to make more friends due to belonging to WELA (11%). Seven percent reported workplace skills and communication as benefits and a very small percentage (1% respectively) reported cross discipline knowledge, the ability to influence others as mentors in addition to increased compassion, understanding and tolerance towards people who are different from themselves. WELA members were asked to rate the overall effectiveness of the WELA programme in terms of the benefits they derived from being a WELA member, how it prepares them for being a student in a male dominated field and how they perceived it prepared them for the world of work. Based on the results, it became evident that WELA members highly rated and valued WELA membership (93%) in terms of personal development and growth, preparing them for studying and entering traditionally male dominated fields.

4 Conclusions

This research aimed to illustrate the benefits of developing interventions, such as WELA and the WELA LDP in an effort to enhance WES growth and development. It is proposed that support and development can lead to retention of women in traditional male dominated fields and provide them with the tools to manage their perceived obstacles and challenges in terms of studying and entering these fields. While is it assumed that these skills will be transferred to the workplace, it is important for organisations to acknowledge that development is required to retain women in the field of engineering. Organisations need to be cognisant of developing a leadership identity and a sense of purpose in potential in women engineers, address the culture of second-generation bias and create a safe space for learning, experimenting and community by involving mentors and coaches. Further studies on this topic will include a survey for early and mid-career women engineers to investigate their transition from student to employee, to establish if their perceived challenges and concerns materialised and if they were able to practice the skills taught and acquired while being active WELA members.

Acknowledgments

merSETA initiated the Chair in Engineering Development, and WELA is one of the five projects identified and supported to develop engineering in the Eastern Cape.

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Securing smart cities by smart card and fingerprint verification

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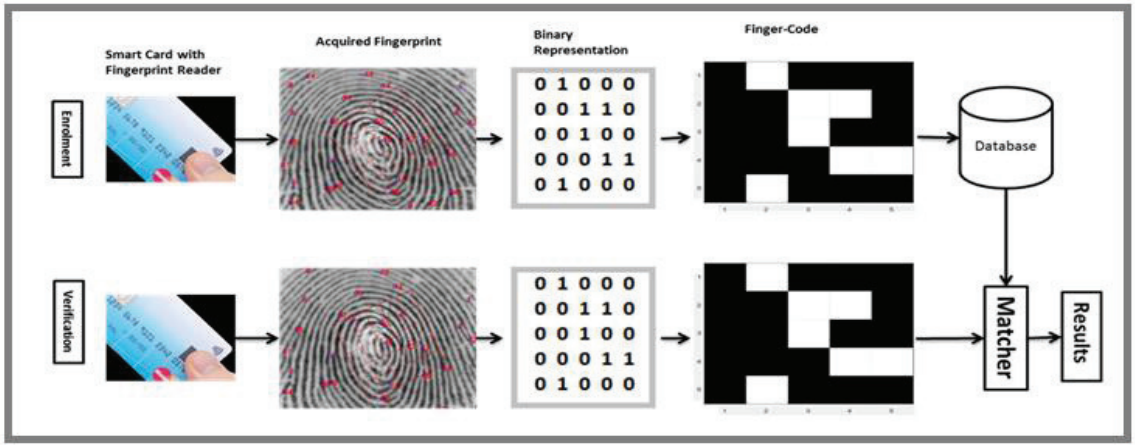

Abstract
The purpose of smart cities is to better the quality of people's lives by using technology that leads to smart outcomes. One way of improving the lives of people is by using online applications such as online banking and electronic purse. However, these applications need to be secured due to fraud. In order to eliminate fraud, biometric technology and smart card verification can be used to make the cities smarter. This paper presents a fingerprint matching algorithm that can be used for verification and identification to add security in smart cities. However, fingerprint verification has its own vulnerabilities. To overcome this challenge, the proposed approach uses the combination of the fingerprint verification and the smart card verification to secure the smart cities. The proposed fingerprint verification algorithm obtained matching accuracy of 81% using Fingerprint Verification Competition 2002 (FVC2002) database.

Themes— Smart cities

1 Introduction

The use of fingerprints in biometrics has gained popularity due to its success in law enforcement, maturity, and distinctiveness . Fingerprint verification is more secure as compared to the traditional usage of a smart card with Personal Identification Number (PIN) code and passwords. This is because PIN codes can be easily guessed, detected or stolen via fraudulent means . Fingerprint matching can be executed using minutiae-based matching. A minutia is a point in a fingerprint where the ridge terminates (ridge ending) or either divides to form two ridges (ridge bifurcation). Minutiae-based matching consists of minutiae extraction, minutiae comparison, minutiae pairing, and fingerprint matching. Fingerprint minutiae-based matching is effective and robust. However, it is not easy to revoke fingerprint once it is compromised and they fingerprint matching algorithms are not 100% accurate. The quality of the fingerprint extractor affects the fingerprint matching algorithm. This implies that poor quality fingerprint images degrade the matching accuracy of the fingerprint algorithms. The other challenges in fingerprint matching include distortion, partial prints, rotation, translation, missing, and additional minutiae.

The proposed approach presents a fingerprint matching algorithm using fingerprint verification and smart card verification to make smart cities safer. A smart city implements technologically advancement features to improve the lives of people and to improve quality of service in the city. A city with such technological innovations is required to have a robust security system . Hence, this study develops and implements a smart card and fingerprint verification system to make the smart cities safer.

In a circular neighbourhood minutiae algorithm which uses circular tessellation to generate a finger code (binary representations) was proposed. This method uses a core reference point as a central point to generate a circular tessellation and to align the query fingerprint and the enrolled fingerprint. The disadvantage of this algorithm is the computation of a core reference point which is not always reliably located in every fingerprint. To overcome this problem, a neighbourhood algorithm using multiple reference points was deployed . The advantage of this algorithm is that it does not depend on a single reference point to align the neighbourhood minutiae between the query fingerprint and the enrolled fingerprint.

This paper is organised as follows: Section 2 presents the methodology of the proposed approach for smart cities. Section 3 discusses the results and Section 4 presents the

conclusion of this paper.

2 Proposed approach

The proposed approach for securing smart cities requires a smart card verification and fingerprint verification. The smart card verification process is executed before the fingerprint verification process. A PIN code is used to verify whether the smart card is in correspondence with the PIN code. If the smart card verification process is successful, the fingerprint verification process is executed.

2.1 Fingerprint verification

The proposed fingerprint method uses multiple reference points to generate a finger code (binary representation). The use of multiple reference point is used to minimize the effect of distortion and translation during fingerprint verification. Each minutia is set as a reference point to generate a square tessellation that is in the direction of the current minutia orientation. This property is used to overcome rotation between the two fingerprint impressions of the same finger. The square tessellation (grid) is generated using 5*5 squares, the minutia in in the middle of the squares as a reference point. The square tessellation is converted into bit-strings using equation 1:

$$B(j) = \begin{cases} 1 & if\ minutia\ is\ present\ inside\ square \\ 0 & otherwise \end{cases} \quad (1)$$

where $B(j)$ represent the bit-string which is generating from the square tessellation. The matching algorithm uses Hamming distance to compare the rows in the query finger code and the enrolled finger code. Each bit-string in a finger code represents a minutia. After comparing the minutia, the total matching minutiae is computed, followed by the computation of the matching score. The query fingerprint is accepted depending on the chosen threshold.

3 Results/ Discussion

This algorithm is beneficial as it requires limited processing power and low memory consumption. The proposed approach obtained the matching accuracy 81% using FVC2002 DB1-b. This method needs improvements when it verifies partial prints and highly distorted fingerprints. However, the percentage of False Match Rate (FMR) in the system can be reduced by fusing the smart card verification with fingerprint verification to obtain the total matching score.

4 Conclusions

The world is experiencing the evolution of smart cities. Technological advancement takes place on a daily basis and they need to be secured. This work develops a fingerprint matching algorithm which is used with the smart card and PIN code to protect the innovations in the smart cities. In future, properties of distortion and partial fingerprints will be studied to enhance the fingerprint algorithm and the algorithm will also be tested on FVC2002 DB1-a.

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Effect of Application of Aqueous Extract Of Moringa Leaf On Growth And Yield Of Tomato (*Solanum Lycopersicum* L.)

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Plates showing tomato field (left) and ripe fruits of Roma savanna vf. (right).

Abstract
The response of two varieties of tomato to level of application of Moringa leaf extract (MLE) was studied in 2015 and 2016 at University of Ilorin Teaching and Research Farm Vegetable field. The experiment was 2x4 factorial laid down in Randomized Complete Block Design (RCBD) with three replications. The treatments comprised: Two varieties of tomato and four levels of MLE (tomato plant without MLE application(Control), application of MLE at 2 weeks after transplanting, Tomato sprayed at 2 and 4 weeks after transplanting and every two weeks till harvesting). Data collected on both vegetative and yield parameters were subjected to Analysis of variance using GENSTAT 17TH edition. Significant treatment means were separated using Least Significant Differences at $p<0.05$. The results showed that treatments significantly affected varietal responses at $p<0.05$ for majority of the parameters observed. Roma savanna had the best performance. Also, significant treatment effect of level of MLE application on root biomass, fruit number, fruit diameter, yield per plant and yield per hectare were observed. The study concluded that application of MLE at every two weeks and tomato variety 'Roma savanna' which responded better than Hausa local variety favour enhanced production of tomato.

Themes— Food security.

1 Introduction

Tomato (*Solanum lycopersicum* L.) belongs to the night shade, Solanaceae family is one of the most important vegetables worldwide. It is economically attractive due to its high yielding capacity in a short duration and high minerals especially iron, lycopene and phosphorus (2; 4). Tomato is ranked as one of the most important vegetable crops in West Africa. It is consumed principally due to its high concentrations of vitamins A, B and C, and fair concentrations of protein, calcium and niacin (2). The global production area for tomato in 2010 was estimated at 4.4million ha with world production estimated at 151.7million tonnes (1). However, the yield of tomato in West Africa particularly Nigeria is not encouraging, especially when compared to developed countries. Nigeria production was estimated at 1.86 million tonnes (1) which was estimated at 1/7th of that of the U.S.A (1). This low productivity may be related to crop types, soil, water, pest, diseases, high postharvest losses, lack of processing and market structure and fertilizer management.

Plant hormones can also be used to increase yield per unit area because they influence every phase of plant growth and development. Plant hormones are organic compound that help to regulate plant physiological process by directing the translocation and accumulation of nutrients in plants. Zeatin, one of the most common forms of naturally occurring cytokinin in plants was found in abundant quantity in Moringa. Extract from Moringa leaf is also rich in ascorbic acid, vitamin E, phenolic compounds, and minerals (3; 2;), capable of promoting plant growth; hence, it is used as a plant growth enhancer. Fugile (3) reported that Moringa leaf extract significantly increased the yield of onions, bell pepper, soya beans, sorghum, coffee, tea, chili, melon and maize when sprayed onto leaves. However, level of application of this extract has not been fully established. Therefore, the objective of this study was to examine the effect of level of application of moringa leaf extract on the growth and yield of two varieties of tomato.

2 Methodology

2.1 Experimental Design and plot layout

A field trial was conducted in 2015 and 2016 at the Teaching and Research Farm, University of Ilorin, Nigeria. The field was ploughed, harrowed, and prepared to a fine tilt with poultry manure incorporated into the field three weeks before planting. The trial was a 2x4x3 factorial arrangement laid down in a Randomized Complete Block Design with two tomato varieties (Hausa local and Roma savannah vf.) sprayed with MLE at four different levels:

control, at 2 weeks after transplanting (WAT) only, 2 and 4 WAT and every 2 WAT till harvest. All treatments were replicated thrice. Net plot size was $6m^2$ while the total gross experimental field covered $300m^2$. The tomato seedlings were raised in the nursery using buckets filled with heat sterilized soil. Four weeks old, healthy, vigorous and uniform size seedlings were selected and transplanted to the field. The inter and intra row-spacing of 40 x 50cm was used. The water extract from young Moringa leaves was obtained using a method developed by Fuglie (3).

2.2. Data collection and Analysis

Data collected include; Plant height, number of leaves, number of branches, number of flowers, number of fruits per plant, Fruit diameter, fruit yield per plant and fresh fruit yield/ ha. All data collected were subjected to Analysis of Variance using GENSTAT statistical software 17th edition. Significant means were separated where appropriate by the least significant difference at 5% probability level.

3 Results/ Discussion

The effect of level of spraying with MLE on some vegetative parameters of two tomato varieties were presented in table I. Varieties responded differently and significantly at $p< 0.05$ to the applied MLE treatment. Roma savanna had the best performance for all agronomic traits observed throughout the period of observation. However, frequency of application of MLE did not have significant impact on vegetative traits observed. Additionally, there was a high significant treatment differences at ($p<0.01$) for all the yield parameters with treatment – MLE applied every 2 weeks till harvest having the highest mean in all the parameters. This implies that the higher the frequency of application the higher the fruit number and size. This result supported that of Foidl (2) who reported that foliar spray of MLE in minute quantity increased yield and fresh fruit weight significantly. Roma savannah vf. had the best performance in terms of number of fruit /stand, fruit weight/ stand and yield/ ha. The performance of Roma savannah may be as result of the improvement in the genetic makeup over the hausa local.

4 Conclusions

The study concluded that application of MLE at every two weeks and tomato variety 'Roma savanna' which responded better than Hausa local variety favour enhanced production.

Acknowledged Nigeria Gov **Tetfund** for financial support.

Table I: Effect of level of MLE application on growth traits of two tomato varieties

Treatments	Plant height		No. of branches		No. of leaves	
	5WAT	7WAT	5WAT	7WAT	5WAT	7WAT
Variety						
Hausa Local	24.67^{b}	37.4^{b}	26.4	42.6^{a}	265^{a}	338.1^{a}
Roma Savanna	28.81^{a}	45.8^{a}	24.1	37.3^{b}	167^{b}	296.7^{b}
LSD $_{(0.05)}$	3.956*	5.28*	5.41^{ns}	4.75^{*}	43.2*	40.03*
MLE level						
Zero Application	27.00	44.6	25.3	39.1	226	312.0
2 weeks only	26.68	39.3	25.9	43.0	246	336.8
2 & 4 weeks only	27.22	41.9	24.0	37.0	193	293.7
Every 2wks till harvesting	26.05	40.6	25.8	40.7	198	327.0
LSD $_{(0.05)}$	5.594^{ns}	7.46^{ns}	7.65^{ns}	6.71^{ns}	61.1^{ns}	56.61^{ns}
Variety x MLE	n.s	n.s	Ns	ns	ns	n.s

* Means followed by different letters along a column are significantly different at p=0.05 ns = not significant. WAT= weeks after transplanting.

Table II: Effect of level of MLE on yield attributes of two tomato varieties

Treatments	No. of fruit per plant	Fruit weight per plant (g)	Numbers of fruit per plot	Yield/ ha (tons)
Variety				
Hausa Local	29.75^{b}	130.1^{b}	140.9^{b}	4.32^{b}
Roma Savanna	40.58^{a}	167.3^{a}	208.7^{a}	5.53^{a}
LSD $_{(0.05)}$	2.53*	15.87*	19.22*	0.546 *
MLE level				
Zero Application	32.17^{d}	133.4^{c}	166.7^{c}	4.40^{c}
2 weeks only	35.17^{b}	149.2^{b}	170.3^{b}	4.93^{b}
2 & 4 weeks only	33.00^{c}	127.7^{d}	162.8^{d}	4.22^{d}
Every 2wks till harvesting	40.33^{a}	184.7^{a}	199.3^{a}	6.14^{a}
LSD $_{(0.05)}$	3.575*	22.45*	27.19*	0.773 *

*Means followed by the different letters are significantly different

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Effect of supplemental phytase on true phosphorus digestiblility in cottonseed meal and rice husk-based diets in broiler chickens

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Images of cottonseed meal, rice husk and excess phosphorus in water bodies (left to right)

Abstract
Available phosphorus is limited in Plant-Derived Feed Ingredients (PDFIs) used in formulating diets for poultry. The PDFIs are characterised by low True Phosphorus Digestibility (TPD) and high Endogenous Phosphorus Loss (EPL) with negative environmental consequences. The potential of exogenous phytase in breaking Phytate-Phosphorus Complex has been documented. However, information on TPD and EPL in Broiler Chickens (BC) fed diets supplemented with phytase is scanty. Therefore, effect of phytase in Cottonseed Meal (CSM) and Rice Husk (RH)-based diets on TPD and EPL in BC were investigated. EPL was reduced at both sites of sampling (ileal and total tract sections). Addition of phytase clearly resulted in 13.27 and 17.94 percentage points increase inTPD; 12.29 and 13.61 percentage points increase in true retention of P (TRP) in birds fed CSM and RH diets respectively. Phytase supplementation reduced EPL and increased TPD in BC.

Themes— Education and Outreach

1 Introduction
Phosphorus (P) is an indispensable nutrient for plants and animals with limited bioavailability in plant-derived feed ingredients for poultry birds. Phytate ($C_6H_{18}O_{24}P_6$) is the principal storage form of phosphorus in plants and it chelates nutrients, minerals such as potassium, magnesium and calcium, which are necessary for phosphorus absorption. Supplementing poultry diets with phosphorus based on feed formulation calculations may lead to its deficiency or excretion of excess dietary phosphorus into the environment. Hence continuous measurement of P is needed to ensure greater utilization of dietary P and reduce the excretion of P into the environment. Estimation of EPL of some feed ingredients by the regression technique is important for determination of TPD of the ingredients in broilers (1). Hence, the need to develop a data base on the effect of microbial phytase on TPD values for CSM and RH-based diets.

2 Method/Experiment/Body
A total of 288, one-day-old Abor Acre broiler chicks, were fed a starter diet till day 20. On day 21, the chicks were individually weighed and allotted to 6 treatments in a randomised complete block design with 6 replicates of 8 birds each. Six semi-purified diets of 3 levels of Total P without and with phytase (1000FTU/kg,Natuphos, BASF Germany) were formulated .Titanium dioxide was added as a marker at the rate of 5g/kg of diet. The chicks were offered the diets and clean water *ad libitum* for 5 days. On days 25, 26 and 27 fresh excreta samples were collected from trays placed beneath each cage at 24-hourly intervals and dried at 55^{o}C using a force draught oven. On day 28, the birds were weighed, killed and digesta from the last 2/3rd of the ileum collected, pooled according to cages, frozen and dried for chemical anaalysis.

2.1 Chemical/Statistical analysis
Samples of CSM, RH, experimental diets, digesta and excreta were analysed for P using the dry-ash digestion method with nitric and perchloric acids. P and titanium concentration was determined using a colorimetric assay. True P digestibility or retention in CSM and RH was determined by regressing digested (PD) or retained P (g/kg DMI) against P intake (PI) (g/kg DMI) for diets with and without phytase supplementation using the linear regression model PD=(TPD×PI)±EPL. Regression coefficients (slopes) were compared between sampling sites for CSM and RH using a Student's t- test

2.2 A Literature Review
Dietary supplementation of phosphorus with exogenous phytase is effective in improving phosphorus digestion in poultry diets (2). Dilger and Adeola estimated the true ileal P digestibility of soybean meal for broilers using the

regression analysis technique where soybean meal was used as the sole dietary source of Ca and P. Studies were also conducted to estimate the TPD of black-eyed pea and peanut flour without or with phytase supplementation (1). Endogenous losses of a nutrient are in-evitable loss of that nutrient by the animal. By taking endogenous losses into account, the animal's actual P needs are better determined (3). Using the regression technique is pivoted on linear relationships between outputs of ileal and feacal P and dietary input levels suggesting that endogenous P are constant and independent of their respective dietary P levels (4)

3 Results/ Discussion

From the studies conducted, strong linear relationships were observed between digested P, retained P and dietary P intake. This relationship permits the determination of diet independent theoretical endogenous P losses (g/kg of DMI) and simultaneous measurement of TPD of the ingredient (3,4). Lower ileal and excreta P outputs were observed in birds fed supplemental phytase compared to birds fed experimental diets without phytase for the respective test ingredients (CSM and RH). There were reductions in Ileal and excreta endogenous P flow of birds fed the respective test ingredients with phytase. Phytase supplementation of the diets significantly ($P<0.001$) increased TPD and true retention of phosphorus (TRP) compared to values estimated for birds fed diets without phytase supplementation. Increase in dietary P intake resulted to increase in apparent digestibility of P in the test diets with phytase supplementation. These results show the efficacy of phytase supplementation in improving amount of digestible P in plant feedstuff and consequently reduce P loss from feed ingredient which confirms previous observations (1,3).

4 Conclusions

Phytase supplementation increased the availability of P from phytate-P complex in the investigated CSM and RH thereby increasing the TPD and TRP of P from the assayed feed ingredients in birds.

A Appendix

Cottonseed meal- Is the byproduct remaining after cotton is ginned and the seed crushed and the oil extracted
Rice husk- The hard protecting coverings of grains of rice

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Geographical distribution and physical access to public healthcare facilities

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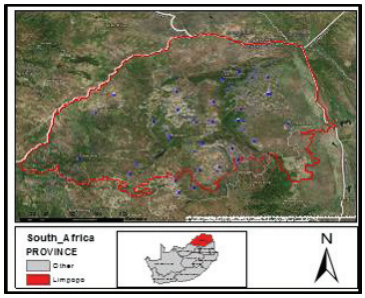

Figure 1 Study area location

Abstract
According to South Africa's Section 27 (1)(a) of the Constitution every person has the right "to have access to health care services, including reproductive health care". In reality however, this right has not been made available to everyone in the country, largely due to distortions in resource allocation. Many South Africans still do not have proper access to healthcare, reasons ranging from money, distance or travel time to care, long queues at facilities and the service the patients receive at public healthcare facilities. There is limited research that focuses on the physical or spatial accessibility to the Healthcare services. In Some instances, ambulances have failed to get to a patient in time due to a spatial barrier, be it lack of proper roads or delay in traffic flow. This paper aimed to use GIS to determine the physical accessibility to public healthcare facilities in two municipalities in Limpopo province.

Themes— Health.

1 Introduction

Healthcare is an important sector in any country and it is a large contributor to the overall measurement of the quality of life and welfare of a population (Tansley et al., 2015). In South Africa, having access to quality healthcare is part of the Section 27 constitutional rights of every South African (Gaede & Versteeg, 2011). However, this right has not been made available to everyone in the country, largely due to distortions in resource allocation. Many South Africans still do not have proper access to healthcare, reasons ranging from money, distance or travel time to care, long queues at facilities and the service the patients receive at public healthcare facilities. There is a need to improve access to quality and affordable healthcare services in South Africa. Access to health facilities can be seen as a measure of the efficiency of a regions health system (Kara & Egresi, 2013) as well as a measure of the standard of living within a given region (Merciu, et al., 2013). South Africa spends a significantly high amount of money on health outcomes, yet still has many areas with understaffing and poor health infrastructure issues. There are multiple strategies and policies aimed at improving accessibility in rural areas (Gaede & Versteeg, 2011).

Using Geographic Information Systems (GIS) to map accessibility can give researchers a clear view of the challenges the area's health system faces as well as how to make a positive change in this area by reviewing what other barriers to access are present (Fisher & Myers, 2011). Although equitable healthcare remains, an issue for many developing regions GIS studies allow for a speedy movement towards betterment. The aim of this paper is to measure the physical accessibility to healthcare facilities in two municipalities of the Limpopo province, South Africa.

2 Methodology

GIS was used to conduct various analysis using methods such as Cost-distance analysis, Euclidean distance analysis and Walking distance analysis. The data used for the research is secondary data in the form of vector and raster models. Raster based accessibility functions are known as distance mapping functions, which are divided into straight-line and cost weighted distance functions (McCoy and Johnston 2001). The straight-line distance function measures the straight-line distance from each cell to the closest source. The cost-weighted distance calculates distances based on the cost to traverse any given cell.

3 Analysis and Results

Spatial distribution of healthcare facilities

The paper focuses on government and tribal owned health facilities due to the fact that majority of the population in Limpopo province use state owned facilities. In Polokwane municipality, there are 37 healthcare facilities, of which 33 are clinics and three are hospitals. In Thulamela municipality, there are 57 health facilities, which are state owned with 44 clinics and 4 hospitals.

Majority of the healthcare facilities in the province are clinics (430). The clinic are spread out throughout the province. The spatial distribution analysis shows a limitation in specialised hospitals, with only 4 in total, three

specialising in psychiatric illnesses and only 1 TB specialised hospital.

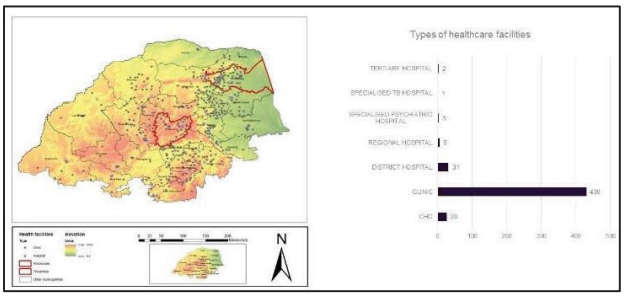

Figure 2 Spatial distribution of healthcare facilities

The Euclidean distance

Out of the 661 Towns or villages in Limpopo province, only 251 are within a 5km radius of a health facility. In Thulamela municipality, 90% of towns are within a 5km radius of a health facility. In the Polokwane Municipality, 83% of the towns or villages are within a 5km buffer. 17% of the towns are outside the 5km radius, with one town (Rietkalk) that is at a 15km radius. In both municipalities, there are no towns or villages that are outside a radius that of 15km.

3.1. The cost weighted distance

The cost-weighted distance calculates distances based on the cost to traverse any given cell. This analysis is intended to determine the time it would take to travel from a given point on the map to the nearest healthcare facility. In order to do this a cost layer was created. This cost layer uses a combination of driving time and walking time to create the cost (in time) that it takes to travel through a single raster cell at walking or driving speeds

Walking and driving time layers:

The time it takes to walk at an average pace of 5kmph through one 10mX10m cell was calculated. The formula was used:

$$\text{Walking speed} = \left(\frac{3600}{5000}\right) x10$$

With 3600 being the number of seconds in an hour and 5000 being the number of meters in 5 km. From the above formula, it takes 7.2 seconds to pass a single 10mX10m cell at a pace of 5kmph.

$$\text{Driving speed} = \left(\frac{3600}{60000}\right) x10$$

The average driving speed of 60kmph was used because usually clinics and hospitals are in populated areas that have a speed restriction of 60kmph. 3600 being the number of seconds in an hour and 60000 being the number of meters in 60km. From the above formula, it takes 2.4 seconds to pass through a 10mX10m cell while driving at an average speed of 60kmph.

The cost layer is created by combining the walking time layer and driving time layer to create a time cost layer that indicates which cells would take 7.2 seconds to walk through or 2.4 seconds to drive through. The two layers were combined to create the cost distance layer, figure 3 below. The lighter colours (which indicates the shorter travel times) are closely linked to the road networks. The driving time was made to cost less than the walking. It is faster to drive than to walk.

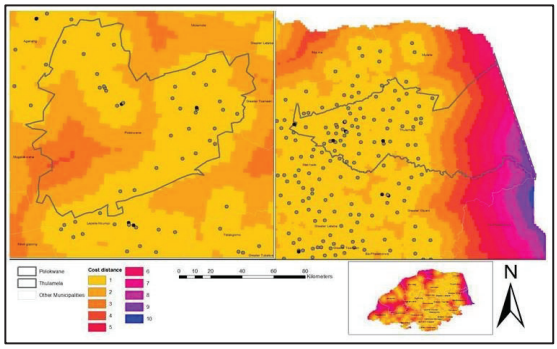

Figure 3 Results of the cost distance analysis

The cost of travelling was ranked from 1 to 10 in terms of travel time. The cheapest travel time being 1 and the longest travel time being 10.

4 Conclusions

The aim of this paper was to measure the physical accessibility to healthcare facilities the Limpopo province, South Africa. The municipalities were chosen based on their category classifications, in order to be able to compare results from an urban municipality to that of a rural municipality.

The results showed that majority of towns or villages are located within a 5km radius of a health facility. This According to CSIR guidelines, (2012), meet the recommended serving radius of healthcare facilities. The cost weighted distance was used to determine the time it takes to travel from any given cell. The study found that there is not much disparity between the two municipalities in terms of distance to healthcare.

Accessibility also needs to be calculated using non-physical variables such as physician-patient ratio, social class, income, ethnicity, age, sex, etc. Future work, involves incorporating potential use versus revealed use of healthcare facilities, aspatial accessibility. To add to the results of physical accessibility, the use of cadastral data or household data will be incorporated.

