



FORECAST
VIRTUAL CONFERENCE **2022**



**10 - 12
AUG
2022**

Science & Technology

a D.R.I.V.E.R. of transformation

DEVELOPMENT | RESILIENCE | INNOVATION | VISION | ENTREPRENEURSHIP | RENEWAL

First joint conference of the Faculties of The University of the West Indies
(Cave Hill, Mona, St. Augustine) in collaboration with
the University of Technology, Jamaica

BOOK OF ABSTRACTS

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Please note that in this booklet, all times listed are Eastern Caribbean time (e.g., for Barbados and Trinidad & Tobago)/EDT (UTC-4:00).

Is this the most recent version of the *Book of Abstracts*?

The conference website can be found at:

<https://www.forecastconference.org.jm/>

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FORECAST 2022 is the first joint conference of the Science Faculties of The University of the West Indies (Cave Hill, Mona and St Augustine) and the University of Technology, Jamaica. With the theme “*Science and Technology: a D.R.I.V.E.R. of Transformation*”, the conference will highlight science and technology as a pillar for regional transformation through its provision of new thought, discourse and foundational knowledge and skills, as well as by driving innovation, entrepreneurship, and resilience in the pursuit of greater development.

The Conference, being the first of its kind, encompasses:

- The *6th Faculty of Science and Technology Conference* of The UWI, Cave Hill Campus
- The *12th Faculty of Science and Technology Conference* of The UWI, Mona Campus
- The *1st Faculty of Science and Technology Conference* of The UWI, St. Augustine Campus
- The *6th International Science Conference* of the UTech, Ja.
- The *2nd Student Grand Innovation Challenge*
(Student teams competing and presenting innovative scientific solutions to real Caribbean challenges related to management and use of water resources.)

Organizing Committee

Deans

<i>Dean FST</i>	Dr Brian Cockburn	(UWI St Augustine)
<i>Dean FST</i>	Dr Jeanese Badenock	(UWI Cave Hill)
<i>Dean FOSS</i>	Dr Kamilah Hylton	(UTech, Ja.)
<i>Dean FST</i>	Prof Michael Taylor	(UWI Mona)

Conference Chair and Co-Chairs

<i>Chair</i>	Dr Curtis Busby-Earle	(UWI Mona)
<i>Co-Chair</i>	Dr Andrew Lamm	(UTech, Ja.)
<i>Co-Chair</i>	Dr Marcia Blair-Thomas	(UTech, Ja.)
<i>Co-Chair</i>	Mrs Marcia Creary Ford	(UWI Mona)
<i>Co-Chair</i>	Dr Peter Chami	(UWI Cave Hill)
<i>Co-Chair</i>	Dr Ricardo Clarke	(UWI St Augustine)
<i>Co-Chair</i>	Prof Samson Omoregie	(UTech, Ja.)
<i>Co-Chair</i>	Dr Zeyar Min	(UTech, Ja.)

Sub-committee Chairs

<i>Abstract Review & Technical Program</i>	Dr Andrew Lamm	(UTech, Ja.)
<i>Technology</i>	Dr Bernd Sing	(UWI Cave Hill)
<i>Finance & Fundraising</i>	Mrs Elecia Myers	(UWI Mona)
<i>Logistics & Programming</i>	Mrs Rosalene Simmonds	(UWI Mona)
<i>Marketing & Communications</i>	Mrs Terry-Ann Collins-Fray	(UWI Mona)
<i>Grand Innovation Challenge</i>	Dr Zeyar Min	(UTech, Ja.)
<i>Secretariat</i>	Mr Deron Maitland	(UWI Mona)

Sub-committee Members

Abstract Review & Technical Program

Andrew Lamm (UTech, Ja.)
Denise Beckles (UWI St Augustine)
Peter Chami (UWI Cave Hill)

Avril Williams (UWI Cave Hill)
Marcia Blair-Thomas (UTech, Ja.)

Technology

Arvind Kumar (UWI St Augustine)
Christopher Muir (UWI Mona)
John Hall (UTech, Ja.)

Bernd Sing (UWI Cave Hill)
Daniel Fokum (UWI Mona)

Finance & Fundraising

Elecia Myers (UWI Mona)
Marcia Blair-Thomas (UTech, Ja.)

Laura Rambaran-Seepersad (UWI St Augustine)
Natasha Corbin (UWI Cave Hill)

Logistics & Programming

Alexa Redway (UTech, Ja.)
Marcia Creary Ford (UWI Mona)
Nicole A. Robinson (UTech, Ja.)
Novi-Ann Davey (UWI Mona)
Tannice Hall (UWI Mona)

Curtis Gittens (UWI Cave Hill)
Michael Forde (UWI St Augustine)
Nikki Bramwell (UTech, Ja.)
Rosalene Simmonds (UWI Mona)

Marketing & Communications

Cecelia Waugh-Hall (UTech, Ja.)
Michael Forde (UWI St Augustine)
Nodley Wright (UTech, Ja.)
Sabraham Green-Smith (UWI Mona)
Tsania James (UWI St Augustine)

Lisa-Ann Rollins (UWI Cave Hill)
Natasha Corbin (UWI Cave Hill)
Rasheetta Dorant (UWI Cave Hill)
Terry-Ann Collins-Fray (UWI Mona)

Grand Innovation Challenge

Louis-Ray Harris (UWI Mona)
Tannice Hall (UWI Mona)
Zeyar Min (UTech, Ja.)

Nickeisha Stephenson (UWI Mona)
Thea Scantlebury-Manning (UWI Cave Hill)

Secretariat

Ackeem Lawrence (UWI Mona)
Deron Maitland (UWI Mona)
Marcia Creary Ford (UWI Mona)
Rosalene Simmonds (UWI Mona)
Terry-Ann Collins-Fray (UWI Mona)

Adam Taylor (UWI Mona)
Khadejah Hylton (UWI Mona)
O'Brien Brown (UTech, Ja.)
Sabraham Green-Smith (UWI Mona)

Welcome Messages

Principal's Welcome



Professor Dale Webber
Pro-Vice-Chancellor and Principal of the Mona Campus, at The University of the West Indies (UWI)

The Principals of the UWI Cave Hill, Mona and St Augustine campuses are very pleased to welcome you to FORECAST 2022, the first joint conference of the science faculties of the University of the West Indies (Cave Hill, Mona and St Augustine) and the University of Technology, Jamaica. The theme of the conference is, "Science and Technology: a D.R.I.V.E.R. of Transformation".

At a time when the United Nations has designated 2022 as the International Year of Basic Sciences for sustainable development, it is very fitting that our University leads the discourse on science and research matters to underscore our relevance and applicability to all sectors of society. The Faculty of Science and Technology at the University of the West Indies has strategically positioned itself as the "go to place for science, research, innovation and solutions", partnering with the public and private sectors to