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Multiple drug resistance of *Campylobacter jejuni and Shigella* isolated from diarrhoeic children aged under five years admitted at Kapsabet County Hospital, Kenya

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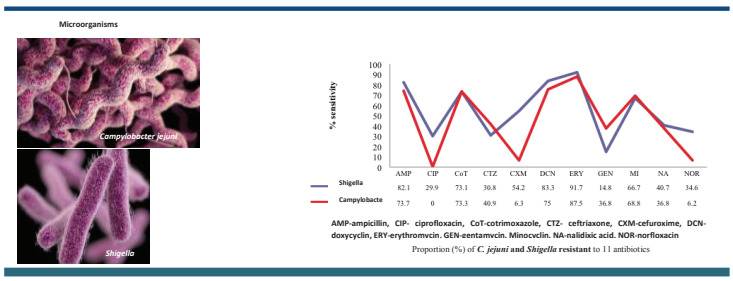

Abstract

Diarrhoea, a common cause of mortality and morbidity in children under five years of age has a case fatality of up to 21% in Kenya with Enteropathogenic *E. coli, Campylobacter jejuni*, *Shigella* spp. and *Salmonella* spp. accounting for 50–60% of the cases. Although most diarrheal diseases are self-resolving and should not be treated with antimicrobial agents, invasive or protracted infections require chemotherapy and are typically managed empirically. However, over the years, sulphonamides, tetracycline, ampicillin and trimethoprim/ sulphamethoxazole that are typically used in the management of diarrheal illnesses have become ineffective in the face of emerging resistance. The objective of this study was to determine the prevalence of *Campylobacter jejuni and Shigella* spp. in children under five presenting with diarrhea at Kapsabet hospital, Uasin Gishu county in Kenya and to evaluate their antibiotic susceptibility.

Themes— Public Health Sciences

1 Introduction

In Kenya, diarrhoea is the third most common cause of mortality and morbidity with a case fatality of up to 21 % [1]. On average 50–60% of cases are caused by bacteria, specifically Enteropathogenic *E. Coli* (25%), *C.jejuni* (10–18%), *Shigella* spp. (5%) and *Salmonella* spp. (5%) while 35% are viral [2]. Recent surveys indicate that of the 165 million cases of *Shigella* diarrhoea that occur annually, 99% occur in developing countries with 69% in children under five years of age [2]. The use of antibiotics for the successful treatment of infectious diarrhea has been severely compromised due to the emergence of multidrug-resistant bacteria, a problem that has been acknowledged on a global scale [3]. One class of antibiotics whose clinical efficacy is particularly diminished due to an increase in the prevalence of resistant bacteria is the aminoglycosides such as streptomycin, gentamicin, tobramycin, kanamycin and amikacin [4]. The aim of this study was to evaluate the drug resistance patterns of *C. jejuni* and *Shigella* spp. and to determine their prevalence as causal pathogens of diarrhoea in children, admitted at Kapsabet County Hospital.

2 Method/Experiment/Body

Study site and population**:** The study was done at the Kapsabet County Hospital in Nandi County, Kenya. The target population comprised of 144 children admitted at the paediatric ward 5 with diarrhea during the study period.

Specimen collections**:** Faecal samples were aseptically collected from 144 cases recruited during the period of study out of which 139 were subjected to the investigations; representing 97% of the total cases observed in the area of study.

Bacteriological procedures: Each specimen was examined macroscopically for colour, texture and presence of any extraneous material, (blood, mucus or watery). Bacterial enteric pathogens were isolated and identified using standard bacteriological methods. Conventional bacteriological tests (catalase, oxidase, hippurate hydrolysis, urease, hydrogen sulphide production and susceptibility to nalidixic acid) were performed to confirm the genus and differentiate at the species level. Selective media (MacConkey (MaC)) and Salmonella-*Shigella* (SS) agar) were used for the recovery of *Shigella*. Non Lactose Fermenting colonies, growing on MacConkey and SS were subjected to selected Biochemical Tests namely; Hi-IMViC/HiASSORTED tests (KB001 and KB002 [HIMEDI-INDIA]), and also Triple Sugar Iron.

Susceptibility testing: Susceptibility categorization was carried using the Kirby- Bauer Disk diffusion method.

Data analysis: Data was analysed using SPSS Version 20. The chi-square - test and Pearson Correlation Coefficient were used to perform and establish any statistical difference among the variables of interest.

3 Results/ Discussion

The prevalence of cases of diarrhea at Kapsabet, Kenya of known aetiology was 33.1% of study population. This implies that 67% of patients did not yield any bacterial isolate, perhaps because other diarrhoeal causal agents such as viruses were not considered during the study, and or the individual parents/guardians may not have made fully disclosure of antibiotic exposure prior to enrolment/participation in the study.

In our study *C. jejuni* was isolated at almost half the frequently as of *Shigella* indicating that shigellosis is more prevalent in rural communities [2]. An increased trend in prevalence has also been reported by World Health Organization, that demonstrates a regular increasing trend of *Shigella* in sub-Saharan countries in the last ten years [5]. The number of isolations for *Shigella* increased with age and reached significant percentages in the 24-35 months age category for both male and female children. The lower shigellosis rate among children under age 1year old may be attributed to the protective immune properties of breast milk or the exclusion of *Shigella*-contaminated foods from their diet. The increased number of shigellosis cases seen after age 1 year, when children are no longer breast feeding likely reflects the lack of natural anti- *Shigella* immunity of recently weaned children. It is possible from this study that children with *C. jejuni* infection/diarrhoea at 39.1 %, may be associated with ingestion of contaminated milk and water, also considering the socio-cultural backgrounds of the community in the study area, where it is reported to be closely associated with domestic animals.

C*ampylobacter jejuni* was resistant at a rate of more than 50% for over five of the drugs tested, indicating a high degree of multiple drug resistance. The fact that *Shigella* spp. showed high resistance levels for ampicillin (82%), cotrimoxazole (73%), erythromycin (91.7%), minocycline (66.7%) and doxycycline (83.3%), illustrated that these may not be drugs of choice in the management of bacillary diarrhoea and the specific enteric bacterial illness in the study area. Low resistance to ciprofloxacin, norfloxacin, ceftriaxone and cefuroxime indicates that these drugs may be more effective; and confirms further the current evidence which supports the use of ciprofloxacin, ceftriaxone, and Nalidixic acid for treatment of bloody diarrhoea [2].

4 Conclusions

The findings of high rates of resistance of *Shigella* spp. to co-trimoxazole, which is the first line drug recommended treatment, demands that a renewed effort be made to seek antibacterial agents that are effective against pathogenic bacteria resistant to current antibiotics and that to successfully manage the threat associated with multidrug-resistant infectious diseases, innovative therapeutic strategies need to be developed, such as the enhancement or potentiation of existing antibiotics against resistant strains of bacteria.

Acknowledgments

We are most sincerely grateful to the parents and guardians who consented to have their children participate in this study. We also thank the entire staff at Kapsabet County Hospital for supporting this study.

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Antioxidant-Rich Biscuit from an Underutilized Crop to Combat Oxidative Stress

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Samples	ANTIOXIDANTS			SENSORY ACCESSMENT		
	Total Phenol (mgGAE/g)	Total Flavonoid (mgQE/g)	OH (mg/ml)	Colour (9)	Taste (9)	Overall acceptability (9)
PM100	5.84±0.02e	1.20±0.02e	2.24±0.02^{a}	5.96±0.92^{e}	7.50±1.18^{a}	7.70±.95^{a}
PM95:OP05	8.32±0.03d	3.34±0.01d	2.13±0.00^{b}	6.27±0.99^{d}	7.50±0.85^{a}	7.40±0.70^{ab}
PM90:OP10	9.60±0.05c	6.27±0.01c	1.97±0.01^{c}	6.80±1.43^{c}	6.10±1.29^{b}	6.50±1.18^{bc}
PM85:OP15	10.32±0.01b	7.84±0.02b	1.80±0.03^{d}	7.19±1.48^{b}	4.40±1.71^{c}	5.70±1.06^{cd}
PM80:OP20	11.87±0.03a	8.12±0.03a	1.72±0.01^{e}	8.60±1.43^{a}	3.00±1.56^{d}	5.10±1.60^{d}

Values represent means of triplicate (n=3). Values with the same alphabet along the same column are not significantly different (p>0.05). PM100 (Control), PM95:OP05 (5%), PM90:OP10 (10%), PM85:OP15 (15%) and PM80:OP20 (20%). PM – Pearl millet, OP – Orange Peel Flour.

Abstract

Orange peels, which consist of valuable bioactive compounds could play an important role in the management of degenerative diseases. This study investigated the effect of orange peel powder (OP) at different level of substitution (5, 10, 15 and 20%) on the antioxidant potentials and consumer acceptability of pearl millet (PM) biscuits. The total phenol value of the biscuit ranged from 5.84 to 11.87 mg GAE/g, total flavonoid ranged from 1.20 to 8.12 mg QE/g and the hydroxyl radical (OH*) ranged from 2.24 to 1.72 mg/ml. The study shows the peak antioxidant properties at 20% substitution of the OP, which could be associated with an increase in OP. Hence, OP could be used as a functional and a nutraceutical ingredient in biscuit production for the management of some degenerated diseases.

1 Introduction

Women are one of the most vulnerable group of people in the world especially when confronted with stress, resulting in degenerative diseases such as cardiovascular disease, hypertension and diabetes millietus. Relationship between diet and occurrence of degenerative diseases, has been established (WHO, 2002). Antioxidants are substances that protect the body from damage caused by harmful molecules called free radicals (Dewi *et al*., 2017). Diets rich in antioxidants are widely recommended for the prevention and management of degerative diseases. Peels of vegetables and fruits, which are regarded as waste in agro – industries and homes have been identified to be rich sources of bioactive compounds and antioxidants (Ajila *et al.,* 2013; Omoba *et al.,* 2015). Biscuits are ready-to-eat snacks widely consumed throughout the world in between meals. It is cheap and affordable, and could be enriched with antioxidants. Previous works have reported the production of biscuits using underutilized cereals such as sorghum, pearl millet, finger millet (Shimray, 2012; Omoba & Omogbemile, 2013; Omoba *et al.,* 2015). The incorporation of orange peels into pearl millets for biscuit production, will not only reduce the environmental challenges pose by wastes, but will result in the production of antioxidant rich biscuit suitable for the management of some degenerative diseases. The aim of this study therefore was to produce a home – made antioxidant-rich biscuit from an underutilized cereal crops.

2 Method/Experiment/Body

Sweet oranges (*Citrus sineresis*) were harvested at Federal University of Technology, Akure, Nigeria and processed into flour as described by a method of Van-Acker *et al*., (2011). Pearl millet (*Pennisetum glaucum*) grains were obtained from *Adedeji* market, Akure, Ondo State, Nigeria and it was processed into powder using the method as described by Komeine (2006). All other chemicals used were of analytical grade. Composite flours were made from the blend ratio of pearl millet (PM) and orange peel (OP) at ratio 100:00, 95:05, 90:10, 85:15 and 80:20. The blends were used to produce biscuits using standard methods and then subjected to sensory analysis.

2.1 Sample Preparation

Biscuits extracts were prepared using acidified methanol (1 % HCl in methanol). It was then extracted with 50 mL of solvents in three different phases as follows: 10 mL solvent was added to 0.5 g of the sample in a conical flask and completely covered with aluminum foil. The sample was stirred for 4 h on a shaking machine (shaker), it was then transferred to 40 mL plastic centrifuge tubes, it was centrifuged at 3500 RPM for 10 min (25^{o}C), decanted. Thus, the supernatants were used to determine antioxidant properties.

2.2 Determination of phenolic (total phenol and flavonoid) content

The total phenol content of the extract was determined according to the method of Singleton *et al.,* (1999). The total phenol content was subsequently calculated and presented as gallic acid equivalent (GAE). The total flavonoid content of the extracts was determined using a slightly modified method of Meda *et al*. (2005).

2.3 Statistical analysis

All analyses were performed in triplicates and data generated was subjected to statistical analysis using Statistical Package for the Social Sciences (SPSS) version 19 using one way analysis of variance (ANOVA) followed by Duncan's Multiple Range Test (DMRT) with $p<0.05$ being considered statistically significant (Stub *et al.,* 2015)

3 Results/ Discussion

Antioxidants and sensory assessment of pearl millet -orange peel biscuits are presented in table 1. Addition of OP into PM for the production of biscuits significantly increase the antioxidant properties of the biscuits. The antioxidant properties increase as the OP substitution increases. The phenol value ranged from 5.84 (PM_{100}) to 11.87 mgGAE/g (20% substitution), flavonoid values ranged from 1.2 (PM_{100}) to 8.12 mgGAE/g (20% substitution) and hydroxyl radical (OH*) range from 2.24 to 1.72 mg/ml. This result agrees with the report of Omoba *et al.,* (2015) that OP is a good source of antioxidants. The colour value ranged from 5.96 to 8.60. There was a noticeable change in colour of the biscuits from grey to dark yellow with an increase level of substitution of ripe orange peel. The dark colour obtained was in agreement with the report of Ashoush and Gadallah (2011) who reported dark color in a biscuit incorporated with mango peel. The taste score ranged from 3.00 to 7.50; the taste of the biscuits decreases with increase in orange peel flour and they are significantly different ($p<0.05$); the decrease in taste as the orange peel increases was in agreement with the report of Okpala and Akpu (2014). The general acceptability ranged from 5.10 to 7.70. The overall acceptability of the biscuit decreases as the orange peel flour increases.

4 Conclusions

The study demonstrated that orange peels can be incorporated into pearl millet flour for the production of antioxidant rich biscuits for the management of degenerative diseases. Incorporation of OP up to 20% resulted in acceptable product. The use of OP in biscuit production will reduce waste and boost the economic status of farmers.

Acknowledgment

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Paleoenvironmental and climati reconstruction based on geochemical evolution of lunette dunes sediments from the western Free State Panfield, South Africa

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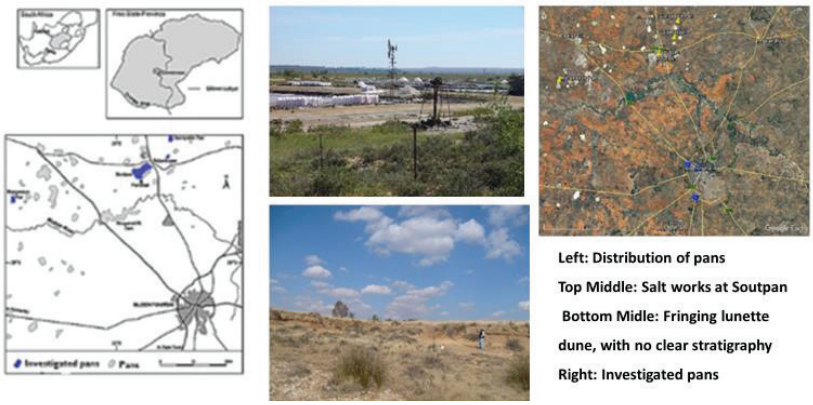

Left: Distribution of pans
Top Middle: Salt works at Soutpan
Bottom Midle: Fringing lunette dune, with no clear stratigraphy
Right: Investigated pans

Abstract
The western Free State is located on an inland plateau in the central part of South Africa. Pans are the most noticeable landform in this Highveld semi-arid landscape. With densities of up to 16 ha/km^2, the western Panfield has the highest concentration of pans in South Africa. Like pans elsewhere, pans in this area have fringing lunette dunes. Lunette dunes are located on the southern and south-eastern pan margins, and this is in agreement with paleoatmospheric wind circulation in this region. Previous studies in this area include in situ sedimentological analysis of lunettes sediments and a detailed optically stimulated luminescence (OSL) dating sequence of exposed faces of lunette dunes. Unfortunately to date much of the findings from previous studies have not been used to reconstruct past climatic and environmental changes. This study aims to close this gap by exploring whether changing environmental conditions are recorded in the geochemical and mineralogical composition of lunettes sediments. The geochemistry together with the existing dated dune records are used to identify fluctuations of wet and dry/cold periods.

Theme: *Climate Change*

1. Introduction

"The essential reason for recognizing the Quaternary is climatic. The record of its history is stratigraphic." Russell, 1964.

This study mainly looks at aeolian landforms, in particular depositional land features. There are various types of aeolian deposits, this study explicitly looks at lunette dunes. "A lunette dune is a bow-shaped form composed of sand, silt and clay that occur on downwind margins of ephemeral lakes." (Laity, 2008: 212). From here on ephemeral lake(s) will be referred to as pan(s).

The following terms; lunette dune(s), lunette(s) and dune(s) are used interchangeably.

This pilot study aims to investigate whether geochemical and mineralogical characteristics of aeolian sediments can be used to reconstruct past climatic changes and paleoenviromental conditions. The study contributes towards better understanding of the chronological record for the study region and comparison of the different lunettes in the study area in terms of age and development.

2. Method

Topographic maps of the region (covering the west-central Free State Province), orthophoto maps, vertical and aerial photographs were used to plot the location and distribution of pans and lunette dunes, as well as to demarcate study sites. Global Positioning System (GPS) was used to map boundaries. Three pan lunettes sites were selected for this study, the minerology of all three sites has never been investigated. The geochemical characteristics of sediments from the three sites, have been described by Rabumbulu (2016). The selection of the study sites was based on: 1. the presence of prominent lunette, with potential to give rise to recoverable palaeorecord, 2. the location of pans with respect to drainage lines, and 3. the existence of published OSL chronologies of the dunes

X-ray fluorescence (XRF) and X-ray powder diffraction (XRD) analysis research was carried out in order to provide a detailed geochemical and mineralogical record of the lunette dunes in the Western Free State. The results from the analysis were useful in determining the provenance, evolution and maturity of the sediments. 43

sediments samples were collected from exposed faces of lunettes from three pan sites. Standard 5g pellets were prepared from homogenised sample for total elements oxide composition by X-ray fluorescence spectrometry and chemical index of alteration (CIA) values were calculated using this equation; $Al_2O_3/(Al_2O_3+CaO+Na_2O+K_2O) \times 100$. Elements geochemical parameters (CIA, Na/Al, Na/Ti, and Na/K) are used as indicators of changes in paleoclimate and paleoenvironmental conditions. Clay minerals (XRD results) are used to support the past climatic and environmental reconstruction of geochemical parameters.

3. Results

In all the study sites SiO_2 dominates the sediment samples followed by Al_2O_3 and Fe_2O_3 being the second most abundant compounds. Samples from Sunnyside Pan and Salpeterpan contain higher ratios of MgO, CaO, K_2O and Na_2O than the samples from Morgenzon. A slight difference in concertation of mobile/soluble compounds is also observed between Profile A and Profile B at Morgenzon Pan. For example, sediments from profile A have slightly higher concentration of manganese (Mn). Most of the sediments taken from profile A contains diphosphorus pentroxide (P_2O_5) which is not present in any of the samples from the other profile.

4. Discussion and conclusion

Geochemical differences between sediments indicate differences in chemical weathering intensities, which is indicative of past climate condition. A higher CIA value occur when most of the alkali and alkaline earth elements have been removed and therefore suggests strong chemical weathering (Sun, et.al., 2009). Higher intensity of chemical weathering in some sediments indicate availability of moisture which can be associated with warmer humid phases. Clear dry or cold periods have been identified between 12000 and 18000 years. The driest conditions based on geochemical parameters appear to have occurred around 4000 years back, this is supported by the presence of Albite and Muscovite in the sediments.

The presence of Muscovite signals colder or drier conditions, this is also supported by the fact that this mineral is only present in samples with low CIA value. Muscovite is not resistant to chemical weathering. If the conditions are conducive for chemical weathering to take place, it is quickly transforms into clay minerals.

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Li_2O_2/Graphene as a material for energy storage

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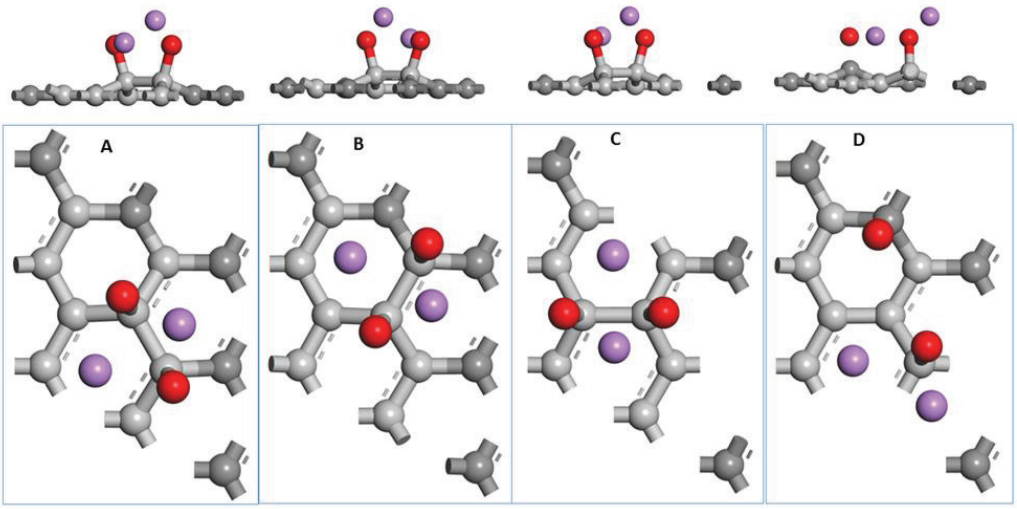

Figure 1: Final configurations of Li_2O_2 adsorbed at A, B, C and D positions of graphene layer. Side and top views of optimized structures of the Li_2O_2 adsorption configurations on graphene are shown with grey, red and purple balls representing carbon, oxygen, and lithium atoms respectively.

Abstract
The ever-increasing global energy needs and depleting fossil-fuel resources demand the pursuit of sustainable energy alternatives, including both renewable energy sources and sustainable storage technologies. Intensive interest in graphene has centred on its 2D crystal lattice and remarkable properties that offer unique opportunities to address ever-increasing global energy demands. The high electrochemical theoretical specific capacity, specific capacitance and ultra large surface-to volume ratio, when combined with its remarkable properties, make graphene an ideal material for enhanced energy storage in lithium batteries. In this study, reaction mechanisms of Li_2O_2 molecule onto graphene are investigated using generalized gradient approximation implemented in density functional theory. Variation on Li_2O_2 adsorption sites relative to two adjacent carbon atoms and high symmetry hollow point for oxygen and lithium atoms respectively is considered. All considered adsorption sites revealed that adsorbent molecules move away from graphene layer together with two adjacent carbons aligned to oxygen atoms.

1 Introduction

The use of graphene in electrochemical devices has been investigated with respect to surface chemistry and structure, heterogeneous charge transfer rate constants on redox species, electrochemical operating window and electrocatalysis of molecules [1,2]. Cyclic voltammetry showed a 13 times higher capacitance on graphene electrode materials than those on bare glassy carbon [1]. Experiments showed that graphene electrode possesses smaller charge transfer resistance compared to graphite and glass carbon electrodes [3]. The low capacity of graphite is ascribed to limited lithium-ion storage sites within the sp2 carbon hexahedrons [4]. Graphene is generally considered an ideal building block in composite materials combined with a variety of inorganic compounds, such as metal oxides, which exhibit exceptional performance. Therefore, significant synergistic effects are expected between graphene and inorganic components when combined at the molecular scale and these may create novel properties different from those of each individual component. The main challenge in using graphene as an electrode material is the precipitation of reaction products on the surface and pores, which ultimately block oxygen passage and reduce the capacity of metal-air batteries [5]. Also clear reaction mechanisms between the surface and discharge products is not yet fully understood. In this study, first principles calculations using density functional theory will be used to investigate reaction mechanisms underlying oxygen reduction reaction products adsorption onto a graphene material.

2 Methodology

All the calculations were performed using density functional theory as implemented in CASTEP code embedded in the Materials Studio software [6]. The core electrons were described using the projector augmented method. The exchange–correlation energy of the electrons were treated using the generalized gradient approximation within the Perdew–Burke–Ernzerhof functional [7]. The plane-wave basis set energy cutoff was set at 650 eV. The unit cell dimensions for 2x2 supercell were set 10.00 x 10.00 x 17.00, large enough to ensure that there were no

interactions between the system and its self-image along the c-axis within the periodic boundary conditions. For geometry optimization the Monkhorst–Pack scheme k-points grid sampling was set at 5x5x1. For atomic positions to be considered fully relaxed, the convergence parameters were set as follows: total energy tolerance 2x10-6 eV/atom, maximum force tolerance 0.05 eV/nm and maximum stress component 0.1 GPa

3 Results and Discussion

To validate the models and theoretical method used in this work, graphene model was geometrically optimized and calculated C-C bond length and bond angles were 1.420 Å and 120º respectively. Adsorbates can vastly change the atomic and electronic structures of two-dimensional materials. Therefore, they are major candidates for property tuning and producing new materials especially if they form ordered configurations. The study investigated possible adsorption sites of Li_2O_2 as one of the products that could potentially form during oxygen reduction reactions. Four possible configurations of lithium peroxide adsorbed onto graphene shown in Figure 1 were considered by positioning Li_2O_2 at various adsorption sites and optimizing the systems. The initial configurations are depicted in Figure 1 with four sites defined as positions A, B, C and D. For all geometrical configurations, the adsorbate is orientated parallel to graphene plane with O_2 molecule positioned equidistance across the adjacent carbon atoms while Li atoms are positioned at the centres of two hexagon rings (hollow site).

The adsorption Li_2O_2 molecule onto graphene layer, along position B parallel configuration was reported to be the most favourable and stable compared to adsorption along other adsorption sites. Two adjacent C atoms shown in Figure 2 are displaced from graphene layer forming a stronger bond with O_2. This suggest a possible formation of CO or CO_2. The calculated adsorption energy equals -0.682 eV. A negative adsorption energy indicates a strong interaction between Li_2O_2 molecule and the two adjacent carbons, which are pulled away from the surface forming C-O bond. The electronic structure revealed that there is charge transfer from Li atoms to graphene with no significant change to the occupied graphene bands.

4 Conclusions

The investigation mechanisms underlying lithium peroxide adsorption onto graphene sheet were carried out from the first principle calculations. Graphene reacts weakly with alkali metals, with Li reacting more to graphene as compared to Na. Adsorption results showed that Li_2O_2 molecule moves away from graphene layer together with two adjacent carbons that oxygens were aligned on top of, possibly forming CO or CO_2. The bond length of oxygen molecule bound to graphene was found to be 1.243Å compared to 1.210Å in vacuum, and was displaced by 1.457Å from the layer.

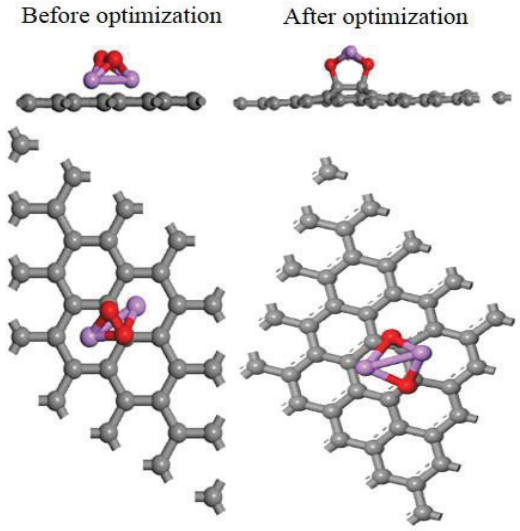

Figure 2: Structural models of Li_2O_2 adsorbed onto 4x4 graphene supercell, before and after optimization.

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The feasibility of implementing Managed Aquifer Recharge (MAR) as part of efforts to addressing climate change impacts on groundwater recharge in northern Ghana

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Abstract
Groundwater, a component of the hydrological cycle which provides fresh water for most living organisms is being impacted by climate change. Ghana is endowed with groundwater resources: a major source of water supply for especially people living in rural areas. Nonetheless, some studies conducted in some parts of the country show that there is a reduction in groundwater recharge. Therefore, as part of global climate change measures, attention is being given to ground water recharge among other areas of concern. Managed Aquifer Recharge (MAR) which represents a feasible solution for recharge of groundwater using surplus surface water is gaining currency all over the world especially in the USA, Australia and in South Africa. The paper therefore intends to examine the feasibility of undertaking MAR as part of measures to addressing groundwater recharge challenges and making groundwater available for dry season irrigation in northern Ghana. It concludes that the demand, technical and management capacity as well as formal government institutions of the country favour the implementation of MAR.

Themes— Climate Change, Water

1 Introduction

Ghana has substantial amount of ground water resources, estimated to be about 26.3 Bm^3 [1]. As a result, most communities in the country rely on ground water for potable water supply because it is safer than surface water, easier to develop using hand pumps in remote areas and is reliable even in protracted drought. As noted [2], apart from the Greater Accra Region where groundwater is not used for drinking due to the high level of salinization, the rest of the regions depend on groundwater for drinking purposes.
The dependence on groundwater to undertake dry season irrigation as a major livelihood strategy has been practised in the country over 200 years ago. This has yielded benefits particularly in the Greater Accra, Volta and Upper East Regions.
Nonetheless, it is noted in the country that it will become water stressed by 2025 even without the impacts of climate change. Moreover, climate change will further exacerbate the situation as this change will bring a reduction in groundwater recharge of 5-22 % for 2020 and 30-40% for 2050 [3]. In a study on the Volta Basin (Pra, Ayensu and the White Volta) using WATBAL model to evaluate potential impacts of climate change on subsurface and base flow for groundwater resources, the results show a reduction in recharges of 17%, 5 % and 22% for Pra, Ayensu and the White Volta respectively in the year 2020 while for 2050 these values will increase to 29%, 36% and 40% for the representative basins [4]. Groundwater recharge is however, mainly through direct infiltration of precipitation with rainfall in all geographic regions. [5] study of recharge in the northern part of the country (Atankwidi catchment) shows that the rate is an average of 6% of total annual rainfall. Coupled with the impacts of climate change is the already existence of poor borehole yields in some part of the country. This is a characteristic of the Northern, Upper East, Upper West and parts of Brong-Ahafo Regions where studies have shown that there are in-sufficient yields with some occurrences of “dry boreholes”. Managed Aquifer Recharge (MAR), an artificial groundwater method is considered [6] an effective tool capable of contributing to boosting groundwater recharge thereby enhancing groundwater adaptation to climate change and its impacts.
The paper therefore intends to assess the possibility of implementing MAR in northern Ghana to improve groundwater recharge for groundwater irrigation in the

wake of climate change.
In order to realise the objectives of the paper, a schematic for entry-level viability assessment for MAR projects contained in Australian Guidelines for Water Recycling (2009) has been adopted. The demand and institutional/capacity components of the framework were only discussed in this paper.

2 The approach
A qualitative approach which allowed for the collection of empirical data on groundwater resources, climate change and its impacts, and adaptation measures in the Ghana was adopted. A desktop review of literature on the physical and hydro-geological characteristics of the study area was also done to obtain secondary data. A case study of the Atankwidi Catchment of the White Volta Basin was employed.
Thus, a four month fieldtrip was undertaken in Ghana in 2017 as parts of efforts to get stakeholders views and involvement in the MAR project. Local dwellers and dry season farmers, local government officials and groundwater/climate change experts were contacted. Data collection tools like interviews, questionnaire, observation and transect walks were used to gather empirical data in Ghana. Formal discussions with the INOWAS Junior Research Group in TU Dresden, Germany together with secondary data from this group about MAR projects yielded supporting data. A review of policy documents about climate change and groundwater resources in Ghana has been carried out also. Hydrogeological studies in the catchment been reviewed and analysed.

3 Results/Discussion
The outcome of the study shows that there is sufficient demand for groundwater to undertake dry season farming. Prevailing conditions of population increase, better road networks and the presence of tomato factory is making dry season irrigation booming. The dire need to abstract more groundwater is seen in measures adopted by farmers such as : continuous deepening of wells depth, number of wells per crop area (new wells and reopening of old wells), migrate in search of groundwater resources endowed areas, conjunctive use of surface and groundwater and some abandoning groundwater irrigation due to lack of available water. In terms of technical and management capacity, the Water Research Institute (WRI) of the Center for Scientific and Industrial Research (CSIR) has groundwater engineers who sometimes collaborate with other groundwater experts from the Water Research Commission (WRC) and International Water Management Institute (IWMI). In fact the IWMI has initiated already MAR projects (Aquifer Storage and Recovery) in the northern part of the country including Wiese in the Upper East Region.

Institutional provisions exist that support the implementation of MAR in the country. These include: policies (Ghana Water Policy, Ghana National Climate Change, Riparian Buffer Zone Policy, and Ghana Environmental Policy), legal provisions (The WRC Act 1996, Act 522, Environmental Protection Agency 1994, Act 490, Drilling License and Groundwater Development Regulations Legislative Instrument (L. I) 1827 (2006), Rivers Act 1903), and administrative bodies (Water Resource Commission, Hydrological Service Department, Environmental Protection Agency, Lands Commission) exist to safeguard the process of MAR implementation

4 Conclusion
It is realised that MAR could be implemented in northern Ghana as a method of increasing groundwater recharge as part of efforts to reducing climate change impacts on groundwater resources. It is however, required that a detailed study of the engineering components of MAR in relation to the country's aquifer system be done. It is further suggested that simple engineering methods of MAR that allow for stakeholders participation be encouraged. There is also the need for capacity building about MAR projects for their sustainability in the country.

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University for Development Studies, Ghana, Government of Ghana, DAAD, TU Dresden Graduate Academy, INOWAS Research Group

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Starch digestion kinetics of ripe and unripe plantain *(Musa AAB)*

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Abstract

Rates of starch digestion were determined using a first order kinetic model curve to determine the rate constant after *in vitro* enzyme hydrolysis of heat treated samples. Activation energies for *in vitro* starch digestion were also extrapolated from the rate curves. Rate constants obtained indicate that plantain flours offer lower rates of starch digestion when pre-treated at 40 - 60^{o}C (ie below gelatinisation temperature) and this is an indication that the use of flours rather than starches of plantain will offer slower digestibility and subsequently lower postprandial glucose levels when incorporated into food products. However, the rate of starch digestion for all samples were not significantly different from each other at 80^{o}C. This can be adduced to complete gelatinisation of plantain starch at this temperature.

***Themes**: food security and health*

1. Introduction

The search for healthier foods and better processing methods that would boost food production for human consumption is currently a global challenge, especially with the high incidence of diet-related diseases such as diabetes mellitus, obesity and other cardiovascular diseases. Plantain is an important tropical crop that still remains underexploited despite its abundance and several claims regarding its nutraceutical potentials [1, 2]. The impact of banana starch and flour on starch digestibility when added to other foods have been tested [3]. However, it is not clear from these results if improved nutritional qualities are better from foods supplemented with starches than with flours, because the difference between the influence of non-digestible starch components in flours and starches have not been tested. Hydrolysis of starch has implications when it comes to diabetes management hence a study of reaction rates is quite significant. In this study *in vitro* starch hydrolysis in plantain flours *in situ* and plantain starch was tested and compared, to check for the impact of other components of plantain on starch digestion.

2. Materials and methods

Sample preparation

Ripe and unripe plantains fingers were purchased from a local market. Unripe plantains selected were full green (stage 2) while ripe plantains used were in the fully ripe stage, ie yellow in colour (stage 6) on the colour index scale [2]. Each finger was peeled and the plantain pulp/fruit was cut into thin slices of about 2 mm thickness, freeze dried, blended into a fine flour and stored in clean plastic containers at ambient temperature. Starch was isolated using standard procedures.

Heat Treatment

A 500 mg sample was treated with 15 ml de-ionised water and vortex-mixed for 5 min to produce a starch suspension. This was subsequently incubated in a shaking water bath for 30 min at temperatures ranging from 40^{o}C to 80^{o}C. After incubation, the sample tube was immediately transferred to another water bath maintained at 37^{o}C for subsequent starch hydrolysis using digestive enzymes as indicated below.

In vitro starch digestion

In vitro starch digestion was performed for 180 min using the procedure of Englyst et al (1992)[4] and glucose was measured using Glucose oxidase peroxidase kit.

First order kinetics curve fitting

The standard first order equation (eqn 1) was used to investigate the kinetics of starch digestion in the samples at various treatment temperatures.

$C = 1 - e^{-kt}$ ……1

Where t is the digestion time (min), C is the fraction of digested starch at digestion time t, and k is the digestion

rate constant (min^{-1}). The value of k was obtained from the slope of a linear-least-squares fit of a plot of ln (1 − C) against t. [5]

3. Results and Discussion

Starch digestion *in vivo* is a complex process that is affected by many factors such as the botanical source of the starch, its physical and chemical properties, processing method and the presence of other food materials such as lipids, enzyme inhibitors and proteins. Englyst [4] was able to establish an *in vitro* method that does not use human digestive enzymes, but compares favourably with *in vivo* digestion in humans. This method has been exploited in examining the rate at which plantain starch digests when present with other food components in comparison to the starch alone**.**

The fitting of first order kinetics was done for ripe and unripe plantain starches and flours covering *in vitro* starch digestion over a period of three hours for samples treated at 40, 40, 60, 70 and 80^{o}C. More similarities were however observed between starches than between flours. Digestion rate constants obtained from the slope of the curves for all samples were not significantly different from each other at 80^{o}C. This can be adduced to complete gelatinisation of starch at this temperature. Pure starches, i.e. RPS and URPS had similar starch digestion rates except at 70^{o}C. In addition, the activation energies for these two samples were not significantly different from each other at 95% confidence interval. The disparity at 70^{o}C may not be unconnected with the purity of the starch. It was quite difficult to isolate pure starch from ripe plantain pulp. The very low rate constants ($0.0007\pm0.0001 min^{-1}$) for flours when compared with the starches ($0.0035\pm0.0004 min^{-1}$) is an indication that the use of flours rather than starches of plantain will offer slower digestibility when incorporated into food products [6]. This observation supports the fact that there may be some digestion retardants such as enzyme inhibitors (eg procyanidin, proanthocyanithin, and narigenin) [7] in the plantain flours, this is similar to the observation for barley grain when digestion of starch in the meal versus digestion of starch in pure starch of barley grain were compared. At lower temperatures (ie before gelatinisation) starch digestion is slower in unripe plantain than in ripe plantain, however, at these temperatures, starch in ripe plantain has very low digestion rate when compared with other flours such as wheat, sorghum, etc [8].

4. Conclusion

Plantain starch has a lower rate of digestion when compared to other starches, however the lower rate constants obtained for plantain flours when compared to the starches suggests that low digestibility of plantain food is a function of both starch structure and some enzyme inhibitors present. These observations are very much dependent on processing temperatures. In addition, the use of rate constants and activation constants may be a better way of comparing the rate of starch digestion in many foods.

Acknowledgements

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Combined genotype effect of HFE and TMPRSS6 is associated with reduced ferritin levels and earlier age of onset in patients with multiple sclerosis

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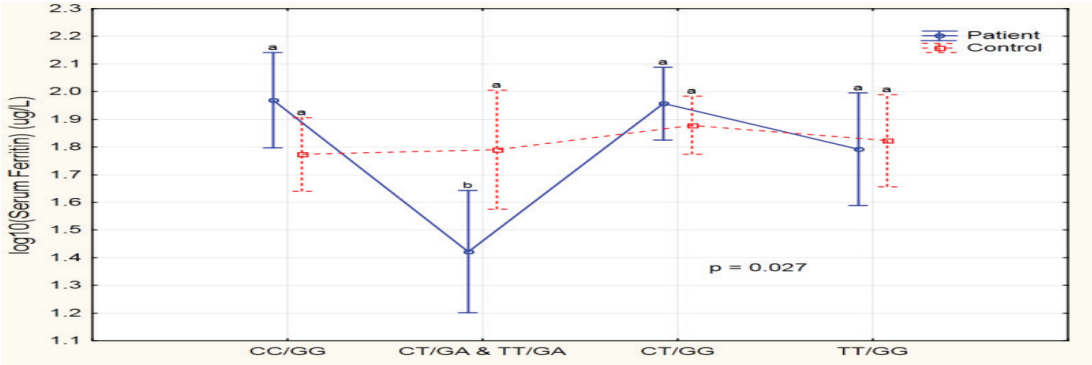

Effect of combined TMPRSS6 and HFE genotypes on ferritin levels in MS patients compared with controls. Post-hoc test differences, a and b labels.

Abstract

Iron dysregulation is considered a possible pathogenic mechanism involved in the inflammatory process underlying multiple sclerosis (MS). Previous studies reported contradictory findings in relation to the iron-loading effect of HFE C282Y mutation in MS patients. Since TMPRSS6 A736V was shown to influence clinical expression of haemochromatosis in patients with the HFE C282Y mutation, we hypothesised that a similar mechanism may explain lack of clinical expression of haemochromatosis previously reported in patients with MS. In this study, biochemical determination of serum iron status showed that in combination the minor alleles of A736V and C282Y, significantly reduced serum ferritin levels independent of age (p=0.0001), sex (p=0.022), body mass index (p=0.003) or dietary red meat intake (p=0.002) in MS patients, but not in the controls. Detection of the minor A-allele of C282Y in the presence of the A736V CT and TT genotypes, were associated with a significantly earlier age of onset of MS (p=0.04), compared to patients without this genotype combination. This study highlights the importance of combining genetic testing with biochemical tests to identify a subgroup of MS patients with life-long increased requirements of iron in the diet.

Themes— *Health*

1 Introduction

Historically considered a single clinical entity, growing evidence confirms that multiple sclerosis (MS) shows marked inter-patient variance in clinical presentation and therapeutic response to disease-modifying treatments [1]. Consistent with the notion that certain sub-groups of MS exist, previous studies highlighted the role of deranged iron homeostasis in relation to the inflammatory process as a pathogenic mechanism in MS, dependent on poorly understood and complex interactions between genetic and environmental risk factors [2, 3]. The question of the "iron paradox" in MS [4] poses significant challenges regarding our understanding of the pathogenesis of this disease. While iron deficiency has been associated with greater disability and disease progression [3], cerebral accumulation and overload of insoluble iron has also been reported in MS patients [5]. It remains uncertain whether the deficiency or overload of iron has a major deleterious effect on disease development and/or progression. The production and maintenance of myelin requires a continuous supply of iron and other essential micronutrients to oligodendrocytes in the central nervous system; a process that is dependent on the concerted and balanced activity of many regulatory proteins including ferritin and transferrin. Conversely, the presence of insoluble iron deposits demonstrated via magnetic resonance imaging (MRI) in demyelinating plaques and their constituents in MS has been linked to its pathogenesis, while these do not contribute towards cerebral iron bioavailability. This may result in iron deficiency and suboptimal myelination capacity by oligodendrocytes.

TMPRSS6 A736V has been strongly associated with an increased risk of developing iron deficiency in the general population as well as reduced clinical expression of hereditary haemochromatosis (HH) in the presence of the HFE C282Y mutation. This raised the question of whether it may be involved in dysfunctional iron regulation as a pathogenic mechanism in MS. On this basis, the aim of the study was to determine the individual and combined effects of TMPRSS6 A736V and HFE C282Y variants on serum iron parameters in relation to lifestyle factors and clinical outcomes in MS patients.

2 Subjects and Methods

2.1 Ethics Statement

Ethical approval for this study was granted by the Human Research Ethics Committee of Stellenbosch University, Faculty of Medicine and Health Sciences.

2.2 Participants Selection and Data collection

The study participants included 121 Caucasian patients diagnosed with MS and 286 population-matched controls without a current or prior diagnosis or symptoms suggestive of neurological disease. Peripheral venous blood samples were collected from all study participants after written informed consent was obtained. Serum iron, transferrin, ferritin and transferrin saturation levels were available from previous studies [6] and lifestyle factors were subsequently documented in a subgroup of 68 MS patients and 143 controls. Data on family history of MS, clinical symptoms, age of diagnosis and onset as well as body mass and height were recorded at entry into the study. For this study, only baseline expanded disability status scale (EDSS) values available for 48 MS patients were used.

2.3 Genetic and Statistical analyses

Genotyping of HFE C282Y (rs1800562) and TMPRSS6 A736V (rs855791) were performed with high-throughput real-time PCR technology, using commercially available Applied Biosystems TaqMan® SNP Genotyping assays on the ABI™ 7900HT Fast Real-Time PCR System.

Genotype distribution and allele frequencies of A736V and C282Y variants were evaluated from allele counts, and Hardy-Weinberg equilibrium was tested. Analysis of variance (ANOVA) was used to determine the individual and combined effects of TMPRSS6 A736V and HFE C282Y on clinical outcomes and iron parameters. Fisher least significant difference (LSD) post-hoc tests were performed to determine possible differential effects of A736V and C282Y. Significance threshold was set at $p \leq 0.05$.

3 Results and Discussion

MS patients homozygous for the A736V T-allele had significantly lower serum iron ($p=0.03$) and transferrin saturation levels ($p=0.03$) compared to CC homozygotes. In MS patients, the C282Y minor A-allele was also associated with a paradoxical decrease in serum ferritin ($p<0.01$) compared to GG homozygotes. The combined effect of the minor alleles of A736V and C282Y, showed significantly reduced serum ferritin levels, independent of age ($p=0.0001$), sex ($p=0.022$), body mass index ($p=0.003$) or dietary red meat intake ($p=0.002$) in MS patients, but not in the controls. In the presence of the minor A-allele of C282Y, the A736V CT and TT genotypes were associated with a significantly earlier age of onset of MS ($p=0.04$).

Based on our findings it may be speculated that HFE C282Y may exert its effect in MS patients on the synthesis of serum ferritin, which is primarily derived from macrophages. The secreted ferritin was shown to be mainly the L-ferritin which contains a low concentration of iron. Ferritin donates iron to myelin-producing oligodendrocytes therefore it may be hypothesized that a decrease in ferritin would impact myelin production. This study confirmed the serum iron and transferrin saturation lowering effect of TMPRSS6 A736V in the South African Caucasian population. Interaction between this functional polymorphism and HFE C282Y may account for the significant ferritin-lowering effect observed in MS patients and could at least partly explain the low penetrance and lack of phenotypic expression of genetic HH previously observed in South African MS patients [7].

4 Conclusions

Our results suggest an epistatic effect between TMPRSS6 A736V and HFE C282Y associated with reduced ferritin levels in MS patients. This finding supports the role of TMPRSS6 A736V as a genetic modifier of HH, correlating with a lack of clinical manifestation of HFE C282Y in a subgroup of MS patients.

Acknowledgments

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Poly(1,2-carboxyethylpyrrole) core-shell magnetic nanocomposites: Synthesis, characterization and magnetic separation tools for pre-concentration of bacteria

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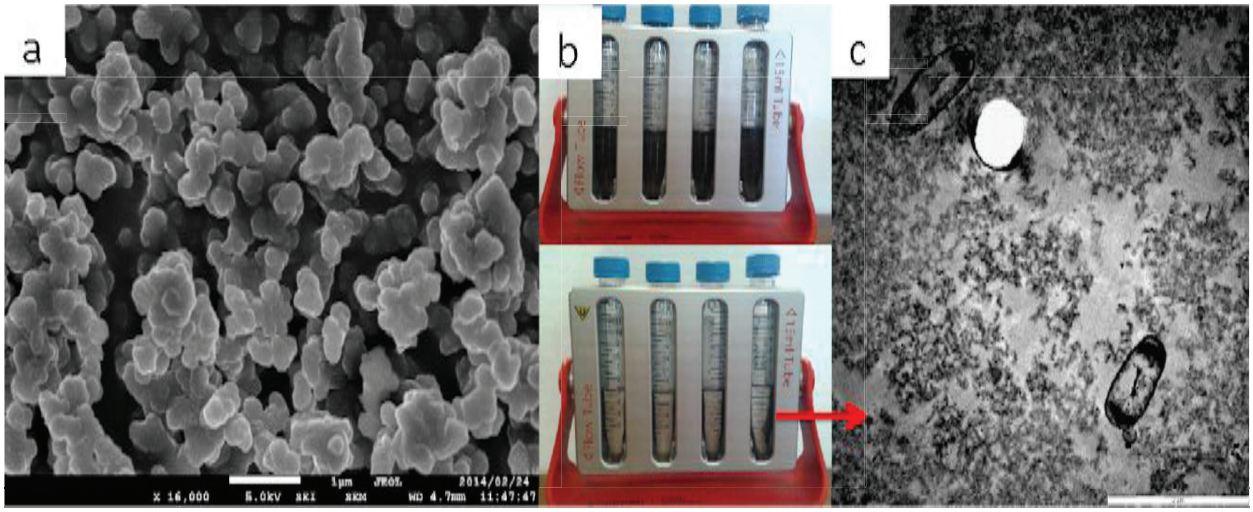

Figure SEQ Figure * ARABIC 4: a) A SEM image of PPy-COOH/ Fe_3O_4 MNCs, b) images of PPy-COOH/ Fe_3O_4 MNCs in suspension before and after magnetic separation and c) a TEM micrograph of antibody-labelled PPy-COOH/ Fe_3O_4 MNCs bound to E. coli cells. Insert: Magnified E. coli cell

Abstract
Magnetic carboxyl-functionalized polypyrrole nancomposites (MNCs) were synthesized using oxidative in-situ polymerization. The MNCs were further bioconjugated with antibodies specific to *E. coli* for immunomagnetic separaion applications. The results show that the MNCs have the potential to be used as tools for bioseperation and bacteria detection.

Themes— Water

1 Introduction

Bacterial infections pose as a huge threat to human health, especially now with the emergence of resistant bacteria. Part of the major challenges in water quality control is the lack of rapid and reliable detection methods. Currently, the standard microbial detection methods involve cell culture and plating as a manner to confirm bacterial strains and the turnaround times are long (2 – 3 days). The development of sensitive and specific detection methods with relatively low turnaround times is of high interest. In recent years, magnetic nanoparticles (MNPs) have been employed in biotechnology and pathogen detection [1]. MNPs are functionalized with biorecognition molecules such as antibodies and aptamers, in order to be used in specified targeting and recognition applications [1,2] Magnetic nanoparticles are biocompatible, exhibit low toxicity and they possess magnetic properties making them ideal for separations, diagnostics and magnetic imaging for detection. Immunomagnetic separation is applied in the form of magnetic nanoparticles or films, which are used to preconcentrate bacteria, while also allowing bacteria detection such as electrochemical detection. Given these properties, they simplify the enrichment process by eliminating the incubation of lower bacteria concentrations and thus reducing detection time.

This study demonstrates the use of poly (1(2-carboxyethyl) pyrrole)) magnetic nanocomposites (PPy-COOH/Fe_3O_4 MNCs), functionalized with antibodies, as immunomagnetic separators for preconcentration of bacteria.

2 Experimental

2.1. Synthesis of bioconjugated poly(1,2-carboxyethyl pyrrole) MNCs Carboxyl groups-containing pyrrole was synthesized through conversion of the cyanide group in the 1,2-cynoethylpyrrole monomer via alkaline hydroxylation. The monomer was then polymerized through oxidative *in situ* polymerization by iron chloride oxidant, in the presence of iron oxide (Fe_3O_4) NPs. Antibody bioconjugation took place through carbodiimide chemistry [4,5]. The resultant nanocomposites were applied in the separation of *E. coli* indicator bacteria from aqueous media. Enzyme-Linked Immunosorbent Assay (ELISA) studies were carried out to confirm that the immunomagnetic separation.

3 Results/ Discussion

The morphology of the MNCs was found to be aggregated

spherical particles. The FTIR confirmed the conversion of cyanide to carboxyl groups by the appearance of a carboxyl peaks at 1399 cm^{-1} (C-O) and 1703 cm^{-1}(C=O) . The characteristic bands of the polymer were observed at 1590 cm^{-1} (asymmetric ring stretch), and 1314 cm^{-1} and 918 cm^{-1} were due to the C-H deformation [6]. There were no alterations to the polymer backbone, except a shift to the right, which could have been due to the incorporation of Fe_3O_4. The incorporation of Fe_3O_4 in the polymer matrix was further confirmed by the XRD, where crystalline peaks were observed at 2θ = 30.013°, 35.475°, 43.038°, 57.904° and 62.498° , which were indicative of the nanocrystalline structure of Fe_3O_4 [7]. The polymer was found to be amorphous. The VSM hysteresis loop suggested that the MNCs are ferromagnetic, thus possessing magnetic properties. The saturation magnetization (σs) value was found to be 9.71 emu/g. The ELISA results showed that the Ab bioconjugated MNCs (denoted as Ab-MNCs) as prepared (8 µg/ml Ab), were found to bind to various *E.coli* strains (O157 *E. coli* strain, K12 strain from the two different sources). Ab-MNCs dilutions of 10 times were done to determine whether higher dilutions will still be detected in this experimental setup. Only the Ab-MNCs 1:10 dilutions had a signal significantly higher than the control wells. The controls in the experiment consisted of the Ab (4 µg/ml) only, the MNCs only and bacteria coated wells. The control wells indicated little background binding. The next step was to test the supernatants after the centrifugation of the particles to determine whether there were unbound Ab molecules left after collection of the MNCs. The supernatants of the particles were tested and there was a significant signal produced by the undiluted supernatant sample, indicating unbound Ab to the MNCs. The presence of unbound antibodies in the supernatant was taken as an indication that all available binding sites for antibodies on the particle surfaces had been bound. In the ELISA tests, a strong signal indicated a strong specific affinity between the commercial antibodies and the *E. coli* bacteria, which were also confirmed by the TEM. Pre-concentration experiments indicated that with minimum dose of 45 mg of bioconjugated MNCs, $1x10^4$ CFU/mL of *E. coli* bacteria were magnetically separated from a 100 mL sample.

4 Conclusions

Poly(1,2-carboxyethyl pyrrole) MNCs were successfully synthesized and bioconjugated. The NCs were confirmed to possess magnetic properties. The application of the MNCs was effective. The MNCs synthesized in this study can be used as potential magnetic separation tools as well as supports in electrochemical detection devices.

Acknowledgments

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Knowledge and Awareness of Heritable Eye Disorders among Undergraduates of University of Benin, Nigeria,

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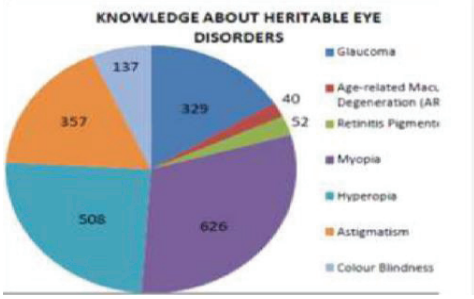

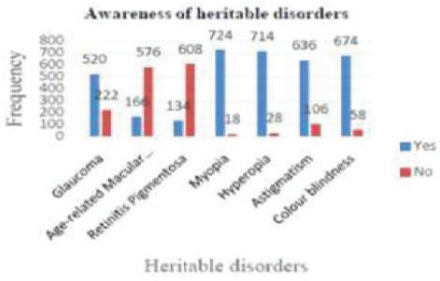

Abstract

Some of the leading causes of avoidable blindness and visual impairment worldwide have been found to be heritable. This study helps to assess the level of awareness and knowledge of heritability of eye disorders among undergraduates of University of Benin, Nigeria. 772 students between the ages of 16 and 30 years were randomly selected from each of the thirteen Faculties in the University of Benin; however, questionnaires from 742 students (312 males and 420 females) were eventually analyzed after the removal of 9 incorrectly filled questionnaires and 21 questionnaires that were not return.70% of the participants were aware of glaucoma, 22.4% age-related macular degeneration, 18.1% retinitis pigmentosa, 97.5% myopia, 96.2% hyperopia, 85.7% astigmatism and 90.8% colour blindness. In addition,44.3% had good knowledge about gluacoma, 5.4% about Age-related Macular Degeneration, 7.0% about Retinitis Pigmentosa, 84.4% about Myopia, 68.5% about Hyperopia, 48.1% about Astigmatism and 18.5% about Colour Blindness. Awareness of heritability of ocular disorders was very high among the respondents. Knowledge of pathological disorders assessed (Glaucoma, Age related macular degeneration, Retinitis Pigmentosa and Colour Blindness) were very low among the respondents. Health education and promotions on these disorders, especially on the retinal disorders is of utmost importance in order to increase knowledge of these disorders.

1 Introduction

According to the World Health Organisation, WHO [1], the leading causes of blindness worldwide include: Glaucoma, Uncorrected Refractive Errors and Age-related macular degeneration among others and these diseases have been found to have a degree of heritability.

Kyari [2] also reported that the leading causes of visual impairment and blindness in Nigeria are cataract,

glaucoma, Age related macular degeneration and refractive errors. Congenital cataract and retina dystrophies which are caused by hereditary factors also contribute to childhood blindness worldwide.

Awareness and knowledge of eye disorders play an important role in helping patients understand the relevance of regular eye examinations and assess timely management options when necessary, this would in turn reduce the burden of visual impairment and avoidable blindness. Hence this study, which seeks to assess the level of awareness of heritability of eye disorders and also the awareness and level of knowledge of each of these disorders among undergraduates of University of Benin.

2 Methodology

The study consisted of 772 students (both male and female) aged 16 – 30 years recruited from the University of Benin. Students were randomly selected from each of the thirteen faculties in the University of Benin, Ugbowo Campus. Pre-tested structured questionnaires were distributed to these students after the purpose of the study had been explained to them and informed consent had been obtained. The data drawn from the questionnaires were then collated and analyzed.

3 Results and Discussion

Out of the 772 questionnaires distributed to the respondents in different faculties, 742 were left after the removal of 9 incorrectly filled questionnaires and 21questionnaires that were not returned. When asked whether ocular disorders were heritable, 79.2% of the respondents said ‘yes’, 5.4% said ‘no’, while 15.4% did not know. The internet represented the major source of information in the majority of the respondents (n = 344) while a few of them reported that their affected family/friends (n = 74) and other sources (n = 73) were the major source of their information on the awareness of heritable disorders. A high percentage (79.2%) of the respondent were aware that some ocular disorders could be heritable. This is consistent with a research conducted by the Department of Health and Human Services, USA in 2004[3]. Awareness of glaucoma was high among the respondents as 70% of the respondents were aware of

glaucoma, Onyekwe *et al*., [4] and Askira *et al*., [5] also reported same result. 44.3% of the respondents had a good knowledge of glaucoma.

Furthermore, in this study, about 40.8% of the respondents knew that glaucoma could be heritable. Only 21.9% of the respondents knew that vision lost due to glaucoma cannot be recovered. Awareness of Age-related macular degeneration (ARMD) was low among the respondents, (22.4%), this is in line with previously conducted research works which showed that awareness of ARMD was low in each study (Attebo *et al*., [6]; Thapa *et al.*, [7]; Vaseem *et al*., [8]). Knowledge of Age-related Macular \ Degeneration (ARMD) was very low among the respondents (5.4%). Only 9.7% of the respondents in our study identified smoking as a risk factor of Age related macular degeneration. According to Zhang *et al*., [9], a few people are aware of the link between smoking and ARMD. Awareness of Retinitis Pigmentosa was the least among respondents (18.1%). Knowledge of Retinitis Pigmentosa was also very low among the respondents (7.0%). Furthermore, only 10.2% of the respondents knew that Retinitis Pigmentosa was a heritable disorder.

Awareness of myopia, hyperopia and astigmatism were 97.5%, 96.2% and 85.7% respectively. There was a high level of knowledge of myopia and hyperopia among the respondents while the knowledge of astigmatism was on the average. Most of the respondents knew about the heritability of refractive error (myopia 76.5%, hyperopia 70.4%, and astigmatism 58.2% was heritable). A large fraction of the respondents did not know that surgery could be used to treat refractive error. Knowledge of Colour Blindness was surprisingly low (18.5%) considering the fact that the awareness was very high (90.8%) among the respondents. Some of the participants had wrong impression about colour vision as 27.9% of the respondents felt colour blindness could result in blindness. However, 55.4% of the respondents knew that colour blindness is heritable. Age, gender, faculty and academic level had significant association with awareness of ocular disorder heritability ($p< 0.05$).Students within the age group of 25-30 years and females had better awareness of ocular disorder heritability. Also, students in the faculty related to science and those at higher academic level were also more aware of ocular disorder heritability. Michielutte et al [10], found that females and people who reached higher levels of education had the highest levels of knowledge of glaucoma and diabetes.

These findings indicated that the respondents were more aware and had more knowledge of refractive disorders than the other pathological disorders of the retina. This may also be attributed to the fact that refractive disorders are more prevalent than diseases of the retina **(**Denniston and Murray, [11]). High exposure to the internet as well as availability of peers who are students in the optometry department may also influence this notion.

4 Conclusion

It is believed that these ocular disorders that had low levels of awareness and/or knowledge have remained so due to lack of proper health education and promotion on these heritable ocular disorders. Health educational seminars or symposia especially on the retinal diseases should be carried out to educate students about heritable ocular disorders.

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The Impact of Motivation and Role Modeling on the Female Students' Choice Of Science and Engineering Discipline in Four Tertiary Institutions In Rivers State, Nigeria (A Case Study)

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Abstract

This study was undertaken to evaluate the experiences of female students in the Sciences and Engineering fields of study from four tertiary institutions (Ken Saro-Wiwa Polytechnic, Rivers State University, Ignatius Ajuru University of Education and University of Port Harcourt) in Rivers State. Random sampling was taken of 450 female students out of which 339 responded. The main instrument for this study was a questionnaire with 12-item instrument. Most of the participants were motivated to study the science courses by female mentors and role models who were female scientists. 95-100% of the participants expressed satisfaction in their choice of study. Low participation of female students in Mechanical and Electrical/Electronics Engineering showed that these courses were dominated by the males. However, in Civil Engineering, 80% of the students had female mentors and role models. Female students in Physics were grossly underrepresented in Ken Saro-Wiwa Polytechnic (0), Rivers State University (2) and Ignatius Ajuru University of Education (3) when compared to other departments in these institutions. Pearson correlation was carried out and there is a positive correlation between the variables studied and intention for further studies. 90-100% of the participants desire to be lecturers when they graduate while the post graduate students would like to become professors in due time. This is in line with the professions of their role models.

Themes— Gender Studies

1 Introduction

Many Science and engineering occupations are predicted to grow faster than the average rate of all occupations [1]. Technology and Science education is very important for both men and women because it accelerates the pace of change in the world [2]. The Science and Engineering courses are seen as "male courses" and so there is gender bias. The female from a tender age is under the illusion that the Sciences and Engineering are competitive fields, hence they develop lack of confidence to pursue such courses

unlike their male counterparts. This has resulted in low participation of women in Science and Technology [3]. The gender question in the fields of Science have been previously ignored due to standing hypothesis that Scientists have a superior ability to root out gender bias in their laboratories but experimental results have shown this to be moribund in many cases [4,5]. The female making a decision to study a Increasing the representation of women in the science and engineering field, has been found to positively influence younger female scientists; this is effective in increasing their sense of belonging and interest in the field, although, the achievements of highly successful female scientist may seem unattainable for those who are biased that science is difficult. From analysis of performance of Science Laboratory Technology students [6], it was observed that more females enrolled in this field of study and the graduation ratio was significantly higher for female students. To get to higher levels in academia and professions, these female students need to be encouraged by those who have excelled in their various careers in Science and Engineering. This study is aimed at evaluating the female students' enthusiasm/motivation in studying the Science and Engineering courses, the impact of female mentors and role models in their choice of study and performance in their academic pursuit. Some of the peculiar problems and challenges encountered as female students are expected to be captured in this study.

2 Method

2.1 Sampling: the study was carried out using a descriptive survey method. The samples consisted of female undergraduate of the Science and Engineering from four tertiary institutions in Rivers State. The undergraduate students were from Ken Saro-Wiwa Polytechnic Bori, Rivers State University and Ignatius Ajuru University of Education while the postgraduate students (M.Sc and Ph.D) were from University of Port Harcourt. The total number of

questionnaires distributed was 450, the number returned was 339.

2.2 Data Collection: The main instrument was a questionnaire with 12 – item instrument which was developed by the researchers.

2.3 Data Analysis: Selected statistical methods and correlation analysis were used. A Pearson's correlation analysis was applied in order to quantitatively confirm the relationship between these items.

3 Results/ Discussion

In the department of Science Laboratory Technology, 40-60% of the respondents were motivated to study the course while 55-75% had female mentors and 65-70% had role models who were female scientists. The students expressed satisfaction in their choice of study and this is evident in the 95-100% response obtained for this question.The female participants from the Physics department were only 2 in a class of 36 students. Females are grossly underrepresented in Physics. These two female students are motivated by mentors and role models to study Physics and they like their choice of course. The study showed that in Computer Science, Physics and Integrated Science courses, students were better motivated by their male mentors as reflected in the results obtainedAbout 54% and 59% of the students in Chemistry and Biology respectively reported that their female mentors motivated them to pursue their chosen courses. All three students in Physics had no female mentors. The data collected from post graduate students in Chemistry and Biochemistry programs of study at the University of Port Harcourt showed that the graduate students had female mentors, role models and like their choice of course of study. All the respondents indicate that they want to be Lecturers at the end of their studies and subsequently become Professors. This appears to be in line with the professions of their role models.

4 Conclusions

From the analysis of the responses from participants in Science and Engineering, 95-100% of them liked their choice of course and would like to continue their studies to Masters or Ph.D level. This is driven by the motivation from their role models that have enhanced their self- confidence to pursue a science and engineering career.

The results of this study points to the need for more effective role modeling by the female lecturers to our female students. A situation where none of the female students was motivated by the female lecturers in the Physics department, as recorded in Rivers State University and Ignatius Ajuru University of Education is worrisome. To maintain student's interest and motivation in the sciences, it is important that female teachers strive to teach well and become counselors, providing the students with enough experiences that will enable them see themselves as competent even in their choice of subjects. About 30% of the participants were not sure what to do after graduation. This stems from lack of motivation, inability to stand up to the challenges of gender differences they come face-to-face with in the tertiary institutions where they have found themselves. The responses from 70% of the participants were geared towards giving back to the society and humanity with the knowledge they have acquired.

Acknowledgments

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Screening of Wild and Mutant Strains of Fungal Isolates from Plantain (*Musa paradisiaca*) Stalks for Amylase Production.

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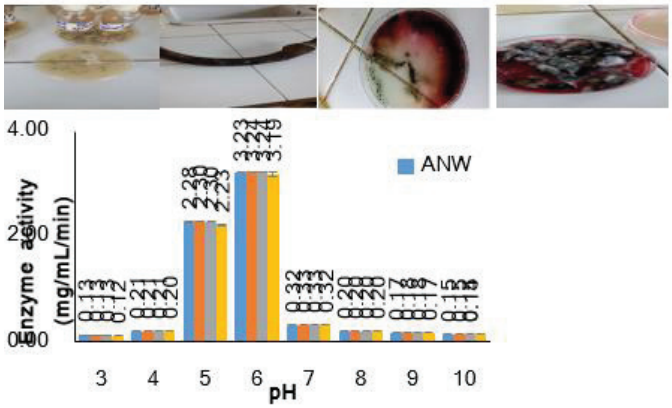

Figure: Growth of *Aspergillus flavus* and *Aspergilus niger* after exposure to ultraviolet radiation. Plantain stalk used for this study. Subcultured fungal isolates and Effect of pH on amylase activities of wild and mutant strains of *Aspergillus Niger*.

Abstract

This study was conducted to determine the amylase activity of wild and mutant strains of fungal species isolated from plantain stalks collected from a dump site at the Federal University of Technology, Akure, Nigeria. Isolation of the fungal species was carried out using standard microbiological methods. Strain improvement of the fungal isolates was carried out by exposing the wild fungal species to ultraviolet (UV) radiation at 240nm for 10, 20 and 30 minutes. The amylase production by the wild and mutant strains were examined quantitatively while the effects of pH and temperature on the amylase activities of the wild and mutant strains were determined. Three mutant strains were obtained each from *Aspergillus flavus* and *Aspergillus niger*. The wild and mutant strains of the fungal isolates showed variations in amylase production. The amount of amylase produced by the fungal strains was found to range from 2.849mg/mL/mins to 3.263mg/mL/mins of which mutant strains of *Aspergillus niger* exposed at 10 mins showed the highest amylase production. Furthermore, the amylase activities of the wild and mutant strains of the fungal species were sensitive to changes in pH and temperature. Amylase was optimally produced for all the fungal strains at pH 6 and temperature of 25^{o}C. This study has revealed the amylase producing potential of wild and mutant (irradiated) strains of *Aspergillus flavus* and *Aspergillus niger*. Therefore, the fungal strains could be employed in the commercial production of amylase, thereby, solving one of the challenges faced in the industries where amylase utilization is high. Findings from the study are promising, however, there is need for intensive studies on the improved strains.

Themes— Industrialization.

1. Introduction

The most widely used thermostable enzymes are the amylases in the starch industry [1] and the enzymes obtained from fungal isolates are much more useful in industries for bakery, starch conversion and biofuel production. Developing countries are depending on enzyme production from fungi because of the non-fastidious nutritional requirement and ubiquitous nature of the fungal enzymes [2]. A distinguishing characteristics of all commercial fermentation processes is improvement of microbial strains for higher enzymatic yield. Such improved strains can reduce the cost of the process and may also impact some specialized desirable characteristics on the products. The purpose of the present investigation is to isolate, characterize and identify fungal species from agro wastes (plantain stalks). In order to enhance the production of amylase, the fungal strains were subjected to mutagenesis by UV light. The enzyme activities of selected fungal strains were compared between wild and UV mutants after exposing them to UV light.

2 Method/Experiment/Body

2.1 Sample collection

Plantain stalk wastes were collected at a dump site at the Federal University of Technology, Akure, Nigeria into a clean sterile polythene bag and transferred to the Departmental Laboratory for further examination.

2.2 Isolation and Identification of fungal isolates

Using a sterile razor blade, 1g of the plantain stalk was cut and placed in 10ml of distilled water. This was shaken properly inside a test tube to obtain the stock culture. Serial dilutions, plating on Sabouraud dextrose agar (SDA) incorporated with chloramphenicol, incubation and subculturing were done using standard techniques. The

colonies were counted as spore forming unit (Sfu/g) while the identification was based on the microscopic and macroscopic features of the hyphal mass, nature of the fruiting bodies and the morphology of cells and spores.

2.3 Mutant generation by ultraviolet radiation

The method described by [3] was employed in preparing mutant fungal strains. The Petri plates were exposed to UV irradiation for 10, 20 and 30 minutes at a distance of 10cm in dark from the centre of germicidal lamp (240 nm). Afterwards, 1ml spore suspension was withdrawn from each labelled plates and plated on SDA medium. The developed mutants were maintained on SDA slant at 4°C in refrigerator until use. The developed mutants and wild parents were quantified for amylase production

2.4 Quantification for amylase production

The protocol described by [4] was used in quantifying amylase production from the wild and mutant fungal isolates.

2.5 Effect of physical factors on amylase activity.

The effect of temperature and pH on the amylase activity was determined by the method described by [5].

2.6 Statistical Analysis

The experiments were carried out in replicates and the results were expressed as mean ± standard error of three values. Data obtained were subjected to one Way Analysis of Variance (ANOVA) and means were compared using New Duncan's Multiple Range Test (SPSS version 16). Differences were considered significant at $P<0.05$.

3 Results/ Discussion

Results from the study show two fungal species, *Aspergillus flavus* and *Aspergillus niger* isolated from the plantain stalks. These fungal species have been implicated in the biodegradation of agro-wastes and production of industrially important enzymes [6]. Hence, their presence on the plantain stalk indicates the biodegradation of the plantain stalk. Furthermore, *A. flavus* and *A. niger* mutant strains after exposure to 10 minutes of ultraviolet radiation were found to produce higher amount of amylase in comparison with the wild strain. This suggest that strain improvement through irradiation by UV could lead to improved amylase production by the isolates. Thymine and cytosine are reportedly sensitive to modification when exposed to UV radiation as it can lead to the production of thymine dimers that can distort the DNA helix and block further replication [7]. Several authors have reported enzyme production by microorganisms when exposed to UV radiation. For instance, a higher cellulase activity by UV mutant strains of *Trichoderma reesei* was reported [8]. However, longer exposure of the fungal strain leads to a decline in amylase production. This implies that longer exposure of the strains to UV radiation might be rather lethal than beneficial to the organisms in terms of amylase production. The catalytic activities of enzymes are reportedly temperature and pH sensitive [9]. The use of optimal temperature for enzyme activity is an indispensable parameter especially in starch processing industries [4]. The enzyme produced by the fungal strains used for this study displayed varying thermostability, acted optimally at temperature of 25^{o}C and displayed least thermostability at 60 ^{o}C. This finding corroborates with the work of [10] who reported similar thermostability range for amylase produced by *Aspergillus* species. Findings from this study showed that amylase produced by each fungal strain is pH sensitive. For instance, amylase produced by each fungal strains was optimally active at acidic or near neutral conditions (pH 5 to 6). This indicates that the fungal strain amylase prefers slightly acidic or neutral pH for its activity. This result concurs with the findings of [11].

4. Conclusion

The study has revealed the amylase producing potential of wild and irradiated strains of *Aspergillus flavus* and *Aspergillus niger*. Results from the study also showed improvement of amylase production after exposure to UV radiation after 10 mins. Furthermore, the fungal amylase was seen to be optimally active at pH 6 and temperature of 25 ^{o}C. Therefore, these strains could be employed in the commercial production of amylase and could help solve one of the challenges faced in the industrial setup where amylase utilization is high. Strain improvement is an essential part of process development for bio-products formation. Developed strains can reduce the costs with increased productivity and can possess some improved and desirable properties. In addition, the cost of disposing the plantain stalk will be reduced and environmental pollution arising from the decomposition of the wastes will be reduced as well.

Acknowledgments

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Growth evaluation of the Mozambique tilapia (*Oreochromis mossambicus*) larvae and juveniles in a chronic exposure to the HIV drug nevirapine

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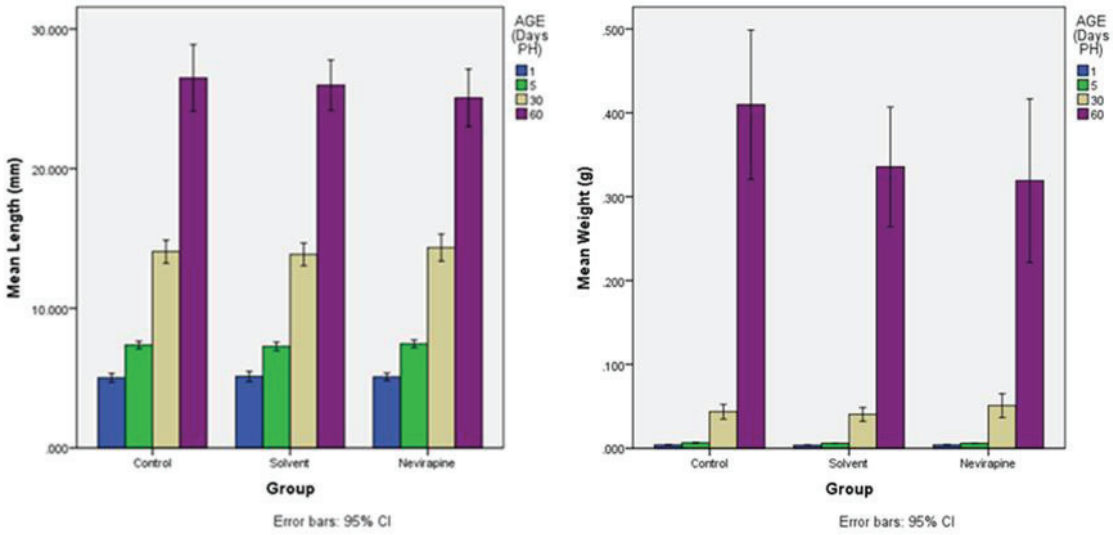

Figure 1: Mean length and weight of larvae and juveniles at day 1; 5; 30 and 60 post hatching (PH)

Abstract:
The ARV nevirapine was detected in South African surface waters and its effects on non-target aquatic organisms are currently unknown. This study aims to assess the potential effects of nevirapine on the growth of larvae and juveniles of *O. mossambicus* in a chronic exposure. Larvae and early juveniles were exposed to nevirapine (1, 48 µg/L) in a static renewal system for 60 days. Weight-length relationships were analysed for 10 individuals from each treatment group at day 1, 5, 30 and 60 post-hatching. No significant adverse effects on the growth of early life stages of *O. mossambicus* were observed ($p > 0,05$).

***Theme*:** Water

1. Introduction

One of the critical emerging pollution problems the entire world faces today is the presence of human pharmaceuticals in aquatic environments as their effects on non-target aquatic animals is still largely unknown. In South Africa, recent studies have showed that anti-retroviral drugs (ARV) are present at quantifiable levels in surface waters as well as in fish tissues [1][2]. No information is available on the potential effects of those ARV on the fish health.

According to laboratory exposures, pharmaceuticals can disturb fish physiology and metabolism including disturbance of growth and development [3]. Early life stages of fish may be more vulnerable to pollutants which may have a negative impact on fish communities and populations [4].
Fish growth is determined among others by the quality of the water. Weight-length relationships including the condition factor reflect the health condition of the fish as a result of the quality of the environment [5].

2. Methodology

2.1 Exposure conditions and procedures
The experiment was conducted in four repeats and three groups: the control (dilution water); solvent control (DMSO) and nevirapine (1,48 µg/L). The exposure started with eggs ± 24 hours after fertilization and was terminated 60 days after hatching. A controlled environmental room was used (27 ± 1^0C; 14:10 hours day/night), oxygen supplied, and the pH maintained between 7,6 and 8,1.
At day 1, 5, 30 and 60 post-hatching, at least 10 individuals from each group were sampled, the total length (TL) and wet weight were measured. The condition factor (CF) of each fish [6] and the mean specific growth rate (SGR) for each group on day 30 and 60 [7] were calculated.
2.2 Water physical and chemical parameters
The exposure media was renewed every 96 hours and the

water quality monitored daily. Nevirapine in exposure media was kept between 80% and 120% of the nominal concentration. The analyses of water were done at an ISO 17025 accredited laboratory using ultra-high-pressure liquid chromatography (UPLC) coupled to quadrupole time-of-flight mass spectrometry (QTOF/MS) [8].

2.3 Statistical analysis
The IBM SPSS Statistics software (version 24) was used for statistical data analysis with a significant level of 0,05.

3. Results and discussion
Variations were observed in the length and weight measurements of larvae and early juveniles of *O. mossambicus* in the same tank. A study on various developmental stages of *O. niloticus* from several broods found that variations in development and growth rates among fish from the same brood were mostly caused by the density of fish and the inadequate quality of food [9]. It was not the case for the present study as the exposure started with the same number of embryos in each tank for each repeat, and all larvae and early juveniles received the same treatment. The mean weight and length from day 1 to 60 are presented in Figure 1. Statistical comparison of weight and length of larvae and juveniles in the nevirapine exposed group to those from the control and solvent control groups showed no significant difference ($p > 0,05$).

A strong positive correlation was found between length and weight from day 1 to day 60 post-hatching in all the three groups: control group rho = 0,958; solvent group rho = 0, 955 and nevirapine group rho = 0, 949 (with $p < 0,0005$). The regression coefficient, R square was 0,864; 0,919 and 0, 873 (with $p < 0,0005$) for the three groups respectively. This shows that as the fish were growing, they were increasing both in length and in weight as expected.
Growing up, the CF of juveniles was getting closer to the unity which is the normal value for healthy adult fish [6]. For 60 days old juveniles, the mean CF was 1,7; 1,6 and 1,6 for the three groups respectively. Studies have showed that fish early life stages have a normal CF > 1 as they increase more in length than they do in other dimensions [5].
The specific growth rates (SGR) for the 60 days old juveniles was 7,47%; 7,13% and 7,04%. It is evident that the fish in all the three groups showed similar growth rates from the first day of their life.

4. Conclusion
This was the first study to assess the effects of nevirapine on larval and juvenile stages of *O. mossambicus*. The actual highest environmental relevant concentration (1,48 µg/L) of nevirapine in South Africa surface waters did not have adverse effects on *O. mossambicus* larvae and early juvenile's growth in terms of length and weight measurements.

Acknowledgement
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Extended Spectrum Beta- Lactamase Mediated Resistance from Abattoir Effluents

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Abstract
The increase in antibiotic resistance has become a major challenge globally. The study was carried out to detect the presence of Extended Spectrum Beta-Lactamase (ESBL) in Gram negative organisms isolated from abattoir effluents. Twenty-one (21) abattoir effluents from the slaughter slab, rinsing point and the butchering table were collected from 3 abattoirs (Choba, Mile 3 & Rumuokoro) all in Port Harcourt, Nigeria. The samples were analyzed for the presence of *Escherichia coli, Klebsiella pneumonia* and *Salmonella typhimurium*. The isolates were subjected to antibiotic susceptibility test using the disc diffusion method and they were further analysed for the presence of ESBL producers using ESBL preliminary screening and ESBL phenotypic confirmatory test. Results obtained showed total viable count of the abattoir ranged from 1.62×105 - 1.85 ×105 Cfu/ml (Mile 3), 1.78×105 - 3.0×105 Cfu/ml (Choba), 1.60×105 - 2.45×105 Cfu/ml (Rumuokoro). Percentage occurrence of *E. coli* was 35.7%, *K. pneumonia* (21.42%) and *S. typhi* (14.28%). The organisms were resistant to cephalosporin and ESBL was detected in some of the isolates.
Keywords: Abattoir, Effluents, Extended spectrum beta-lactamase, Resistance.

1 Introduction

Extended Spectrum Beta – Lactamase (ESBL) producers are Gram negative bacteria that produce enzymes that brings about resistance to most beta – lactam antibiotics (Silvia *et al*., 2014). ESBLs being plasmid mediated can easily be transmitted among members of enterobacteriaceae which may contain several antibiotic resistance determinants that can facilitate the dissemination of resistance to other commonly used antibiotics (Rottier *et al*., 2012). The abattoir industry provides domestic meat supply to over 150 million people and employment opportunities for teaming people in Nigeria. However, the abattoir industries are less developed in developing countries. Facilities for the treatment of abattoir effluents are lacking, potential health risks from waterborne pathogens can exist in water contaminated by abattoir effluents, runoff from feedlots, dairy farms (Nafarnda *et al*., 2012). The study was carried out to detect the presence of ESBL mediated resistance in Gram negative organisms isolated from abattoir effluents.

2 Materials and Methods

2.1 Collection of samples and analysis

A total of twenty-one (21) abattoir effluents samples from the slaughter slab, rinsing point and the butchering table were collected from 3 abattoir (Choba, Mile 3 & Rumuokoro). Each water sample was inoculated into freshly prepared Eosin - methylene blue agar, Salmonella – Shigella agar and MacConkey agar and incubated at 37^0C for 24hrs. Colonies were counted; sub- cultured and identified using standard microbiological techniques.

2.2 Antimicrobial Sensitivity Testing

Susceptibility was determined by the Kirby Bauer disc diffusion method as described by CLSI (2013) using 24 hours culture prepared using Mac Farland Standard was swabbed on to surface of Mueller Hinton agar Plates and antibiotics disc were placed and incubated at 37^0C for 24hrs.

2.3 Detection of Extended Spectrum Beta – Lactamase

ESBL was detected using CLSI screening method and phenotypic confirmatory method. Screening method involved Ceftazidime, ceftriaxone and cefotaxime discs were placed on a Mueller Hinton Agar plate at appropriate distance and incubated aerobically overnight (18-24 hours/37°C). Isolates showing an inhibition zone size of ≤22 mm with ceftazidime ≤25 mm with cefriaxone and ≤27 mm with cefotaxime were positive for ESBL which were confirmed using the phenotypic confirmatory test by the disc diffusion method. ESBL was confirmed using Ceftazidime disc without clavulanic acid and ceftazidime with clavulanic acid combination discs were placed on the same plate and incubated aerobically overnight (18-24 hours/37°C). The isolates showing an increase in zone size of 5mm or more around ceftazidime with clavulanic acid as compared to ceftazidime alone were confirmed to be ESBL producer (Giriyapur *et al*., 2011).

3 Results/ Discussion

E. coli, K. pneumonia and *S. typhimurium* were isolated from the abattoir effluents, the highest in occurrence was *E. coli* (35.7%) followed by *K. pneumonia* (21.42%) and *S. typhi* (14.28%). Total viable count of isolates from the abattoir ranged from 1.62×105 - 1.85 ×105 Cfu/ml (Mile 3), 1.78×105 - 3.0×105 Cfu/ml (Choba), 1.60×105 - 2.45×105 Cfu/ml (Rumuokoro). High counts of *E. coli* (1.85×105) was observed in the rinsing point of Mile 3 abattoir, *K. pneumonia* (3.0×106 Cfu/ml) was higher in Choba. High counts of *S. typhi* (2.45×105 Cfu/ml) were observed in the slaughter slab of Rumuokoro abattoir.Antibiotic susceptibility tests results obtained showed clear zones of inhibition for *E. coli* (0-25 mm), *K. pneumonia* (0-28 mm) and *S. typhi* (18-20mm). Most of the isolates were resistant to third generation cephalosporin like the Ceftazidime, Cefuroxime and

Cefixime. Out of the 10 isolates, ESBL was detected in 7. Effluents from abattoir are often discharged into water bodies without treatment, thus resulting in serious health hazards due to its contamination by bacteria. These water bodies are used by individuals for different purposes which in one way or the other get in contact with humans. This makes these water bodies serve as a source of contamination by infected animals or sewage from animals (Sehgal *et al*., 2008).

The study revealed the presence of 3 organisms namely; *E. coli, K. pneumonia and S. typhimurium*. The presence of these pathogenic bacteria suggests the presence of other opportunistic and pathogenic bacteria. It should not be concluded that the abattoir effluents contain only these three organisms since the study was based on only samples studied. The butchering table had the least number of isolates (17.8%) while the rinsing point had the highest number of isolates (28.56%), this might be attributed to the fact that the butchers place their foot wears on the place where the meat is washed, the blood and faecal matter from the animals. The isolates were resistant to most of the antibiotics. Based on this abattoir effluents should not be discharged directly into water bodies because they can lead to the increase in drug resistant organisms.

4 Conclusions

Untreated abattoir wastes like blood, faeces and intestinal contents discharged into the environment and water bodies contain large amount of bacteria which are multi – drug resistant and ESBL producers pose serious public health issues to humans.

Acknowledgments

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Fisheries and Aquaculture Vulnerability to Climate Change

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Abstract
Department of Agriculture, Forestry and Fisheries (DAFF) assessed the vulnerability to Climate Change (CC) of all South African (SA) marine fisheries, including the marine aquaculture sector. Vulnerability indices were assigned to 16 different fisheries/fisheries groups and the marine aquaculture sector. These took into account a) the sensitivity to CC of each resource and the fishery dependent on it, b) the potential impacts on human livelihoods of environmentally-induced changes in the resource, and c) the ability of the fishery to adapt to such impacts.

Themes— Climate Change and Food security.

1 Introduction

The Vulnerability index for an exploited natural resource as the product of 3 indices, viz: a Sensitivity index indicating the sensitivity of the resource and fishery to climate change, an Impact index indicating the impact on earnings, employment, food security and community well-being caused by adverse changes in the system and/or fishery, and an Adaptability index quantifying the ability of those who exploit the resource to adapt to these impacts.

2 Methods

2.1 Sensitivity Index

The sensitivity of the resource was rated 1 (low), 2 (medium) or 3 (high) based on whether the concerns about the effect of CC on resource abundance, distribution and behaviour were mostly low, medium or high. The sensitivity of the fishery was similarly rated from the overall level of concern about reduced catching efficiency, damage to infrastructure (vessels and factories), increased production costs and deterioration in the quality of sea water used in production.

2.2 Impact index

The prioritisation of loss of income, loss of jobs, reduction in food security and breakdown of community was noted. Each factor was given a Priority rating, with the highest priority being given a score of 1, the second highest a score of ½, and the other two a score of zero. These ratings were weighted by a Value rating of 1, ½ or 0 according to the relative value of that aspect of the fishery compared to that of the other fisheries. The weighted ratings for each of the 4 aspects are added to give an overall Impact Index for the fishery.

2.3 Adaptability Index

The adaptability was rated from 1 (highly adaptable) to 4 (completely unable to adapt) on the basis of the adaptability of humans to each of the 7 negative effects.

3 Discussion

With the exception of the recreational and the (very small) demersal shark fishery, people engaged in the Line Fish sector appear to be by far the most vulnerable to climate change because of a) the sensitivity of both the resources and the various fisheries to climate change, b) the importance of these fisheries in terms of employment and social value, and c) their very low capacity for adaptation. Despite the very high value of the fishery in terms of revenue and employment, people employed in the demersal fishery appear to be less vulnerable than those in many of the other fisheries because the resources themselves seem to be relatively insensitive to environmental change, and the fishery is in any event well able to adapt to changes in the resources on which it is based. The lowest Vulnerability indices are those for fisheries which are of little value in terms of direct income and employment (i.e. large pelagic fish and sharks, the recreational fishery, demersal sharks, small invertebrates and seaweed, and South Coast rock lobster). Aquaculture, and the fisheries for West Coast rock lobster, small pelagic fish and the jig fishery for squid were all scored as intermediate. This was accepted as being realistic in general, although it was noted that the relative values could change substantially as a result of subsequent changes to the indices and any re-weighting of them.

4 Conclusions

The fisheries most vulnerable to CC appear to be the Line

Fish fisheries (particularly the commercial small boat, small-scale and net fisheries), followed by the fishery for small pelagic fish (sardine, anchovy and round herring) (see Table 1). The former is driven by the large number of people likely to be affected by CC, and their very poor ability to adapt to it, and the latter by the economic value of the catch and the large number of people involved in the fishery. The demersal fishery, although generating even greater income and employing more people than the small pelagic fishery, was rated less vulnerable because of its greater capacity to adapt. In all variants, intermediate vulnerability ratings were also accorded to the West Coast rock lobster and squid fisheries, and the aquaculture sector. Fisheries employing relatively few people and/or generating comparatively little income, such as the fisheries for abalone, large pelagic fish, sharks and small invertebrates, were rated as least vulnerable, irrespective of whether their perceived sensitivity to changes in the environment was taken into account or not.

Acknowledgments

The contributions made by the various DAFF Working Groups are appreciated in the compulsion of the Vulnerability survey.

Table 1: Vulnerability Indices.

	Sensitivity Index	Impact Index	Adaptability Index	Vulnerability Index	Rating
3 Abalone	2	0.25	3	1.5	L
4 Aquaculture	3	1.25	2	7.5	M
5 Demersal	1	1.5	1	1.5	L
6 Large pelagics & sharks	1	0	1	0	L
7 Line fish					
9. Commercial (small boat)	3	3	3	27	H
Recreational	1	0	1	0	L
Small scale	3	3.5	2	21	H
Netfishery	3	1.75	4	21	H
Demersal sharks	3	0	2	0	L
8 Rock Lobster					
South Coast	1	0.25	2	0.5	L
West Coast	1	1.5	2	3	M?
9 Small invertebrates & seaweed					
Oysters	1	0	3	0	L
White mussels	1	0	3	0	L
Seaweed	1	0	3	0	L
10 Small pelagics					
Sardine	3.0	1.5	2.0	9	M
Anchovy/round herring	3.00	1.25	3.0	11.25	M
11 Squid					
Jig	2	1.5	1	3.0	M?

Development of a Non-Derivatizing molten hydrate salt pretreatment system for South African corn cob: A preliminary investigation

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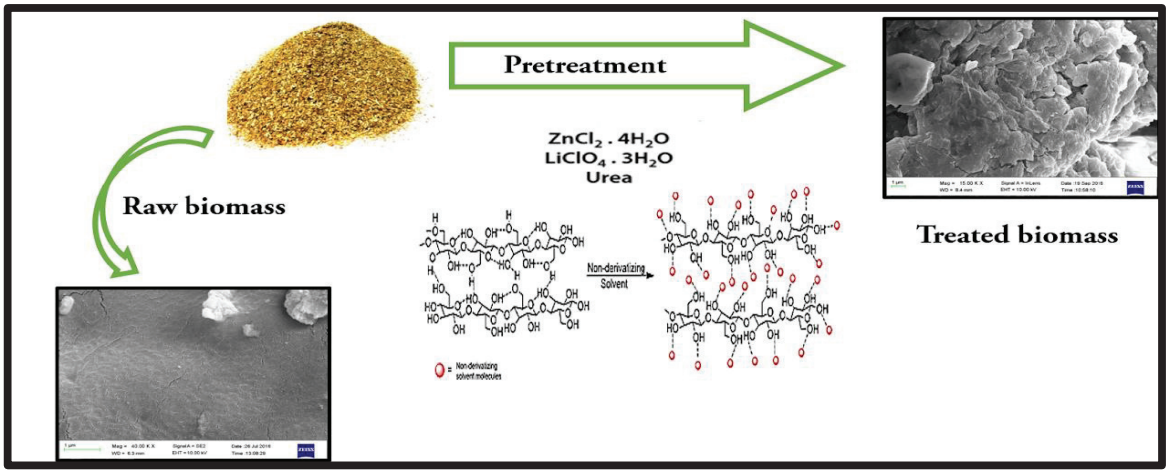

Figure 1: Scanning electron micrographs of raw biomass and $ZnCl_2.4H_2O$ treated biomass

Abstract

The future widespread production of biomass-derived fuels, chemicals, and materials requires cost-effective processing of sustainable feedstock. Pretreatment is arguably the most expensive processing step in the processing of lignocellulosic biomass. Seven molten salt hydrate systems namely, unary, binary and ternary mixtures are proposed in this study. The study is aimed at determining a novel pretreatment process which is less energy intensive, generates less waste and is both environmentally and economically more attractive than conventional routes. Outcome of the preliminary investigations show favourable amounts of polysaccharide fractions (68%) in the corn cob waste. In addition, pretreatment with the unary complex ($ZnCl_2.4H_2O$) was able to deconstruct the biomass. Although in its preliminary stage, the results show the feasibility of the study in the determination of a novel pretreatment process for corn cob waste. However, further research effort is needed to expand on the feasibility.

1 Introduction

There is currently a global energy crisis which has resulted from the increase in demand for energy from rapidly industrializing nations, the dwindling petroleum and natural gas supplies as well as the detrimental effects of carbon dioxide emissions from fossil fuels on climate change. To supply the changing world demands without further damaging the environment, the current oil-based economy must be switched to a bio-based economy. Bio-based products can be developed to replace existing petroleum-based product. Lignocellulosic biomass (LCB) which is abundant, cheap and does not contribute to net CO_2 emission is and alternative source for the biorefinery to produce energy and platform chemicals currently produced from oil refinery [1]. However, the natural recalcitrance of LCB is a major challenge to achieving enzymatic hydrolysis. Therefore, there is a need to develop efficient pretreatment technologies that will be economical and environmentally friendly to do this.

Examples of LCB are agricultural residues, such as corn stover as well quickly grown grasses or plants, such as switchgrass. In South Africa, there is immense potential in the beneficiation of corn cob waste as large quantities of the waste are discarded annually. Corn cob waste often causes environmental pollution due to lack of its effective utilization or disposal. The conversion of the waste corn cobs to valuable chemical products is therefore extremely important. Due to the recalcitrant nature of lignocellulose, however; it is very challenging to process the biomass into chemicals for value-added products [2]. As a result of the low solubility of the cellulose in common solvents, it is often required to use environmentally hazardous and/or costly systems to dissolve cellulose and separate the lignocellulosic components. A variety of studies have been done on the dissolution of cellulose, however, few studies have been done on the use of cellulose solvents on the pretreatment of lignocellulosic material. Awosusi *et al.* investigated the effect of water of crystallization of $ZnCl_2$ on the pretreatment of biomass and reported that the

highest overall yield of fermentable hexose sugars was achieved using $ZnCl_2.4H_2O$ pre-treatment of the cob samples at conditions of 70 ^oC for 1 h and 4-d enzymatic digestion using cellulase [3]. Finding environmental friendly and economically feasible solvent systems, such as molten salt hydrate systems, which are able to pre-treat lignocellulosic biomass efficiently is of extreme importance. This study therefore seeks to compare the efficiency of seven different molten hydrate salt solvent systems on the pretreatment of South African corn cobs towards developing an efficient environmentally benign solvent for LCB treatment. The efficiency will be assessed as the ability for the pretreatment to retain polysaccharide fractions, and lignin removal post-pretreatment as well as the physical deconstruction of the biomass.

2 Method/Experiment/Body

The raw corn cob waste is subjected to seven different pretreatment solvent systems namely unary: $ZnCl_2.4H_2O$, $LiClO_4.3H_2O$, and Urea binary: $LiClO_4.3H_2O$/Urea and $ZnCl_2.4H_2O$/Urea and ternary: $LiClO_4.H_2O/ZnCL_2.4H_2O$/Urea at 70$^oC$ for 60 minutes. Physicochemical properties of the corn cob were determined prior to and post pretreatment in order to determine the efficiency of the solvent systems during the pretreatment. The chemical characterisation done by compositional analysis of the solid and liquid fraction. The important mass balances used for analysing the efficiency of pretreatment processes include glucose, xylose and lignin balances. The efficacy of the pretreatments will be determined according to the amount of polysaccharides retained in the solid fraction, the solubilisation of hemicellulose and the removal of lignin.

For the physicochemical characterisation, the treated biomass will be analysed using Scanning Electron Microscopy (SEM), Light Microscopy (LM), X-ray Diffraction (XRD), Fourier Transform Infrared Spectroscopy (FTIR) and a rheometer. SEM and LM analysis will be used to observe any effect of the pretreatments on the surface morphology of the biomass. XRD analysis will be conducted to see whether the pretreatments had any effect towards the crystallinity of cellulose while FTIR analysis will be done to determine the presence and absence of important functional groups of the biomass. In addition, the rheometer will be used rheological properties of the biomass slurry after pretreatment.

3 Results/ Discussion

Compositional analysis of the corn cob prior to pretreatment shows hemicellulose with the highest percentage at 42% followed by cellulose at 26% and lignin which is a combination of AIL (Acid insoluble lignin) and ASL (Acid soluble lignin) at 23%. The extractives which consist of chlorophyll, waxes, fats, resin acids, terpenoids, phenolic substances, and gums makes up 9% of the biomass composition. These results show a favourable amount of the polysaccharide fractions which is promising for the fermentation to biochemical and biofuels.

Preliminary investigations into the feasibility of using molten hydrate salts as a pretreatment method for corn cob waste shows that the unary complex ($ZnCl_2.4H_2O$) pretreated biomass undergoes a structural change to a more roughened and compacted surface morphology compared to the SEM of the untreated corncob which revealed a smooth, intact surface with ordered fibres (figure 1). These changes in the supramolecular structures can be attributed to the molten salt solubilizing the cellulose by the interaction between ionic species and hydroxyl groups which breaks the hydrogen-bonding network and separates the lignocellulosic components.

4 Conclusions

Corn cob waste was treated using a mixture of various molten hydrate salt systems and the resulting residues characterised.

The following conclusions were drawn from the study.

1) As a whole, corn cobs are promising resources for biofuel and biochemical production. The compositional analysis shows that there is an adequate amount of carbohydrates in the corn cob samples which is indicative of high theoretical fermentable sugar yields.

2) Based on the SEM analysis, the deconstruction of the biomass cell wall is achieved by the pretreatment of the biomass at 70^oC for 60 minutes in $ZnCl_2.4H_2O$

These results correlate with previous work done by Awosusi *et al*. The pretreatment process is however still in the infant stages, and more efforts are needed to further characterise the pretreatment residues and optimize the operation as well determine a kinetic model of dissolution.

Acknowledgments

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Composite "Ogi" Liquor: An effective Alternative to ORS in the Management of Diarrhoea caused by *Escherichia coli* O157: H7

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Plate 1: Production of "Ogi" for LOFCO using indigenous technology

Abstract
Administration of Oral Rehydration Solution (ORS) is a simple way of treating diarrhoeal patients. This is primarily to prevent complications such as dehydration and loss of electrolytes. However, since it is possible that the sachet of the special salts for preparing the solution may not be available in cases of emergency especially in rural areas, there is the need to search for an alternative in treating diarrhoeal patients. In this study therefore, the liquor of 48h fermented composite "ogi" (LOFCO) was investigated as an alternative to ORS by comparing their chemical compositions using standard assays and also their effect when administered to albino rats infected with *Escherichia coli* O157:H7, the aetiologic cause of haemorrhagic diarrhoea. It was observed that LOFCO has similar chemical compositions with that of ORS and also caused the recovery of rats infected with *E. coli* O157:H7 unlike the ones that were administered ORS that did not recover throughout the duration of the investigation. From this study therefore LOFCO is being recommended as a better alternative to ORS since in addition to having similar chemical composition which can be exploited in replenishing lost electrolytes and minerals during episodes of diarrhoea, it also has therapeutic effect on rats infected with *E. coli* O157:H7.

Themes **-** Public Health Sciences (including Medicine)

1 Introduction
Diarrhoea is one of the leading causes of infant mortality. One of the organisms that cause diarrhoea is a strain of the bacterium, *Escherichia coli* called enterohaemorrhagic *Escherichia coli* (EHEC). This organism causes a type of diarrhoea that is referred to as haemorrhagic diarrhoea. In addition, it causes life threatening conditions such as haemolytic uremic syndrome and occasionally kidney, especially in young children and the elderly. Infections caused by this organism are however difficult to treat because the organism is known to be resistant to many antibiotics. Moreover, the use of antibiotics can also precipitate complications [1]. Oral Rehydration Therapy (ORT) is a simple way of treating diarrhoeal cases. It is used to prevent dehydration and replenish the nutrients and electrolytes that are lost during episodes of diarrhoea. It consists of sodium salts, a carbohydrate and water. It is prepared by dissolving readymade packets of these salts, that is, oral rehydration salts in clean water [2]. However since it is possible that access to sachet of oral rehydration salts may be limited especially in rural areas, the possibility of using the liquor of fermented composite "ogi" (LOFCO) was investigated as an alternative to ORS. LOFCO is the liquor on top of composite "ogi" that is normally poured away to scoop the slurry when one wants to prepare pap. Pap is a popular weaning food in Nigeria.

2 Method/Experiment/Body
2.1 Source of *E. coli* O157:H7/Preparation of LOFCO
E. coli O157:H7 used in this study was obtained from the Microbiology Department, University College Hospital, Ibadan, Oyo State, Nigeria while LOFCO was got from composite "ogi" prepared from the following grains; Red guinea corn (*Sorghum bicolour* L), millet (*Pennisetum typhoideum* L) and yellow maize (*Zea mays* L.) (ratio 1:1:1) according to [3]. The grains were purchased from a local market in Akure, Ondo State, Nigeria. The brand of ORS salt used was Hydrolyte Oral rehydration Salt, (NAFDAC REG. No. A4-2156) produced by Archy Pharmaceutical Limited, Lagos, Nigeria. Wistar albino rats (n=15), aged 5-6 weeks with weight averaging 45g were used for the *in vivo* assay. They were bought from the Department of Animal Production and Health (APH), Federal University of Technology, Akure, Ondo State, Nigeria.
2.2 Determination of the chemical composition of LOFCO

The glucose content of LOFCO that was used for the therapeutic assay was analysed according to the method described by Shankara [4] while sodium and potassium salts present in LOFCO were analysed using the methods described by Harries [5] and AOAC [6] respectively.

2.3 Infection of rats with *E. coli* O157:H7 and effect of the administration of LOFCO or ORS on the infected rats.

Prior to infection with the organism, the rats were observed for a period of 14d for any sign of illness before they were orogastrically infected with the determined infectious dose (1.8×10^6 cfu/ml) of the organism in another assay [7]. After infection, the rats were daily examined for signs of illness such as weakness, loss of appetite, unformed stool. At the onset of symptoms of infection, the rats were divided into three groups (5 rats per group). The first group was given LOFCO, 1ml; four times per day, the second group was given 1ml of ORS, 1ml, four times daily while the third group was left untreated. The rats were daily observed for signs of recovery. All the rats were kept on broiler's starter and sterile water throughout the period of the investigation.

3 Results/ Discussion

The LOFCO used was observed to have similar chemical compositions with that of the ORS used except that it has no sodium citrate but it has lower values of sodium chloride (2.93g/l) and glucose (13.40g/l) which were very close to that of WHO standard [8] which are (2.60g/l) for sodium chloride and (13.50g/l) for glucose respectively, unlike that of the ORS used which were higher (3.50g/l for sodium chloride and 20.0g/l for glucose) (Table 1). In the therapeutic assay, the infected rats which were administered LOFCO recovered 72h after the commencement of the treatment but those that were administered ORS did not recover throughout the 120h duration of the investigation (Table 2). The observation that LOFCO has similar chemical composition with that of ORS shows that, it can be exploited in the absence of ORS for the restoration of electrolytes that are lost during episodes of diarrhoea. Moreover, the recovery observed in the infected rats by the 72nd hour of administration of LOFCO showed that LOFCO has therapeutic potential while the none recovery of the ones administered ORS throughout the 120h duration of the investigation showed that ORS does not have therapeutic potential. The therapeutic effect displayed by LOFCO might be as a result of metabolites produced by lactic acid bacteria, *Lactobacillus plantarum* and fungi such as *Saccharomyces cerevisiae* and *Candida krusei* that have been reported by a couple of researchers to be present in fermented "ogi" [3]. The inability of ORS to mediate recovery of the infected rats lends credence to the fact that its usage in diarrhoeal cases is just to restore the electrolytes and fluids that are lost during episodes of diarrhoea [2].

Table 1: Comparison of the chemical composition of LOFCO and ORS

Chemical/Electrolyte	Composition (g/l)		
	A	B	C
Potassium chloride	1.86	1.50	1.50
Sodium chloride	2.93	3.50	2.60
Sodium citrate	0.00	2.90	2.90
Glucose	13.40	20.00	13.50

Key: A= LOFCO; B= ORS; C= WHO standard [8] (2006).

Table 2: Effect of LOFCO or ORS on the recovery of albino rats infected with *E. coli* O157:H7 and on their stool by 72h of administration

Rat group/Treatment	Observations
I	A, RA, FS, SF
II	W, LA, FS, SF
III	W, LA, US, DF

Key: I = LOFCO; II= ORS; III= Infected but not treated with ORS or LOFCO; A= Active; W= Weak; RA= Restored appetite; LA = Loss of appetite; FS= Formed stool; US = Unformed stool; SF =Smooth fur; DF = Dull fur

4 Conclusions

From this study, LOFCO appears to be a better alternative to ORS because it has therapeutic effect in addition to having similar chemical composition with ORS which can only checkmate dehydration. Therefore LOFCO is being recommended instead of ORS for the management of individuals infected with *E. coli* O157: H7 because of the dual effects.

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Adsorption of BTEX Compounds from Water Using Green-Synthesized Iron Nanoparticles

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Abstract
This study reports the adsorption of benzene, toluene, ethylbenzene and xylene (BTEX) compounds from water using iron nanoparticles synthesized from green tea leaves. The iron nanoparticles were applied to BTEX-contaminated water and the adsorption capacity of the nanoparticles, as well as the equilibrium isotherms were determined. The results showed that the iron nanoparticles had a higher adsorption capacity for toluene, ethylbenzene and xylene while benzene was the least adsorbed compound in the group. The results also showed that the adsorption of BTEX by the nanoparticles was best described by Langmuir kinetics. This study highlights the possibility of applying green-synthesized iron nanoparticles to water polluted with mono-aromatic organic compounds.

Themes—Water.

1 Introduction

In line with the United Nation's Sustainable Development Goals, access to clean and safe water is a global priority (Griggs *et al.,* 2013). As a result, intense research efforts have focused on the development of novel materials and systems for potable and wastewater treatment. Of these efforts, nanotechnology-based systems are fast becoming popular (Wang *et al.,*2014). The use of nanoparticles for the removal of various pollutants and pathogens have been reported; of which iron nanoparticles, in the form of iron oxide or nanoscale zero-valent iron are the most commonly reported. The green synthesis of these nanoparticles (Crane and Scott, 2012), which focuses on the elimination of environmentally-destructive chemical residues, and their effective activity against a variety of organic and inorganic pollutants has been reported.

In the face of declining water quality and recalcitrant organic pollutants, green-synthesized nanoparticles present an array of water treatment possibilities that may be beneficial, not only to the water sector, but also to the environment. In this study, we report the synthesis of green synthesized nanoparticles and their application to BTEX-contaminated water under different pH and salinity conditions.

2 Method

2.1 Iron Nanoparticle Synthesis and Characterization

Green-synthesized nanoparticles were produced in the laboratory using a technique adapted from Huang *et al.,*(2014). 0.1 M $FeSO_4.7H_2O$ (Sigma Aldrich) was prepared. Five grams of green tea leaves was added to 150 mL distilled water and incubated at 80°C in a water bath for three hours. The green tea filtrate was collected using a laboratory sieve and incubated at 25°C for one hour to allow for cooling. 75 mL of prepared $FeSO_4.7H_2O$ was added to mixture and incubated on a rotary shaker at 35°C for six hours. At the end of the incubation period, the solution was centrifuged at 6000rpm for 15 minutes to collect the black pellets that formed. The pellets were washed with distilled water three times and dried overnight at 50°C.

2.2 Adsorption and Equilibrium Studies

Adsorption capacity was determined by using equation (1) to determine the amount of each BTEX (mg) taken up per gram of the adsorbent. Linear representations of the Langmuir (equation 2) and Freundlich (equation 3) isotherms were applied to the data set and the best fit was determined using the r-squared value.

$$Q_t = \left(\frac{C_0 - C_t}{m}\right)v \qquad (1)$$

$$\frac{C_e}{q_e} = \frac{1}{q_m K_L} + \frac{C_e}{q_m} \quad (2)$$

$$\ln(q_e) = \ln(K_F) + \frac{1}{n}\ln(C_e) \quad (3)$$

Where C_e is the concentration at equilibrium; q_e is the amount of adsorbate removed at equilibrium; q_m is the maximum adsorption capacity; K_L is the Langmuir constant and K_F is the Freundlich constant

3 Results/ Discussion

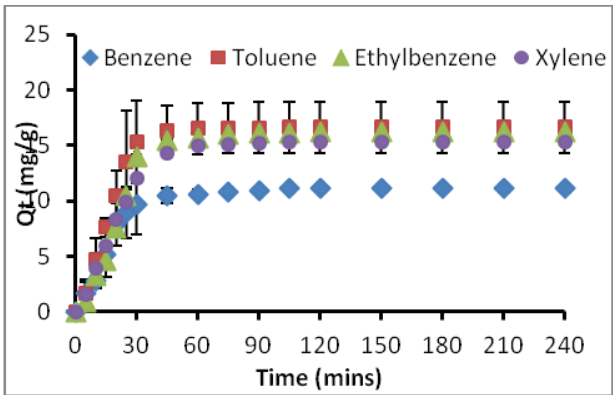

Figure 1: Adsorption capacity of green-synthesized iron nanoparticles

Benzene was least adsorbed at 11.17mg/g, while toluene, ethylbenzene and xylene were adsorbed at 16.66mg/g, 16.17mg/g and 15.29mg/g respectively. The relatively low adsorption of benzene was attributed to it being the most soluble component of the BTEX group. Benzene has a solubility of 1780mg/L while toluene, ethylbenzene and xylene have solubility values of 500mg/L, 150mg/L and 150mg/L respectively. High solubility values have been attributed to low adsorption potential in adsorption studies (Dabrowski et al., 2005).

Langmuir			**Freundlich**	
q_m (mg/g)	**K_L (Lmg-1)**	**R^2**	**K_F**	**R^2**
0.274	6.47	0.996	-	0.797

The Langmuir isotherm was a better fit for the data than Freundlich with a higher r-squared value of 0.996. The Langmuir constant showed the affinity between the iron nanoparticles and the BTEX components.

4 Conclusions

The results show that green-synthesized iron nanoparticles have the potential to remove BTEX compounds. Surface modifications such as emulsification can improve the removal of such pollutants from water.

Acknowledgments

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The Five-Factor Model: An exploratory study on the personality profile of STEM students in a Nigerian University

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Abstract
The Big Five Factor Model (FFM) is a comprehensive and current perspective in personality studies, it explains personality from five dimensions namely, Extraversion, Agreeableness, Conscientiousness, Neuroticism, and Openness. These traits have been found to be related to a wide range of life outcomes including academic performance and success. In the light of the importance of STEM in human development and advancement, it is imperative to examine the personality profile of STEM students with an aim to identify dominate traits, gender differences as well as create a platform for therapeutic intervention where counselling and guidance is required. This study therefore sought to examine the personality profile STEM students in a Nigerian University.

Theme: Education and Outreach

1. Introduction

Although we may have a number of common attributes with fellow human beings, personality is that unique way one individual differs from the other. Personality is defined as "the coherent pattern of affect, cognition, and desires (goals) as they lead to behavior" (Revelle, 2013). Personality bears a huge impact on life, it correlates strongly with life satisfaction (Boyce, Wood, & Powdthavee, 2013). Although personality studies are age long and span diverse theoretical views, the current view is that human personality can be condensed into the Five Factor Model (FFM) comprising Openness(Appreciation for art, emotion, adventure, unusual idea, imagination and curiosity) Conscientiousness (A tendency to show self-discipline, act dutifully and aim for achievement) Extraversion (Energy, urgency and the tendency to seek stimulation and the company of others) Agreeableness (A tendency to be compassionate and cooperative rather than suspicious and antagonistic towards others) and Neuroticism (A tendency to easily experience unpleasant emotions such as anger, anxiety, depression, vulnerability, hostility and impulsiveness. (Costa and McCrae (1985, Digman, 1990, Goldberg, 1993). The need to have a personality profile of STEM students cannot be overemphasised, personality profiling affords the opportunity to predict the likely course of an academic life by virtue of prevailing traits and their correlates. This provides a veritable tool for intervention where and when needed. Additionally, in an environment where science is perceived as a man's domain, it will be beneficial to see if there are gender differences in the personality profile of STEM students. This study therefore sought to examine the personality profile of STEM students in a Nigerian University.

2. Materials and Methods

The study involved three STEM based faculties of the University of Benin, Nigeria. Participation in the study was voluntary and consent was given by willing participants before the administration of the questionnaire. Respondents were consecutively recruited, only full time degree STEM students were eligible to participate in the study. The questionnaire contained three sections which sought information about the respondents' demographic data, mentoring need, challenges of STEM and the Big Five Inventory. The Big Five Inventory (John et al. (1991) is a standardized psychological assessment tool with commendable psychometric attributes. Data was analysed both descriptively and analytically using SPSS.20.

5. Results

The total number of respondents was three hundred and seventeen (M=189; 59.62%; F=128; 40.38%, 42%), with an age range of <18years to 29 years. A hundred and thirty nine (43.85%) were from the Faculty of Engineering, sixty –six (20.82%) from Life sciences a hundred and twelve (35.33%) from Physical Sciences. Our results show no significant difference in gender on conscientiousness, extraversion and neuroticism. A significant difference was found between males and females on the openness to experience trait ($X^{2=.000;\ P<}$ 0.05). Males had a higher likelihood to be open to experience. A significant difference was also found between males and females on agreeableness trait ($X^{2=.000;\ P<}$ 0.05). Males had a higher likelihood to be agreeable.

4. Conclusion

The ratio of males to females in the faculty of Engineering calls for demystifying Engineering as a male profession. The low index of openness to experience among female STEM students may be attributed to psycho-social expectations that stifles explorative tendencies. This no doubt can have far reaching effect on career development. The results reflect a need to step up the agreeableness trait among female STEM students as this is fundamental to sustaining relationships and networking for career development. The high proportion of females who had positive neuroticism traits is an

indication that female scientists are vulnerable to psychological health challenges. The need for psychological appraisal, intervention and mentoring of STEM students cannot be overemphasized.

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Plain Language funding proposals for clearer communication between scientists.

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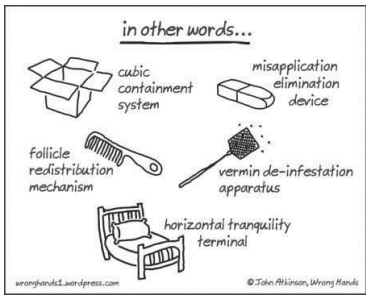

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Abstract

Communication is the cornerstone of our global society. English is widely accepted as the *lingua franca* in most scientific fields, although many scientists are not mother tongue speakers of English. Communication can therefore be hampered by a lack of vocabulary or even different "Englishes" from around the world. Because of rapid technological advancements and complex problems, scientists are often required to collaborate on projects [1]. In this context, the term *scientist* is a very broad one that includes different fields and specializations, each using field-specific terminology and concepts. For this reason, when cross-collaboration is necessary, it can be difficult for scientists to communicate with one another.

One example of where inter-disciplinary communication is necessary is funding proposals. Proposals are rarely reviewed only by scientists in the same field - usually a reviewing committee is comprised of several scientists from different specializations. Proposals risk being rejected because the message of a proposal is lost in this interdisciplinary setting. One way to better facilitate this communication process is through the use of Plain Language.

This paper, will look at sections of a rejected funding proposal and use the principles of Plain Language to illustrate how the message could have been improved through changes in the language use, structure and layout of the funding proposal.

Theme: *Science diplomacy*

1 Introduction

The Plain Language movement has been gaining traction since the 1960s, and is currently very popular in the fields of law and the medical sciences [2]. In several countries, legal documents, contracts and public health announcements have been reviewed and then rewritten into Plain Language because legalese and complex medical jargon is inaccessible to the layman. In the South African context, the writing of the *National Credit Act (35 of 2005)* in Plain Language helped to promote the public's access to fair contracts and greater transparency from financial institutions providing credit to consumers. This is one example of the direct impact of Plain Language on the public. Implementing Plain Language principles can also have a positive influence on the way research will be communicated in the future.

Currently, companies such as the Council for Scientific and Industrial Research (CSIR), the University of Pretoria and Creamer Media communicate scientific research and big projects to the public. They do this via social media and publications such as *ScienceScope*, UP's *Innovate* and commercial media such as *Engineering News*. In this effort to communicate complex ideas to the public, several problems can arise. For example, the complex ideas can be misunderstood or over-simplified because most journalists writing for these publications are not themselves scientists; or some important information can be omitted or even misinterpreted [3]. One way to improve communication with the media, is for scientists themselves to be aware of Plain Language principles. If they apply these principles from the start of a project, which often begins with the writing of funding proposals, users of such documents will already gain a clearer understanding of complex ideas and concepts. This paper will focus on how applying Plain Language principles could aid clearer communication by looking at a rejected funding proposal.

Funding proposals are often evaluated by a committee of scientists who do not necessarily specialize in the same field as the scientist(s) writing the proposals. This creates a problem because what makes a given funding proposal unique is its field-specific details, terminology and concepts. Therefore, such proposals need to be

communicated to a group of educated peers (from various fields), and need to be clear enough that the proposed research message does not get lost. Ideally, for all proposals to be evaluated on equal merit, it is important that the information be presented clearly, without misconceptions or the omission of crucial information.

A definition of Plain Language reads as follows:
A written communication is in plain language if its wording, structure, and design are so clear that the intended readers can easily find what they need, understand, and use it [4].

In Plain Language, the intended readers should always be kept in mind. It is important for readers to be able to access the information in such a way that they can find what they need from a document, without needing to read it several times. Shifting the focus in funding proposals from the author to the readers creates a need to evaluate the document in its entirety for clarity. Plain Language does not mean that a text is "dumbed down". It does mean ensuring that whatever is written takes into account what the readers already know and need to know to understand the document. Even if readers are educated scientists working in a similar field, will new concepts be clear and is the proposed research clear enough in the author's mind to be able to write about it?
Funding proposals are one example of how Plain Language can aid communication between scientists from different fields. By adhering to certain guidelines, proposal documents can be written in Plain Language from the start to promote research in the future.

2 Discussion
To be able to review whether a document is written in Plain Language or not, it is necessary for language practitioners to evaluate the document based on specific Plain Language guidelines. These guidelines cover both a micro and a macro level. At a micro level, there is a focus on sentences, forms of address, terminology and the layout of the document. At a macro level, the structuring of the information and the message of the document is reviewed. It is necessary to examine a document on both the micro and macro level because the two are linked and a document needs to "work" on both levels. Looking at the layout or design of a particular document can assist in making sure that the message comes across clearly. It is important to review headings, the overall grouping of relevant information, and alternative ways of presenting certain concepts, to ensure that no information is left out, and to avoid misunderstanding [5].
2.1 The rejected proposal
This paper will be looking at a rejected funding proposal in the fields of mechanical engineering and applied mathematics. The proposal was for the development of a software package to solve multi-physics problems. This proposal was submitted in a very specific template. Word limit constraints had to be taken into account.
Guidelines for analysing this proposal:
Main and sub-headings.
Average sentence length.
High frequency words versus low frequency words.
Presenting the information in a visually appealing way or the lack of descriptive visuals.
Field-specific terminology.

A first reading of the proposal shows a problem with the headings. Most of the main headings are noun strings and fail to indicate what a particular section is about. Thus, readers cannot identify a schema for the information. Very field-specific jargon is used and needs to be taken into account. Although specific terminology is not always a problem in the scientific community, some terms pertaining to mechanical engineering in this document could be problematic to readers with a laser physics or computer programming background, for example.
2.2 A Plain Language re-write
The proposal was re-written in a Plain Language format to allow for a comparison between the original and the Plain Language version. Only the main sections of the document will be discussed, focusing on the gist of what the software was supposed to do and how the software would have had an impact in the field. Re-writing the original also gives a researcher a chance to build vocabulary, enhancing his/her skills in presenting information specific to the software package clearly, something that can be useful for later communication with a wider audience.

3 Conclusion
Most Plain Language research and applications have focused on the fields of law and the medical sciences, but there is also a need for clearer communication between different fields in the scientific community. One way in which clearer communication can be immediately beneficial to the scientific community is in clarifying and improving funding proposals. Plain Language funding proposals can aid committees to decide where money should be allocated, by assisting the readers to understand the science behind a certain project.

Appendix
Before and after Plain Language translation of sections of a rejected funding proposal.

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Nutritional Status of Some Pregnant Women Attending Antenatal Clinic at State Specialist Hospital, Nigeria.

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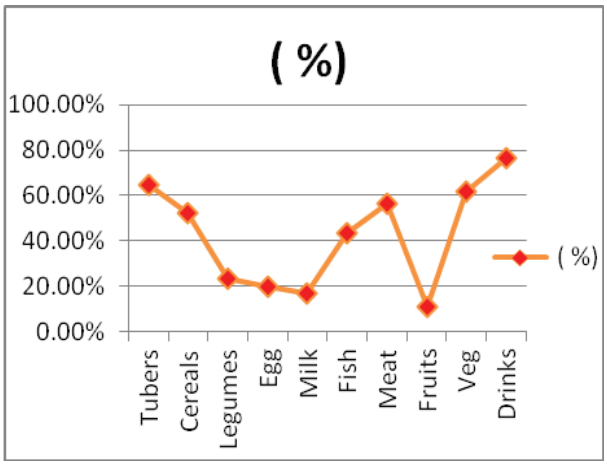
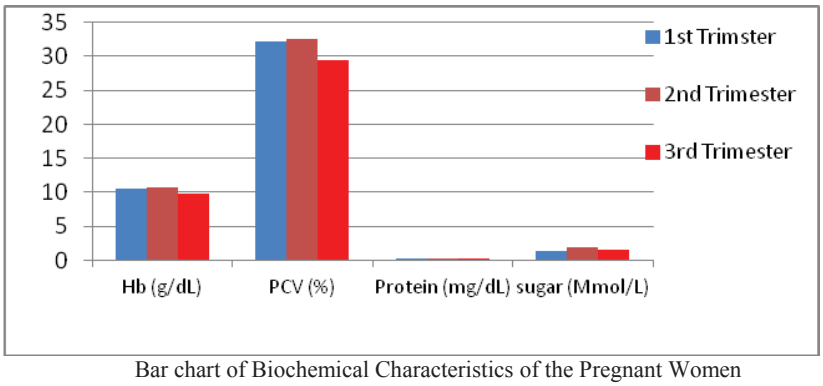
Nutrient	1st Trimester MEAN±SD	2nd Trimester MEAN±SD	3rd Trimester MEAN±SD	RDA
Calories (Kcal)	2589.45±16.32	2875.32±17.46	2945.00±18.32	2500.00
Protein (g)	41.46±13.62	43.35±14.05	43.65±14.56	65.00
Calcium (mg)	705.00±15.45	845.00±17.46	1090.00±20.03	1200.00
Iron (mg)	20.86±8.32	21.32±10.45	21.88±12.46	38.00
Vitamin A (mcg)	332.20±4.13	359.12±4.60	370.15±5.70	800.00
Vitamin C (mg)	16.32±4.02	20.13±5.30	19.02±4.60	40.00

Nutrient intake of the pregnant women in relation to different trimesters



24 Hour Dietary Recall of Food Consumed by Pregnant Women

Different Trimester



Bar chart of Biochemical Characteristics of the Pregnant Women

Abstract

The nutritional status of some pregnant women attending antenatal clinic in the State Specialist Hospital, Akure, Ondo State, Nigeria. A total of 90 pregnant women in different trimester were randomly selected. Information on their nutritional intake, 24 hour dietaty recall and socioeconomic pattern were obtained through pre-tested general assessment questionnaire. Biochemical assessment were analysed according to standard procedures of World Health Organization (WHO). The mean value of the haemoglobin ranged from 9.72 g/dL to 10.77 g/dL, Protein value ranged from 0.17 mg/dL to 0.28 mg/dL while the mean value of the level of sugar in their urine ranged from 1.13 Mmol/L to 1.89 Mmol/L. Protein, Calsium and Vitamin A and C were below Recommended Dietary Allowance (RDA). It can be concluded from this study that a higher percentage of the selected pregnant women were malnourished.

***Theme*:** Health

1. Introduction

Pregnant women need additional protein for initial deposition of pregnancy related tissue and to maintain new tissue [1]. Nutrition is a combination of processes by which living organisms receive and utilize the materials necessary for maintaining function, growth and renewal of its components. Pregnancy is an anabolic process and nutritional requirement of a women increases during pregnancy to meet the needs of the growing fetus and the maternal tissues associated with pregnancy. Since the nutritional status of the expectant mother is one of the most important determinants affecting pregnancy outcomes [2]. Throughout the world, pregnancy and lactation are considered vulnerable periods for both the mother and the child. Improving nutritional health of women before and during pregnancy is important not

only because it has implication for the mother's health but also because of link between maternal nutrition, infant health and pregnancy outcome [3].

2. Method/Experiment/Body

The study was carried out in Ondo State Specialist Hospital, Akure. The hospital is located in Akure South Local Government Area (LGA) of Ondo State.

Method

Ninety (90) pregnant women each in different trimester of pregnancy were randomly selected. Data on their nutritional intake, 24 hour dietaty recall and socioeconomic pattern were obtained through pre-tested general assessment questionnaire. Biochemical assessment were analysed according to standard procedures of World Health Organization (WHO). Data was analyzed using descriptive statistics. Blood and urine samples were obtained from the selected pregnant women for biochemical assessment according to standard procedures. This involved the collection of the blood samples of the selected pregnant women to assess their Packed Cell Volume (PVC) and haemoglobin level and the collection of their urine samples to access their urine sugar/glucose and presence of protein in urine. The mean values of the parameter were obtained. Twenty four (24) hours recall method was used to obtain dietary information from selected pregnant women. The food intake was converted to nutrient intake using the food consumption table and the adequacy of the nutrient intake was assessed by utilizing the Recommended Dietary Allowance (RDA).

Statistical analysis

Statistical analysis included descriptive statistics: percentage, mean and standard deviation (SD). The binary logistic analysis was done to test the relationship between sociodemographic characteristics and nutritional status of pregnant women. Statistical analysis was done by using SPSS, version 16.0.

3. Results/ Discussion

Nutrient Intake of the Pregnant Women in Relation to Different Trimester

The mean nutrients intake by the pregnant women in the first trimester was less than that of second and third trimester and the Recommended Daily Allowance (RDA) However, in all the trimesters, the pregnant women mean Protein, Calcium, Iron and the mean Vitamin A and C intake were below the RDA while the Calories intake were above RDA this might be as a result of high consumption calorie foods. This show that the diet of the pregnant women were not adequate to meet the requirement of nutrient during pregnancy.

24 Hour Dietary Recall of Food Consumed by Pregnant Women

Seventy six point seven percent (76.7%) of the pregnant women consume soft drinks instead of natural fruits drinks that contain more nutrients. This could be as a result of inadequate nutrition education.

Biochemical Characteristics of the Pregnant Women

The mean value of haemoglobin and PCV of the pregnant women studied were below 11gldL and thirty five percent (35%) respectively which indicated the presence of anaemia. Protein in the urine is within the normal range this indicates a good health condition.

4. Conclusions

Haemoglobin level of the pregnant women were below the normal value which indicates anaemic condition, also the presence of sugar in their urine may be as a result of type of food consumed (carbohydrate rich foods).

The actual mean intakes of all the nutrients analyzed except for the calorie were below the Recommended Dietary Allowance (RDA). Therefore, it can be concluded that effective nutrition intervention should be directed towards pregnant women to improve maternal nutritional status.

Acknowledgments

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Contribution of the UNESCO MAB Programme to Sustainable Development in South Africa

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Abstract

The UNESCO MAB Programme is spatially implemented through biosphere reserves, which are designated areas that manage the complexity of people, development and nature. Biosphere reserves are specifically aimed at showcasing sustainable development in action. South Africa has nine biosphere reserves that collectively cover approximately 9% of the country's surface area. Biosphere reserves are managed to fulfil three complementary functions of which sustainable development is one. This paper focuses on the intangible values that are generated through South African biosphere reserves. We report on a wide range of projects that are implemented in collaboration with relevant role-players. These projects contribute significantly to sustainable development, mitigate against the effects of climate change, while delivering economic benefits to local communities.

Themes— Sustainable Development; Climate Change; Environmental Education

1 Introduction

The Man and the Biosphere (MAB) Programme is a UNESCO Programme that attempts to demonstrate the reconciliation of environmental protection with sustainable development. South Africa initiated its participation in the MAB Programme in the early 1990s and entered into a country agreement with UNESCO in 1995. At present there are nine designated biosphere reserves, collectively covering an area of 111 544 km^2, approximately 9.2% of South Africa's total land area. This is clearly not an insignificant figure and demonstrates the MAB Programme's contribution to the national conservation estate.

The MAB Programme and its biosphere reserves provide an important practical means by which South Africa can achieve a number of its critical national priorities and meet numerous international commitments, including the Sustainable Development Goals (SDGs).

Biosphere reserves are constantly being changed and modernized in accordance with UNESCO's guidelines for the MAB Programme (Köck & Arnberger 2017). The new global roadmap for the MAB Programme, comprising of the MAB Strategy and Lima Action Plan (UNESCO 2017), highlights the importance of biosphere reserves in assisting countries towards achieving the SDGs, adopted by the United Nations in September 2015.

This paper supports the positioning of biosphere reserves as the actual practical implementation platforms for the MAB Programme: as critical sites for jointly promoting conservation and sustainable socio-economic development, climate change mitigation and adaptation, and improving resilience; and as sites for demonstrating the importance of ecosystem services, environmental education and transboundary provincial collaboration.

2 Methods

A social science research method was followed to obtain relevant information from all biosphere reserves in South Africa. Techniques used included unobtrusive content analysis, questionnaire surveys, and participant observations (Babbie 2010).

As a starting point, biosphere reserve documentation was reviewed to gather information. Participant observations were a consequence of the direct involvement of the researchers with biosphere reserves and related issues in South Africa (Sandström 2008). A dedicated questionnaire addressing individual biosphere reserve projects as well as on the observed value of implementing the MAB Programme, has been distributed to all South African biosphere reserves. The questionnaire was structured around four core pillars: (i) biodiversity conservation, awareness and research; (ii) employment and quality of life; (iii) ecosystem services; and (iv) facilitation.

3 Results

All biosphere reserves submitted completed questionnaires. The results included much valuable information on a wide range of projects covering different topics, such as job creation, carbon sequestration, environmental monitoring,

awareness, and ecotourism. They also provided insight into the values generated through these biosphere reserves and the role these sites fulfil in climate change mitigation, environmental education, and in promoting sustainable development practices.

The results were used to draft an informative brochure on the value generated by the MAB Programme in South Africa, as well as a documentary film that was made available to all biosphere reserves as well as online.

4 Discussion

Sustainable development, as showcased in biosphere reserves, includes sustainable environments, sustainable economies and sustainable cultural societies (Hoang 2012). All these complexities are being addressed through biosphere reserves.

Biosphere reserves incorporate three specific zones, of which the innermost core zone occupies legally constituted protected areas that offer valuable ecosystem services, both locally and regionally. Protected areas generate a large range of ecosystem services, including education opportunities, capacity building and scientific knowledge (Smit *et al.* 2017).

Biosphere reserves are large landscapes and therefore play a crucial role in securing biodiversity corridors towards mitigating the effects of climate change. Ecological consequences related to the effects of climate change often include a higher risk of droughts and floods (Meggle 2015). Such ecological changes have an undeniable economic, social and cultural impact, particularly, as is the case of South Africa, on vulnerable societies and poor populations.

As demonstrated through the different projects, biosphere reserves contribute considerably towards job creation and improved livelihoods. In addition, awareness is being raised about the interconnectedness of people with the natural environment. Local communities are included in decision-making, and sustainable living practices are being supported.

5 Conclusions

Biosphere reserves are custodians of, and co-enablers for collaborative and synergetic actions in the landscape. The UNESCO recognition elevates biosphere reserves to an international level.

Having access to the resources, experience and wisdom of others around the globe through UNESCO and the World Network of Biosphere Reserves is of immense potential value in the drive towards sustainable development. Biosphere reserves therefore aspire to become internationally recognised for their balanced and effective approach to ecological sustainability and human development.

The UNESCO biosphere reserve designation in accordance with the MAB Programme adds credibility and marketability to a specific landscape. In turn, this encourages investment into ecological management, provides socio-economic opportunities and enhances environmental and social well-being.

Appendix

Questionnaire on the value of the MAB Programme in South Africa – 2016.

Acknowledgments

All biosphere reserve management entities are acknowledged for sharing information on relevant projects and activities. Local communities linked to the biosphere reserves are thanked for their support and for telling their stories.

The Cape Winelands Biosphere Reserve kindly provided funding towards a film that was produced as a secondary part of this research.

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Technology Divide among Urban Female Youth

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Abstract
Laboratory studies are crucial for subjects such as Electrical and Computer Engineering (ECE) which is considered to be one of the emerging subjects of choice among students of Bangladesh. However, a technology divide is observed in the laboratory-based classes where female students are not very vocal or participative as they are in their corresponding theory classes. We have conducted a two year long study on students to find out reasons behind such division and possible ways to improve the laboratory education in a way it is inclusive regardless of gender where we share some findings here.

Themes—Education and Outreach

1 Introduction

In recent years, there have been numerous efforts to increase the number of female presence in technology related fields in educational institutions, laboratories and workforces. Activities include initiatives where events are either female only or require mandatory female presence in groups in workshops, programming events, discussion sessions, conferences etc. This trend is visible even in a developing country like Bangladesh which prides in being visionary to prioritize female issues. We take a look at the current status of urban female youth in technology fields through ongoing positive initiatives.
Women facing technology divide is not a new problem. The early leadership of female computer scientists were later dominated by their male colleagues [1] which continues over social, political and cultural barriers. Gender disparity has been the focus of researchers for long periods of time starting at the beginning of computational studies [2]. There has been an array of research focusing on the apparent fear in women to pursue technology based opportunities [3]. The problem exacerbates in Bangladesh, where a preconceived notion of topics exist which influence a person to choose a particular subject. There has been in-depth studies showing female undergraduates are encouraged to study the social-sciences over engineering sciences [4]. We cover an in depth literature review in the following section.

We focus on qualitative analysis of current situation of urban female youth in Bangladesh. We look at the group who are privileged compared to other population groups of Bangladesh and try to shed light on existing opportunities and challenges that still exist in technology related fields.

2 Qualitative Studies

Methods: We have focused on a qualitative study which is based on a quantitative questionnaire based study conducted previously [4]. We considered multiple events to engage Undergraduate students along with conducting several focus group discussion sessions. We conducted two female only academic events (poster competition) where the call for poster asked for only female participation. We had three female only focus group discussions – one included only female undergraduate students, one included female professionals (all from academia) and the last one included a mixed gender session.

Findings:
Support from Authority and Community: From the very beginning, every event organized received support from various authorities showing that infrastructural barriers are not present.
Reluctant Participation of Female Students: It was alarming to find out very low number of female participation in female only events.
Support from Male Faculty Members: The event was actively supported by many male faculty members along with female faculty members. In female only events, male faculty members often do not participate in discussions anticipating uneasiness.
We have observed findings from the mixed gender sessions.
Male Dominated Leadership: One drawback of the mixed gender activity showed male dominance in leadership roles. This is a general problem in group activities and must be considered seriously.
The female only focus group had interesting findings:
Eagerness from Male Students: Many of the male students have visited the organizing authority and asked for their inclusion so that they can raise their voices regarding various challenges.
Inherent Barriers: Female only sessions of academics and students revealed that there is a personal barrier to break that is inherent from social setup.
Fear to make Mistakes: Female only sessions opened up the fact that there is a fear in Laboratory classes to make mistakes in the fear of what others would think of the student.
The mixed gender session initiated interesting findings:
General Negative Perception: There was a perception that female students do not participate in active learning and they are asked to write the reports rather than conducting an experiment.
Exploitation of Perceived Weakness: Male students mentioned that there are few female students who would use the general concept that they are weaker in laboratory materials and would ask male classmates to work on behalf of them.

The general findings were similar in each discussion where the social barriers, personal barriers and perceptions were the main concerns.

3 Discussion

The study on urban female engineering students opens up challenges that are not generally addressed or discussed. However, the lower number of active participants in academic events (poster competition) shows that there are untold challenges.

The fear of making mistakes or what others would think of the female student is a problem discussed in many of the discussion sessions. The generalized way to blame female students for one incident triggers such reservation even more.

It is evident that there is a great requirement to generate awareness regarding ongoing challenges which could improve the situation. Female students should know of the existing challenges that are not personal for a single person, but it is evident in many others which could allow them to fight such challenges.

4 Conclusions

Laboratory education itself requires different skill sets compared to traditional theory classes in Undergraduate Universities. In laboratory classes, one has to really think of a solution towards a particular problem, solve the problem, test it - all within the required time of the particular laboratory class. Limited number of instructors often prioritizes to help only few students where female students often fall behind. On top of that, female students have shown a tendency not to share their problems easily. Many factors are at work here which varies from the fear of what others might think of her to not preferring to be visible. Moreover, a male student often is exposed to machineries earlier compared to his female classmates. All these factors affect a particular female student who in turn shows poor performance or performance that is not very enthusiastic. We have spent two years discussing, observing classrooms and working our solutions suggested by the fellow students to improve the situation. Some solutions were straightforward and could be tried in laboratory classrooms while others require awareness generation and long-term changes. However, we consider this work to be valuable as it initiates the conversation where female students are sharing the barriers they are facing. That day is not far where many of the female students will take leadership positions and contribute towards positive changes. A solution local to Bangladesh may pave the way towards a global solution strategy.

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Citizen Perceptions: A trajectory on the effectiveness of prepaid water meters in Harare

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Abstract

Prepaid water meters have been contentious in Harare, even prior to their implementation with residents citing that the new tools are an unbiased technology which is simply meant to benefit the service provider, whilst restricting potable water consumption. This study articulates that despite the resident's views on prepaid water meters, potable water should not be distributed free of charge, but yet it should be available as a fundamental need. Through a mixed method research design, 271 structured questionnaires were administered to Harare residents in enabling the provision of a measurement of the resident's views regarding the metering system and the descriptive statistical analysis was used to determine the results. Ten interviews were also conducted with key informants based on their expertise as the service providers instigating the prepaid water meters. Two focus group discussions with two of the civil water organizations that are crucial catalysts between the Harare City Council and Harare residents were also conducted. Conclusively, the aim of this study was not to disregard prepaid water meters but to understand their efficacy through the lens of the citizens as the service users whose role is very vital role in enabling the effectiveness or ineffectiveness of the meters. Furthermore, this study ultimately recommends that the effectiveness of prepaid water meters will only be successful with due reflection on all-encompassing stakeholder engagement and pro-poor approaches.

Themes— Smart cities; Water

1 Introduction

This study addresses the extensive question of the efficacy of prepaid water meters through the citizen's lens by striking a balance between the Human rights-based approach and the systems theory to water. This study espouses the deviating interpretations on the effectiveness of prepaid water meters, with some citing that the tools effectively strike a balance between social parity and institutional sustainability (Mudzingwa, 2015). McDonald (2002) posits that a prepaid water meter is a definitive cost retrieval tool which is able to execute the computation of water volume used by coercing payment. Swyngedouw (2006) asserts that prepaid water meters enable service providers to evade the costs aligned to non-payment and debt accrual because the water valve automatically shuts down when credit is exhausted. McDonald (2002) further applauds prepaid water meters for being the most appropriate system that promotes payment of services to ensure efficient revenue collection as opposed to conventional water meters which deliver water on credit. There are no other remarkable merits over conventional water meters other than the presumptuous hopes of revenue accrual. Matabvu (2015) affirms that water prepayment transfers accountability to residents who are left at the expense of the metering system which disconnects them when they fail to recharge. It becomes imperative to empirically understand these realities by questioning why the Harare City Council is advancing with prepaid water meter implementation, which has already been forbidden in other developing and developed countries. The core of this study is not to totally disregard prepaid water meters as being anti-poor, but to acknowledge that their effectiveness with adequate support of the public.

2 Method/Experiment/Body

Purposive sampling was used to select the participants from civil water organizations who formed part of the focus group discussions.

Systematic sampling was also used to select the Harare residents who formed part of the survey, because it adopts simple random sampling at the beginning in order to establish a sampling interval which creates a quasi-random selection method. The estimated representative sample size was derived

through the Raosoft sample size calculator for the maximum variability of the sample based on the entire Harare population (Raosoft, 2004). The author then used descriptive statistical methods through SPSS to analyse the findings of the study as gathered from the survey. Content analysis was used to analyse the interviews because it gave a descriptive presentation of data, thematic analysis was ultimately used in discussing the common and recurrent themes from the data gathered.

3 Results/ Discussion

A greater population of the Harare residents actually rely on boiling water or disinfecting it through filtration or using water disinfectants. Empirical evidence from this study shows that, out of the total respondents, 31.8% disagreed and 22.7% agreed on the satisfaction with post-paid water meters. Residents also argue that in the context of Zimbabwe as a fragile state Prepaid Water Meter's (PPWM'S) are not sustainable because water is a human right and citizens will be affected when they do not have credit, which will expose them to water-borne diseases (WHO, 2015; UNICEF, 2016). Residents ultimately confirmed that the City Council should restructure the existing system and ensure constant potable water supply to meet the water demands before implementing PPWM's because PPWM's will certainly not guarantee water supply. Feedback from the research also comprehended that PPWM's will unfortunately not meet the potable water needs of the residents because they do not change the source of raw water, rather they only change the methods of payment. Hence the residents dispute the effectiveness of PPWM, citing that they are simply an expensive extension of the corrupt City Council. The study comprehended that the City council is being ignorant of the technological aspect of the PPWM set-up and simply capitalizing on profit accrual. As a matter of fact, profit accrual might not be as successful as projected because there is a national cash-crisis and this might ultimately further set the city council back into overwhelming debt (Matabvu, 2015; Nhema & Zinyama, 2016).

4 Conclusions

In conclusion, the aim of this study was not to disregard prepaid water meters but to understand their efficacy through the lens of the citizens as the service users who play a vital role in enabling the effectiveness or ineffectiveness of the meters. Likewise, in identifying the perceptions of the Harare residents regarding the effectiveness of prepaid water meters for concrete potable water supply, the study admits that there are diverse responses from the residents. It is reflective from the responses that some residents are actually very receptive to the PPWM's citing that they will ensure accountability and value for money. Simultaneously, some of the residents are still unreceptive of the PPWM's citing that the Harare City Council coerced them and thus they feel deprived of their citizenry rights. Hence, the study confirms that the implementation of PPWM's for potable water supply in the absence of public participation from the Harare residents is irrational.

Acknowledgments

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A Mixture GARCH approach to Crude oil price Volatility with extensions to Financial risk modelling

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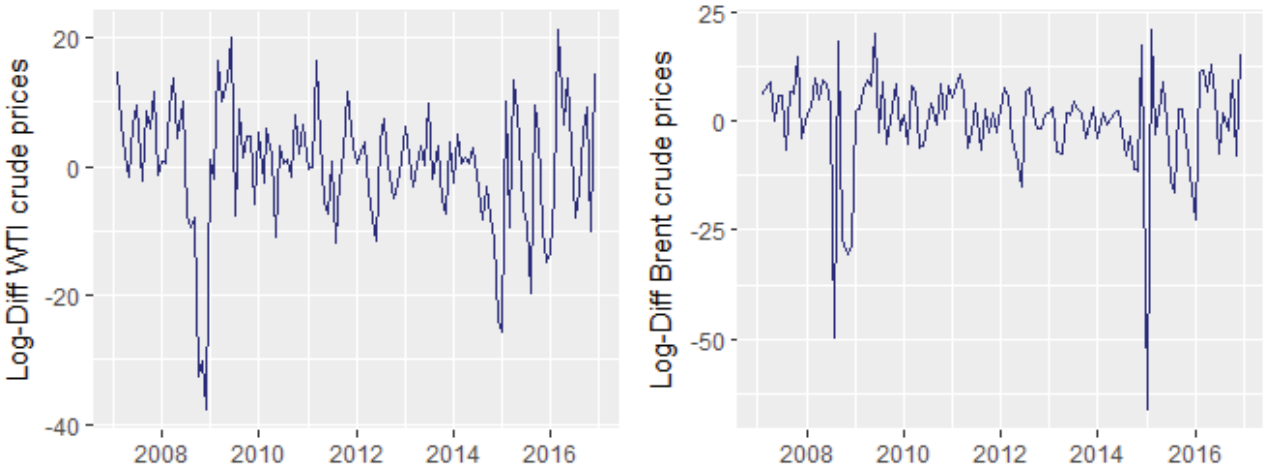

Log-difference of WTI and Brent crude prices from January 2007-December 2016.

Abstract

This paper applies selected Mixture and 2-regime Markov switching asymmetric GARCH models in estimating volatility and consequently computing value-at-risk (VaR) on log-difference WTI and Brent crude oil prices from January 2007 to December 2016. This was done by considering a mixture of Student's-t distributions with varying variances over different time and regimes. Mixture GARCH models were compared to their single regime asymmetric GARCH variants and 2-regime Markov switching counterparts. We found that although the Markov switching models were able to adjust for spurious high persistence found in the single regime asymmetric GARCH models. Under relative performance and hypothesis-testing evaluations, the VaR forecasts derived from the Markov-switching GARCH models were not necessarily preferred to their Mixture regime counterparts.

Themes— Oil prices, Value at Risk, Makov Switching, Asymmetric GARCH, Backtesting

1 Introduction

Many world economies including the Nigerian economy has in the recent years taken a huge hit as a result of recent oil price fluctuation. Some studies involving crude oil prices include [9] who forecasted crude oil market volatility using both single regime and regime switching variants of selected GARCH models.[1] studied the effect of exchange rate policy and falling crude oil prices on the Nigerian stock market.[4] investigated oil price risk in some emerging stock markets. [3] applied VECM to the oil price and stock market relationship and found that oil price shocks leads to a fall in stock market returns.

This study applies selected Mixture and Markov switching GARCH models to average monthly closing price of the West Texas Intermediate (WTI) crude oil from January 2007 to December 2016, average monthly closing price of the Brent crude oil price from January 2007 to December 2016. Value at Risk (VaR) was predicted and back-tested based on each of

the models. The back-test results were compared to select the optimal models for capturing volatility and consequently VaR forecast performance.

2 Method

The single, mixture and 2-regime Markov-switching variants of the following asymmetric GARCH models were considered. 1. sGARCH ([5]) 2. GJR-GARCH ([6]) 3. EGARCH ([7]) 4. TGARCH ([8]) The models are estimated by the Maximum Likelihood (ML) technique. Risk forecasts are backtested using the Unconditional Coverage(UC) and Conditional Coverage (CC) tests of as well as the DQ test Furthermore, for each of the models, Diebold Mariano tests were applied to pairs of their Markov switching and mixture variations.

The data is composed of 120 Brent and WTI monthly oil prices between 2007-2016

3 Results/ Discussion

Descriptive statistics revealed that the average monthly price of WTI over the period considered was 78.45USD with the highest monthly price over the period being recorded as 136.70USD and lowest monthly price over the period as 31.28USD while that of Brent was 84.04USD with a maximum price of 135.38USD and minimum price of 31.22USD over the period considered. Both the WTI and Brent price series were negatively skewed. The Jarque Bera and Phillips-Perron Unit Root Tests reveal that both price series are non-stationary,hence, log difference of the two price series were computed and subsequence analysis was conducted based on the differenced series. Preliminary model diagnostics based on the AIC and BIC selected the mixture of TGARCH models as the optimal model for the WTI price series while the sGARCH model was selected as optimal model for the Brent price series. 1% and 5% VaRs were generated based on each of the sGARCH,GJR-GARCH,EGARCH and TGARCH model variants considered. The VaR results were backtested at both 5% and 1% VaR level of significance. It was observed from the VaR back testing procedures that for the Unconditional Coverage(UC), we accept the null hypothesis of correct exceedances for all the models. Furthermore, the Conditional Coverage(CC) test results reveal that the not only do all the models predict

Although all the models seem to do well in predicting the correctness of exceedances and independence, the DQ test results reported slightly better performance with the Markov-switching models. Diebold Mariano (DM) tests however revealed equal accuracy between the Markov switching and mixture model variants.

4 Conclusions

This work investigated the comparative advantage of selected Makov switching and mixture variants of selected asymmetric GARCH models in capturing the dynamics and forecasting 5% and 1% VaR for monthly prices of WTI and Brent crude. The VaR forecasts were backtested using both frequency based tests (Unconditional coverage (UC) and Conditional coverage (CC) tests) and regression based tests (DQ test). Accuracy of pairs of Makov switching and mixture variants for each model type was also investigated using the Diebold Mariano (DM)tests. Backtest results reveal no significant difference between model performance and accuracy of one Makov switching variant over the mixture variant.

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Disseminating Innovation on Dry Season Rice Farming in Remote Communities in Kwara State, Nigeria: Extension Volunteers to the Rescue

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Abstract

The abysmally low extension agent to farmer ratio is a significant challenge to the dissemination of information on dry season rice production in Nigeria. This case study explores the use of agricultural science teachers of secondary schools in remote, rice-growing communities of Kwara State as volunteer extension service providers, particularly to ameliorate rice farmers' annual loss to flooding through the introduction of dry season rice farming. Fifty-two agricultural science teachers were trained, and each was deployed to one of the fifty-two farmer –groups into which the rice farmers in the study area had been divided. A field survey was carried out with the use of an interview schedule to assess the effectiveness of the teachers in extension service delivery. Descriptive statistical tools, the Probit and Multiple Regression models were used to analyse data collected. Results reveal a high level of effectiveness, influenced by the age of the teachers, their level of education and distance to clientele.

Themes— Education and outreach

1 Introduction

Rice farmers in rural areas of Nigeria have inadequate information on dry season rice farming. Unfortunately, the trio of poor infrastructure, insufficient number of extension agents (EAs) and dwindling allocations to extension has resulted in the almost total neglect of remote communities in the country [1]. Extension experts from the University of Ilorin, as part of spirited efforts at community development, developed a proposal and secured a grant from the African Forum for Agricultural Advisory Services (AFAAS). The project involved improving access of rice farmers to extension using agricultural science teachers as volunteer EAs. The Universal Basic Education Programme of the Federal Government of Nigeria provided schools within walking distances in rural communities. These schools have agricultural science teachers who reside in these communities, in most cases are natives, and speak the local languages. Teachers are highly respected, and their opinions held in high esteem in rural communities. Importantly, they possess a background in agriculture, and with the right training and some empowerment, they

can function as EAs to farmers in their neighbourhood. The idea is premised on the theories of social change and process of change [2]. The broad aim of the initiative is to improve farmers' access to agricultural extension services by engaging agricultural science teachers as volunteer EAs. Specifically, this study: determine the willingness of agricultural science teachers to serve as volunteer EAs; compared the level of access of rice farmers to agricultural advisory services before and after the commencement of the project, and assessed the effectiveness of the teachers in extension service delivery.

2 Method/Experiment/Body

Edu and Patigi Local Government Areas were purposively selected for the project because they are the hub of rice production in Kwara state. All 52 available Agricultural Science teachers in the two Local Government Areas were trained and attached to a farmer-group for service delivery. Two seasons into the project, three farmers each were randomly selected from the 52 farmer-groups that benefitted from the project to give 156 respondents for the farmers' survey. A questionnaire was administered to the teachers while a structured interview schedule was used to elicit information from the farmers. Descriptive statistics, a five-point Likert-type scale, Ranking and the Multiple Regression Analysis were used to present and analyse the data collected.

3 Results/ Discussion

Results reveal that 89% of the teachers were willing to serve as volunteer extension service providers. The parameter estimate from the Probit Regression Analysis shows that the age of the teachers negatively influenced their willingness at $P<0.05$ while their level of education positively influenced willingness at $P<0.01$.

Findings also show that before the commencement of the project, 36% of rice farmers in the study area were not aware of the existence of extension service providers. 39% had no extension contact during the immediate past 12 months period while 25% had received a maximum of two extension contact in the 12 months period considered. Two planting seasons into the project, 27.6% of the farmers had extension contacts fortnightly, 57.0% weekly and 15.4% had more than one contact per week.

With mean scores of 4.09, 3.91, 3.89 and 4.40, the volunteer Eas were most effective in imparting record keeping skills, disseminating information on increasing quantity and quality of produce, better post-harvest handling, and reduction of crop loss to flooding. The teachers were least effective in facilitating access to farm credit (Mean score = 1.44), linkage with cheap sources of input (mean score = 1.24). On the average, the overall mean score of 3.32 indicates a high level of effectiveness of the teachers. Multiple Regression Analysis to identify possible predictors of the level of effectiveness of the teachers show that age of the teachers (-0.523), their levels of education (0.819), and distance to clientele (-1.872) explained 42.2% of the variations in the level of effectiveness of the teachers in providing extension services to the farmers.

4 Conclusions

Findings lead to the conclusion that agricultural science teachers are willing and can be effective volunteer agricultural Extension Agents to farmers within proximity to them. However, support in the form of training and supervision should be intensified for older teachers and those with lower levels of education. It is also important that their activities should be limited to farmers in their proximity for effectiveness. The unique advantage of this initiative is the multiplication of agricultural extension service providers at minimal cost thereby enhancing farmers' access to extension services. The cost implication and institutional framework should be worked on in a bid to assess the possibility of extending same to other rural communities.

Acknowledgments

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Implementation of a pathology-supported genetic testing strategy to detect common risk factors shared between breast carcinoma and associated comorbidities

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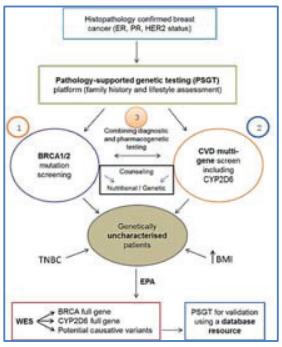

Abstract

Obesity constitutes a major risk factor for cardiovascular disease (CVD) found to equal or exceed recurrence risk in breast cancer survivors. The aim of this study was to compare the prevalence of obesity and other cardio-metabolic risk factors between estrogen receptor (ER)-positive and ER-negative breast cancer patients participating in a chronic disease screening program. Eighty-eight breast cancer patients were screened for variation in the methylene tetrahydrofolate reductase (*MTHFR*) gene as part of a CVD multi-gene assay performed in conjunction with a medical and lifestyle assessment. Based on family history and age at diagnosis, extended mutation screening of the *BRCA1* and *BRCA2* genes were performed in genetically uncharacterised patients. Body mass index (BMI) was found to be significantly higher in ER-positive compared to ER-negative breast cancer patients (p=0.028), independent of age or *BRCA* mutation status. Presence of the apolipoprotein E (*APOE*) E4 allele reduced the mean age of breast cancer diagnosis/onset by an average of 10 years, regardless of ethnicity, alcohol consumption, current smoking and a family history of cancer (P=0.003). *MTHFR* 1298 A>C was furthermore found to be significantly associated with BMI, after adjustment for ethnicity and a family history of cancer (p=0.01). Co-inheritance of *MTHFR* 677 C>T and genetic variants involved in blood clotting could partly explain co-morbidities known to be associated with anti-cancer treatment. Routine assessment of BMI alongside genetic screening for molecular commonalities may identify treatment targets across clinical entities and at the same time serve as a screening step for identification of breast cancer patients eligible for extended genetic testing using whole exome sequencing (WES).

Themes — Health

1 Introduction

Most studies fail to demonstrate a significant overall survival difference between sporadic and familial breast cancer caused by mutations in the two major tumour suppressor genes, *BRCA1* and *BRCA2* [1]. This finding confirmed the importance of lifestyle factors and genetic risk modifiers as determinants of adverse clinical outcome across breast cancer subtypes. Obesity constitutes a major risk factor for CVD found to equal or exceed recurrence risk in postmenopausal breast cancer survivors. Due to the known effects of obesity, alcohol and smoking on DNA methylation implicated in breast cancer and its associated comorbidities such as depression and CVD, genes involved in the folate-homocysteine pathway are important therapeutic targets in relation to both gene-diet and gene-drug interaction. In this study, we sought to determine whether a pathology supported genetic testing (PSGT) strategy [2] used to assess CVD risk in breast cancer patients, facilitates differential diagnosis of inherited and lifestyle-related breast cancer towards selection of genetically uncharacterised familial cases for WES.

2 Method

2.1 Study population

The study population included a subset of the validation data set (including a total of 87 patients) comprising 83 (60 Coloured and 23 Caucasian) breast cancer patients for whom ER-status was available [3]. This patient group was combined with 81 (with known ER status) of the 88 breast cancer patients in the implementation data set derived from the chronic disease risk screening program. HER2 status,

determined only in the implementation data set using immunohistochemistry (IHC), was confirmed by fluorescence in situ hybridisation in equivocal IHC2+ cases. Age was used as a proxy for menopausal status using a cut-off age of 50 years to define postmenopausal status.

2.2 Methods

All patients were screened using a CVD multi-gene assay previously described by Kotze and Thiart [3]. to determine the extent to which comorbidities, some of which may be treatment-related, matched or were discordant with the test results. A combined service delivery and research approach was used to identify breast cancer patients in the implementation data set considered for BRCA mutation screening based on well-established referral guidelines including early age of onset and a family history of cancer [4].

3 Results/ Discussion

Genotype-phenotype association studies demonstrated that presence of the *APOE* E4 allele reduced the mean age of breast cancer diagnosis/onset by an average of 10 years in South African breast cancer patients, regardless of ethnicity, alcohol consumption, current smoking and a family history of cancer (P=0.003). MTHFR 1298 A>C was furthermore found to be significantly associated with BMI, after adjustment for ethnicity and a family history of cancer (p=0.01).

BMI was found to be significantly higher in ER-positive compared to ER-negative breast cancer patients (p=0.028), independent of age or *BRCA* mutation status. Seventeen patients included in the implementation data reported treatment-related side effects, including chemotherapy-induced cognitive dysfunction and/or drug resistance/side effects related to the concomitant use of tamoxifen/aromatase inhibitors. In addition, four patients reported side effects with the use of aromatase inhibitors and other drugs.

Genotype-phenotype correlation of these 17 cases showed that in eight patients, the clinical profiles matched their genetic test results. Four (4.5%) breast cancer patients reported symptoms of cognitive impairment, two of whom tested positive for both the risk-associated *APOE* e-4 allele and the *MTHFR* 677 C>T mutation previously linked to this condition. A total of 27 (30%) breast cancer patients reported a comorbid diagnosis of depression, 12 (44%) of whom were *MTHFR* 677 T-allele carriers. Of the nine patients who tested positive for mutations in the factor II and V genes, four *MTHFR* 677C>T carriers (out of 7 patients) also experienced deep vein thrombosis and/or recurrent pregnancy loss.

4 Conclusions

We demonstrated the potential value of the CVD multi-gene assay performed alongside the assessment of relevant non-genetic data to guide clinical and therapeutic decision making across clinical entities. A multi-disciplinary approach to chronic disease risk management could assist clinicians in the development and timely implementation of personalized lifestyle-based intervention strategies aimed at decreasing cumulative cardio-metabolic risk in patients with or at risk for breast cancer. In addition to its added value in the context of chronic disease risk screening, the clinical application of our PSGT approach could also assist clinicians in the identification of patients set to derive optimal benefit from extended genetic testing including *BRCA1/2* mutation screening and ultimately WES in genetically uncharacterised patients or those experiencing drug side effects or failure [5]. A genomic solution is provided to facilitate the lowering of cumulative risk and at the same time identify the need for further analysis beyond the limitations of the CVD multi-gene assay.

Acknowledgments

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Numerical Simulation of the Flow Dynamics of CerebroSpinal Fluid along a Shunt Device in Patients with Hydrocephalus Pathology

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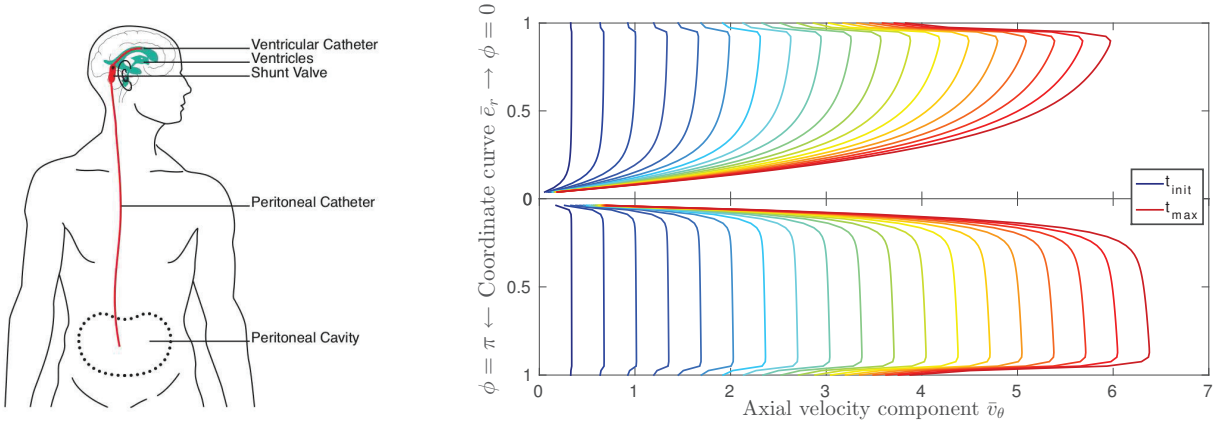

Ventriculoperitoneal shunt implanted into human body for cerebrospinal fluid drainage [1] (left) & Expansion throughout time of the axial velocity component evaluated at the end of the ventricular catheter and induced by an upstream pressure force (right).

Abstract

This project focuses on the CerebroSpinal Fluid (CSF) flow problems into a shunt circuit implanted in patients with hydrocephalus pathology. This medical device has a flow-regulating valve that encounters many types of failure after surgery. We will show that the shunt malfunctions are only caused by the dynamic of flow upstream of the valve. The physical properties of fluid flow will be well known only in the ventricular catheter (VC) with toroidal geometry, via the resolution of Navier-Stokes equations. An ideal geometry for the VC will be find accordingly to calculated velocity and pressure fields, initial conditions and outflow constraints. A 3D fluid flow theoretical model with dimensionless Navier-Stokes equations expressed in curvilinear coordinates, conservative form and in physical basis will be developed. To avoid the difficulties to evaluate the nonlinear Navier-Stokes partial differential equations and pressure gradient term computation, numerical techniques such as Finite Volume Method and Fractional Step Method will be choosen to discretize the spatial and temporal derivatives. The implemented numerical code will be validated. And a cross-correlation function between initial conditions and geometry of VC (curvature, section, position...) will be established for neurosurgeons.

Themes— Theoretical & Computational Fluid Dynamics, Health.

1 Introduction

The human brain is enveloped and protected by a colorless liquid named CerebroSpinal Fluid. This fluid composed by 99% of water, is produced in the ventricles. Sometimes, an accumulation of CSF inside the skull, caused by a mismatch between CSF production and resorption into its circulation system, leads to hydrocephalus. This condition is not a disease but a disorder of cerebrospinal fluid hydrodynamics which can induce brain damage [2]. The consequences are the augmentation of intracranial pressure and the enlargement of the cranium during childhood. The solution is to drain the CSF surplus by ventriculoperitoneal shunt [3]. This treatment includes many complications and $40 - 50\%$ of patients with implanted shunts are evaluated with device failures during the two first years after surgery [4, 5] (mechanical failure of flow-regulating valve, obstruction of drains and valve, overdrainage caused by a high pressure gradient between inflow from ventricles to valve by gravity effect). Frequent revisions are required in these cases in adults or during infancy. The shunts malfunctions are entirely a hydrodynamics issues upstream the valve. The aim of this project is to simulate the flow dynamics in VC. The CSF drainage will be optimize in order to make the valve mechanism more efficient. It will be necessary to know the optimal values of velocity and pressure fields in VC and its ideal geometry. These parame-

ters will satisfy the initial conditions and respect the outflow constraints. A local problem described by the Navier-Stokes equations will be solved.

2 Method

The local pressure and velocity fluctuations will be provide by the theoretical formalism of Navier-Stokes equations. The curvature of VC is similar to toroidal geometry. The equations of motion are expressed in curvilinear coordinates then particularize in toroidal coordinates. The physical characteristics of fluid flow model is given by these equations in physical basis with physical components [6], in 3D, dimensionless and conservative forms. Our ideal geometry of catheter will be find accordingly to calculated pressure and velocity fields. The equations are completed by initial and boundary conditions. The theoretical model due to the nonlinearity of the advection term of Navier-Stokes PDE is complicated to solve and can be simplified with reasonable hypothesis conform to the physics of the problem. And the pressure which is a fundamental parameter in medical practice, is accessible only in gradient term and therefore complicated to compute. We used numerical analysis to discretize and solve equations (Computational Fluid Dynamics : CFD). Several numerical methods for spatial discretisation were developed these last decades. We adopted a fractional step methods (projection method) to discretize the temporal derivative and separate the pressure and the velocity computations [7, 8], and the Finite Difference Method to discretize the primitive variables over a staggered grid.

3 Results

We implemented the discretized model in computer and established a numerical code. This numerical process simulates the CSF hydrodynamics into the VC we can geometrically compare to a $1/4$ of a ring donut ($\theta = \pi/2 \rightarrow 0$; $\varphi = 0 \rightarrow 2\pi$; $R/r_0 = 100$, with R the major radius and r_0 the minor radius). The second figure above shows how the axial velocity component progress throughout the time if we evaluate it on the node located at the exit of the catheter. The figure on the top describe the velocity profiles when $\varphi = 0$ (above the catheter axis i.e. above $r = 0$). And the figure on the bottom characterizes the same velocity profiles for $\varphi = \pi$ (below $r = 0$). The input velocity profile injected is parabolic with a maximal value on the axis ($r = 0$) set at 1. The Reynolds number which describe the importance of the inertial forces compare to the viscosity forces $\mathrm{Re} = 100$ i.e. we are in the low Re flow (laminar flow) in order to avoid the turbulent case. According to the amplitude and width of the velocity profiles in the figure, the energy of the flow when $\varphi = \pi$ is higher than for $\varphi = 0$ because of its deformation due to the curvilinear geometry and the gravitational effect.

4 Conclusions

With an adequate numerical method, we are able to discretize and calculate the pressure gradient term. And the computation of primitive variables i.e. the pressure p on each node over our grid and the resulting velocity components ($\bar{v}_r$ and $\bar{v}_\theta$) throughout the interfaces downstream is decoupled for the temporal discretisation. The velocity profile in the spanwise direction was neglected when we compare it to the streamwise component $\bar{v}_\theta$. As expected, we have an θ-quasi-unidirectional non-symetric flow. *In fine*, some criteria will be established for the neurosurgeon who will no longer have to take chances during the shunt implementation.

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Modelling Ammonia-Nitrogen Fate and Transport in UMngeni River.

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Abstract

Water scarcity is a major global challenge, and South Africa is one of the countries facing this challenge. The increasing drivers of challenges in access and use of water are climate variations, population increase, industrialization, and urbanization. These drivers have too exacerbated both surface and groundwater pollution resulting in limited access to clean water. The emerging changes in the character of solute transport have no doubt compromised water quality, and hence limiting accessibility to potable water. Water quality modeling is a useful tool in assessing water quality status and restoring river water quality. A conceptualized Hybrid-Cells-In-Series model with ammonia oxidation (HCIS-NH_3) is used to simulate water quality status along river reaches in UMngeni River. The advantage of HCIS-NH_3 model is that it considers first-order ordinary differential equation whereas the well-known Advection-Dispersion Equation (ADE) model considers second order partial differential equation. Variations in stream geometry, flow, and kinetic reactions can also be accounted in the HCIS model as a variable parameter model which is restricted in case of the ADE model due to the limiting assumptions. Accounting this flexibility of the HCIS Model, this study developed further model components to simulate Ammonia-Nitrogen through mass balance in all cells of the model. Synthetic and field data were used to test the HCIS model's potential to simulate Ammonia-Nitrogen fate and transport. The simulation results are as expected and demonstrated the scope of the proposed model.

1. Introduction

Rapid development such as industrialization, urbanization and extreme population growth has caused enormous amounts of chemical and wastewater effluents to be discharged into rivers (Kumarasamy, 2015; Olaniran et al., 2014). South Africa is one of the countries facing water scarcity amid increasingly high water demands (Olaniran et al., 2014). Increasing water scarcity has limited the access to good water quality often causing water poverty as well as associated illnesses. The Hybrid Cells in Series (HCIS) model is used to simulate selected water quality

parameter. This model is made up of three different cells namely a plug flow cell and two unequal completely mixed cells with interchangeable residence time parameters, all coupled into series within a single hybrid unit (Ghosh et al., 2008; Kumarasamy, 2015). In this study the HCIS model is coupled with ammonia kinetic component, to simulate ammonia-nitrogen fate and transport along UMngeni River, Durban, South Africa.

2. Methodology

In order to simulate ammonia concentration along a river reach, a river reach is conceptualized to consist of series of hybrid mixing units. Each hybrid unit is comprising one plug flow and two well mixed cells, having residence times T_1, T_2 and T_3 respectively, all connected in series. Details of pollutant movement and mixing processes in each cells of hybrid model are illustrated in Figure 1.

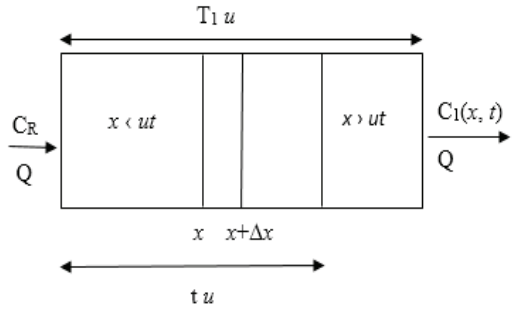

Figure 1: Ammonia-nitrogen concentration through a plug flow cell.

3. Results and Discussion

The observed data for ammonia concentration collected from UMngeni Water is compared to simulated ammonia concentration using the HCIS-NH_3 model. The simulated data compared to observed data indicated that HCIS-NH_3 model can be used to simulate ammonia concentration along UMngeni River. The reduction of the peak ammonia concentration is due to the distance traveled from the point of injection downstream, algae consumption, the transformation of ammonia, and ammonia dilution along the stream which is due to dispersion and molecular diffusion. Other factors that affect ammonia concentration reduction along hybrid units are re-aeration and high flow velocity as a result of high rainfalls. Ammonia oxidation plays a significant role in ammonia concentration transformation which results in concentration reduction.

4. Conclusion

Introduction of ammonia oxidation rate into HCIS model results in simulation and prediction of ammonia transport. The model takes into account advection and dispersion with three-time parameters (T_1, T_2, and T_3), whereas previous water quality models such as ADE and CIS only consist two-time parameters (advection and dispersion). The two parameters for completely mixed cells can be varied, and T_3 can significantly affect the input of the HCIS unit impulse response. The HCIS model's capability to simulate pure advection, advection, and dispersion makes it being the more suitable model for pollutant transport.

Appendix

Appendix consists of data collected to complete simulate ammonia-nitrogen using the HCIS-HN_3 model. Thus, is daily and monthly rain fall data, river discharge, pollutant concentration from UMngeni River, Midmar Dam discharge, and electrical conductivity.

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Estimation of zero rebate knock-out barrier options using antithetic Monte-Carlo simulations

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Abstract

The valuation of barrier options have attracted enormous attention in finance, owing to the fact that they are risk hedging tools utilized by investors and market practitioners. This research work considers the pricing of zero rebate knock-out barrier options from an antithetic Monte-Carlo perspective. The exact prices, used as benchmark of the simulation are obtained from the extended Black-Scholes pricing formula for barrier options. Thus, the research will focus on comparing the prices of the ordinary Monte-Carlo simulation (MCS) and the antithetic variate Monte-Carlo simulation (AMCS) to the exact price. Furthermore, error analysis and computational efficiency of both simulation method will be investigated. Computational results show that AMCS, as a variance reduction technique, provides more efficient result.

Themes— Industrialisation

1 Introduction

Barrier options are class of path dependent exotic options which are traded both over the counter and at standardized exchange derivatives market. Barrier options are either activated or extinguished when the underlying asset breaches a specific barrier level. They are generally cheaper when compared to the standard vanilla options and they pose difficulty during hedging, owing to their path-dependency nature. Regarding their popularity, barrier options trading account for "50% of the volume of all exotic options and 10% volume of all traded securities" [2].

The potential impact of this research is not to put forward a new formula for obtaining the prices of barrier options. However, we seek to estimate these exotic knock-out barrier options (basing our estimated results on the theoretical prices found in existing works of literature) using AMCS approach as well as, to carry out a comparative study on barrier options. Hence, this research aims at estimating the values of the zero-rebate knock-out barrier options using AMCS approach.

2 Method

We introduce the simulation techniques used in the barrier options pricing. The extended Black-Scholes price formulas for the exact prices of barrier options can be found in [1].

2.0.1 Pricing knock-out barrier option using AMCS

The underlying asset price dynamics is described by the stochastic differential equation below:

$$\mathrm{d}S(t) = S(t)(r\mathrm{d}t + \sigma \mathrm{d}Z(t))\,, \tag{1}$$

where the risk-free interest rate is denoted by r. Also, $Z(t) \sim \mathcal{N}(0,t)$, is the Brownian motion defined in the risk-neutral probability measure. Equation (1) is obtained using Ito's lemma, and the solution is:

$$S(t) = S(0)\exp\left(\left(r - \frac{\sigma^2}{2}\right)t + \sigma Z(t)\right). \tag{2}$$

AMCS involves introducing negatively correlated random variables and applying them in the discretized forms[1] of equation (2). Hence, we have:

$$S^{\pm}(t+\Delta t) = S(t)\exp\left(\left(r - \frac{\sigma^2}{2}\right)\Delta t \pm \sigma(\sqrt{\Delta t})\epsilon\right), \tag{3}$$

where ϵ follows a standard normal distribution with the parameters $\epsilon \sim \mathcal{N}(0,1)$. Next, the payoffs are discounted using the risk-neutrality concept. For the zero rebate down-and-out (ZRDO) barrier call options, the discounted payoffs are[2]

$$v^{\pm}(t+\Delta t) = \mathrm{e}^{-r\Delta t}\max\{S^{\pm}(t+\Delta t) - K, 0\}\,. \tag{4}$$

Finally, the mean of the discounted payoffs gives the required option value. Thus, the value of the AMCS down-and-out call option, denoted by V_A^*, is given below:

$$V_A = \frac{1}{M}\sum_{i=1}^{M}\frac{1}{2}(v^{+}(t+\Delta t) + v^{-}(t+\Delta t))\,.$$

[1] For the MCS, one discretized price process is needed.
[2] Equation 4 when $S > B$, and 0 when $S \leq B$.

3 Results/ Discussion

Pricing ZRDO barrier call options. Consider the given parameters: $S = K = 10, B = 8, r = 0.04, \sigma = 0.15, T = 1$, and the exact price 0.8022. We also consider the time step to be $\Delta T = \frac{T}{N}$, where $N = 100$ evenly spaced time points. The results are displayed below:

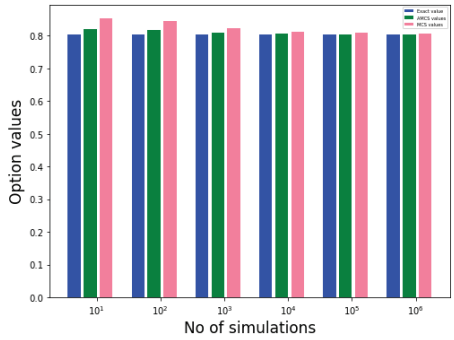

Figure 1: DO barrier option values with ATM features

In Figure 1, the MCS and AMCS with smaller discretization time points of $N = 100$ are compared to the exact Black-Scholes price. The exact Black-Scholes price remains unchanged, as they are unaffected by the simulations. We observe a wide disparity between the values obtained from both the MCS and the AMCS methods when the number of simulation is 10, compared to the exact price. But, when the number of simulation is increased further together with the time points, the convergence rate became faster. As observed in Figure 1, the values from the AMCS will converge faster towards the exact value as compared to the ordinary MCS.

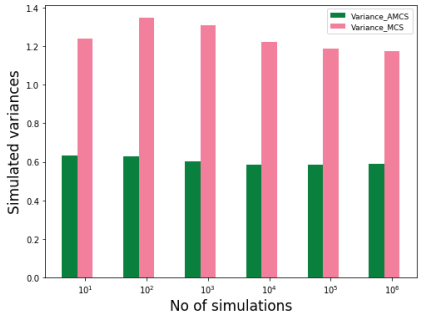

Figure 2: Variances for ATM down-and-out barrier options

Figure 2 graphically shows the variances obtained from the results in Figure 1, as it compares the two variances on the different simulation methods used. One of the ways AMCS provides a better estimate can be seen in its reduction of variances. Thus, the AMCS achieves its accuracy and high speed of convergence by reducing the variances of the simulation. We equally observed that the use of the AMCS reduced the variance of the MCS by two, or little above two.

Table 1: Standard Errors & Computation Time (Secs)

M	MCS (Serror)	AMCS (Serror)	MCS (Time)	AMCS (Time)
10^1	0.3518	0.2511	0.0030	0.0044
10^2	0.1160	0.0792	0.0040	0.0052
10^3	0.0362	0.0246	0.0150	0.0393
10^4	0.0111	0.0077	0.1070	0.2754
10^5	0.0034	0.0024	1.1505	2.2887
10^6	0.0011	0.0008	12.1193	23.0339

Increasing the number of simulation results to the reduction of the standard error, as can be seen in Table 1. The AMCS poses a disadvantage in the computation time, as the computation time doubled when compared to the standard MCS (See Tavella 2003). Furthermore, when the 95% confidence interval of both simulation methods are been constructed, a wide disparity is observed when the number of simulation is small. With the increase in the simulation numbers, the width of the interval reduces and the AMCS provides a more precise and thinner interval which captures the option value. Thus, the faster rate of convergence of the AMCS in relation to the MCS makes the former to be more effective.

4 Conclusions

Antithetic variate technique is a variance reduction Monte-Carlo method developed to improve the efficiency of the ordinary MCS. This research work had compared results obtained from the MCS and AMCS, to the Black-Scholes theoretical fair price for zero-rebate knock-out barrier options. We observed that the computation time for the AMCS doubled in comparison to the MCS. However, the AMCS provides more accurate and precise results with higher rate of convergence. Thus, in pricing and hedging more forms of exotic derivatives using Monte-Carlo method, the antithetic variate method is highly recommended in comparison to the normal MCS.

Acknowledgments

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Optimal waist circumference cut-off points for predicting metabolic syndrome among low-income black South African adults

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Abstract

This study determined the optimal cut-off point of waist circumference for metabolic syndrome among low-income earning South African black population, in Eastern Cape, South Africa. This cross-sectional study included 998 adults attending out-patient clinics in the largest settlement in Buffalo City Metropolitan Municipality, South Africa. The optimal waist circumference cut-off point was determined through Receiver Operating Characteristics analysis using the maximum Youden index. Among men, waist circumference cut-off value of 95.25cm yielded the highest Youden index of 0.773 (Sensitivity=98%, specificity=79%, Area under the curve: 0.893). For women, waist circumference of 89.45cm yielded the highest Youden index of 0.339 (Sensitivity=88%, specificity=46%, Area under the curve: 0.713). The prevalence of metabolic syndrome among men, women and both sexes using the new cut-off points were: 17.8%, 20.8% and 17.7%, respectively, compared to; 15.6%, 24.8% and 21.8%, using the traditional cut-off values of 94 cm and 80 cm for men and women, respectively. The traditional waist circumference value slightly under-estimated the prevalence of metabolic syndrome among men and over-estimated among women and the overall population. A specific waist circumference cut-off point for South African blacks is needed for correct identification of the metabolic state of the populace in order to develop appropriate interventions.

Theme: Health

Introduction

Metabolic syndrome (METs) is characterized by clustering of metabolic abnormalities such as central obesity, hypertension, dyslipidemia, and glucose intolerance.[1] Controversies exist concerning the correct anthropometric values relative to ethnicity, genetic background, sex, and sociocultural context.[2] Studies have shown that waist circumference (WC) is among the most powerful tools for predicting METs and that the optimal cut-off values for various indices, including WC, may differ by sex and race.[3] Studies investigating the WC cut-off points of METs for Africans are rare, and have reported inconsistent results.[4] Additionally, such studies in the South African context are conducted on high-income and urban settings; while only few studies are reported in low-income, rural settings.[5] This study sought to determine the optimal cut-off point of WC for METs among low-income earning, rural South African black population, using the cardiometabolic screening data of out-patients attending health facilities in Buffalo City Metropolitan Municipality, Eastern Cape, South Africa.

Methods

This cardiometabolic screening survey invovled 998 adults (321 males, 627 females) attending the three largest out-patient clinics in the largest settlement in Buffalo City Metropolitan Municipality, South Africa. Demographic information was obtained with a questionnaire. Waist circumference and blood pressure and fasting blood glucose measurements followed standardized protocol. Metabolic syndrome was defined using the International Diabetes Federation (IDF) criteria.

Data were analysed using SPSS software, version 21.0 (SPSS Inc. Chicago, IL). The optimal WC cut-off point was determined through Receiver Operating Characteristics (ROC) analysis using the Youden index [maximum (senitivity + specificity − 1)].[6] Waist circumference was excluded from the

classification of METs, because it was an outcome variable for developing cut-points. Previous studies have used 2 or more components other than WC to classify METs in South Africa.[5]

Results/Discussion

Among men, WC at a cut-off value of 95.25cm yielded the highest Youden index (0.773) with a corresponding sensitivity of 98% and specificity of 79% (Area under the ROC curve (AOC): 0.893, standard error (SE): 0.018, p-value: 0.000, 95% confidence interval (CI): 0.858-0.928). At the traditional cut-off value of 94cm, the Youden index slightly dropped to 0.74, with sensitivity and specificity remaining the same. For women, the WC at a cut-off value of 89.45cm yielded the highest Youden index (0.339) with a sensitivity of 88% and specificity of 46% (AOC: 0.713, SE, 0.020, p-value: 0.000, 95% CI: 0.673-0.753). At the traditional cut-off value of 80cm, the Youden index dropped to 0.249 with a corresponding increase in sensitivity to 100% and a significant reduction in specificity to 25%. The prevalence of METs among men, women and both sexes using the new cut-off points (WC ≥ 95.25cm for men and ≥ 89.45cm for women) were: 17.8%, 20.8% and 17.7%, respectively, compared to; 15.6%, 24.8% and 21.8%, using the traditional cut-off values of 94 cm and 80 cm for men and women, respectively. Notably, consistent with our study, the waist circumference cut-off point currently being utilised for the diagnosis of METs in sub-Saharan African females (80 cm) [7] is too low and will therefore over-estimate the prevalence of METs. As such, there is need to validate the WC ≥ 95.25cm for men and ≥ 89.45cm for women observed in this present study for other sub-Saharan African populations. Country, ethnic-and gender-specific waist cirmference cut-off points are needed, because adopting other waist circumference criteria to diagnose African black populations may either under-or overestimate the presence of the METs. As pointed out by Murphy et al.[8], optimal ethnic-specific WC cut-off points are seemingly useful as a screening tool that provides benefits in the detction of obesity and assessing the risk of other related diseases such as diabetes and cardiovascular disease. Viewed in this perspective, the findings from this prospective study provide up-to-date, evidence-based data which can be utilised for public health interventions in low-income populations, at least among underserved black Africans, in this setting.

Conclusion

The traditional waist circumference value used for the diagnosis of metabolic syndrome may not be suitable for this study participants as it might have slightly under-estimated the prevalence of METs among men and over-estimated the prevalence of METs among the women and the overall population. There is a need to determine a specific waist circumference cut-off point for South African blacks as this will assist in correctly identifying the metabolic state of the populace and develop appropriate interventions.

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Subjecting Sales and Production Volumes of Precious Metals to a Univariate and Bivariate Change Point Detection Approach

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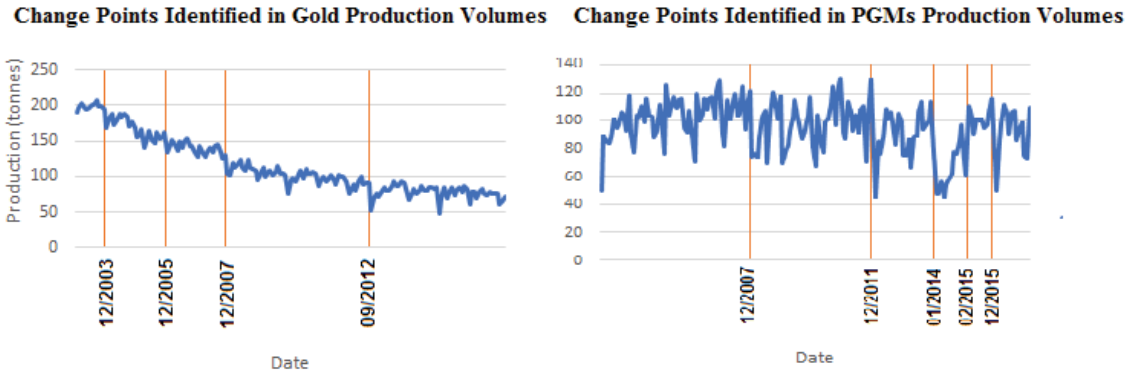

Change points identified using the Bayesian change point detection approach.

Abstract

This paper subjects production volumes and sales of Gold and Platinum Group Metals (PGMs)to a change point analysis that identified changes in the generative parameters of the sales and production volumes data of each metal. A univariate approach, namely: the Bayesian Change Point Analysis (BCP) and a multivariate approach, namely the Non-Parametric Multiple Change-Point Analysis (MCP) were applied in this paper. The change points identified were then linked to possible past events that could explain the changes. This was done in order to create a deeper understanding of the factors that influence the volumes of metals produced in South Africa as well as their respective sales. The results reveal that production drops were caused predominantly by mining strikes and increases in production costs, while the sales were influenced by fluctuations in commodity prices and exchange rates.

***Themes*—** Industrialisation

1 Introduction

The socio-economic environment within which the South African mining sector operates is complicated, with a vast number of factors influencing the production volumes and sales of metals. This complexity makes it challenging for mining stakeholders to react to any sudden changes, either in volume produced or price of the metal. In this paper the focus is thus to do a retrospective data driven Bayesian (univariate) and frequentist (multivariate non-parametric) change point analysis on Gold and PGMs in an attempt to create a greater understanding of the factors that impact the production volumes and sales of metals in South Africa.

2 Change Point Methodology

The Bayesian Change Point Analysis (BCP) [Barry and Hartigan, 1993] was briefly discussed and compared to other change point approaches (for full discussion please refer to [Ingham, Yadavalli and Das, 2017]). A multivariate approach, namely Non-Parametric Multiple Change Point Analysis of Multivariate Data (MCP) [Matteson and James, 2014] was also investigated in order to identify any factors or events that could potentially cause changes in multiple metals. Change points can be described as locations where abrupt variations in the generative parameters of a sequence of data occur. Change point detection has applications in areas such as finance, biometrics and robotics.

2.1 Bayesian Change Point Detection (BCP)

The Bayesian approach to change point detection [Barry and Hartigan, 1993] states that the sequence of data has an underlying sequence of generative parameters that are divided into contiguous blocks. The blocks are divided so that all observations in a block have equal parameter values. The BCP approach was selected above the DP and CBS approach as it provides not only the location of the change points, but also its probability of occurrence.

2.2 Non-parametric Multiple Change Point Analysis of Multivariate Data (MCP)

This approach uses a divisive estimation that "sequentially identifies change points via a bisection algorithm" [Matteson and James, 2014] under very mild assumptions. MCP was used in order to identify any factors or events that could potentially cause changes in both Gold and PGMs.

3 Results

3.1 Bayesian Change Point Approach Results

Table 1: Bayesian Change Point Analysis for Gold Production

	Date	Prob.	X1
12	12/2003	0.704	192.94
36	12/2005	0.742	154.83
60	12/2007	0.736	129.81
117	09/2012	0.814	88.70

Table 2: Bayesian Change Point Analysis for PGMs Production

	Date	Prob.	X1
60	12/2007	0.732	105.62
108	12/2011	0.738	107.11
133	01/2014	0.624	82.20
146	02/2015	0.708	79.68
156	12/2015	0.626	99.82

3.2 Non-Parametric Multiple Change Point Analysis of Multivariate Data Results

Table 3: Multiple Change Point Analysis for Gold and PGMs Production

Break Points Location	Date
58	10/2007
109	01/2012
142	10/2014

4 Discussion of Results

Table 1 identified BCP change points at the end of the calendar year for 2003, 2005 and 2007. These changes were possibly due to the new production plans that are generally implemented at the beginning of each year in mines. The probable cause of the 09/2012 change point could be the strikes in AngloGold Ashanti in September 2012.

Table 2 shows the change points identified by BCP in PGMs production volumes. The probable cause of the change points identified at 12/2007, 12/2011 and 01/2014 were labour strikes. The change point at 02/2015 could be due to a rebound in production after the low production in 2014. In December 2015 a change point occured as production dropped in January of 2016. This drop was due to a marginal surplus of PGMs created in 2015 [Topf, 2017].

Table 3 shows the change points identified by MCP for the Gold and PGMs production volumes. The change point around 10/2007 was also identified in the Gold production volumes and the change point around 12/2011 was identified in the PGMs production volumes.

5 Conclusion

BCP [Barry and Hartigan, 1993] and MCP [Matteson and James, 2014] algorithms were selected to identify the change points in the production volumes and sales data of the metals. The results from the BCP and MCP analysis were then investigated in order to link possible causative events to the identified change points.

A Appendix

Acknowledgments

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Investigating Industrial Effluent Impacts on Municipal Wastewater Treatment Plant

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Abstract
Industrial effluents with high concentrations of heavy metals are widespread pollutants of great concerns as they are known to be persistent and non-degradable. Continuous monitoring and treatment of the effluents become pertinent because of their impacts on wastewater treatment plants. Heavy metal identification was done using Inductively Coupled Plasma Optical Emission Spectrometry (ICP-OES). The physico-chemical analysis was also done using multi-parameter probe. Correlation coefficients of the measured values were done to investigate the effect of the industrial effluents on Leeuwkuil treatment plants. Heavy metal resistant bacteria were also identified and characterised by polymerase chain reaction and sequencing. The concentrations of most heavy metals and physico-chemical parameters of the industries were higher than the inflow, upstream, downstream, final effluent and potable water 1 and 2. The presence of the heavy metals and their correlations in all the sampling points indicate the influence of the industrial waste on Leeuwkuil wastewater treatment plants and the purification plants in Vaal, Vereenining South Africa. The wastewater treatment plants were observed to be effective in maintaining some of the physico-chemical parameters (temperature, pH, and chemical oxygen demand) but were not effective on heavy metals (copper, lead and zinc) within South Africa green drop Standards. Heavy metal resistant bacteria were identified and characterised to enhance the knowledge of bioremediation and its applications.

Theme— Water.

1 Introduction

Water is important for all life because it is an essential natural resource for sustainability of life on earth. It plays an important role in our economy, food production, health and environment (Halder and Islam, 2015). Despite the importance of water, it is still regarded as the most mismanaged resources in the world (Fakoyode, 2005). Industrial wastewater pollution is a notable problem in South Africa because it contains high concentrations of heavy metals that are known to be persistent and non-degradable. With rapid industrialisation all over the world, pollution of water resources is increasing drastically and South Africa is not an exception (Kamika and Momba, 2013). It has been realised that discharges of untreated or incompletely treated wastes containing algal nutrients, non-biodegradable organics, heavy metals and other toxicants by most industries will accelerate the deterioration of receiving water bodies (Olaniyi *et al*, 2012). Therefore, treatment of wastewater prior to discharge into the environment is desirable to avoid pollution. In addition, continuous monitoring becomes pertinent because of their impacts on wastewater treatment plants. It is noteworthy that the persistent presence of heavy metals in municipal effluent and their ability to bio-accumulate after treatment emphasises the need for easy, cost-effective and biological methods to determine and control toxicity levels of industrial effluents and help minimise domestic households receiving polluted water. It is based on the above reason that this study was carried out to investigate the correlation between an increase in heavy metal pollution in water and the location of industries around Vereeniging in South Africa and to ascertain the effectiveness of the Leeuwkuil municipal water treatment.

2 Method

Heavy metal identification was done using Inductively Coupled Plasma Optical Emission Spectrometry (ICP-OES). The physico-chemical analysis was also done using multi-parameter probe. Correlation coefficients of the measured values were done to investigate the effect of the industrial effluents on Leeuwkuil treatment plants. Heavy metal resistant bacteria were identified and characterised by polymerase chain reaction and sequencing.

2.1 Physico-chemical parameters analysis

Onsite analysis of water samples included taking duplicate readings of temperature, pH, electrical conductivity, salinity, total dissolved solids (TDS), and dissolved oxygen (DO) using a multi-parameter ion specific meter (Hanna instruments, version HI9828, SN 08334776) was done by immersing the probe into the water samples (Chinedu et al., 2011).

2.2 Heavy metal analysis

Elemental concentrations of aluminium (Al), Copper (Cu), Zinc (Zn), Manganese (Mn) and Lead (Pb) in the water

samples and industrial effluent were analysed using Inductively Coupled Plasma Optical Emission Spectrometry (ICP-OES) (PerkinElmer Optima 5300 DV). These samples were digested using concentrated HNO_3 (Chinedu, et al., 2011). All digested samples were filtered using 0.45 μm filter paper, prior to ICP-OES analysis. The target elements were analysed by direct aspiration into the ICP-OES, data inclusion was based on correlation coefficient readings of >0.999 benchmarked against the standard curves

2.3 Bacteria characterisation

DNA was isolated from each sampled culture using a quick g-DNA extraction kit. The PCR amplification was carried out in a thermal cycler and the PCR product was sent to Inqaba, Pretoria South Africa for sequencing. The 16s gene sequences obtained was analysed by BLAST algorithm. Sequences obtained were compared to the non-redundant nucleotide database at the National Centre for Biotechnology Information.Based on the scoring index, the most similar sequences were aligned with the sequences of other representative bacterial 16S rDNA regions by using Cultural W software. The 16S rDNA sequences selected bacterial strains were then deposited in GenBank with the accession numbers.

3 Results and discussion

The concentrations of heavy metals and physico-chemical parameters of five industrial effluent were higher than the other sampling points (Inflow, final effluent, downstream, upstream, potable water 1 & 2) across all the seasons and did not meet the South Africa green drop Standards for effluent. The presence of heavy metals in these industries indicated the influence of the industrial waste on Leeuwkuil wastewater treatment plants situated in Vereenining, (Gauteng) South Africa. Leeuwkuil wastewater treatment plants were observed to be effective in maintaining some of the physico-chemical parameters (temperature, pH, and COD) but were not effective in maintaining total dissolve solids, electrical conductivity and heavy metals such as (copper, zinc and lead) across the seasons within South Africa green drop Standards. The quality of the Vaal River is poor in terms of its BOD, DO COD and EC, which are all above South Africa National and WHO standards. Nonetheless, physicochemical parameter of the portable water samples such as temperature, BOD, DO, COD (except in winter), TDS, Al, Cu, and Zn (except Pb) were within the WHO and SANS standard. Heavy metal resistant bacteria (that are resistant to Al, Cu, Zn and Pb) were identified and characterised to enhance the knowledge of bioremediation and its applications. Some of these bacteria like *Serratia marcescens*, *Pseudomonas aeruginosa*, and *Sphingomonas* spp are said to be pathogenic and must be removed so it does not affect human health. However, *Sphingomonas spp* and *Alcanivorex spp*was are useful despite the role it plays in human diseases because they have degradable ability and can be applied in bioremediation of environmental contaminants (Yabuuchi and Kosako, 2015).

4 Conclusions

This study evaluated the correlation between heavy metal pollution in water and the location of the industries in order to ascertain the effectiveness of the waste water treatment plant. Heavy metals were identified and quantified in the effluent from Leeuwkuil sewage plant, industries, Vaal River, and potable water. The results indicate that Leeuwkuil sewage plant was effective in maintaining some physico-chemical parameters within required standards. Four bacterial isolates showed 100% similarity to *Pseudomonas aeruginosa, Serratia marcescens, Bacillus sp. strain* and *Bacillus toyonensis*, were found to be resistant to Al, Cu, Pb and Zn. These bacteria identified can be considered for further study in bioremediation.

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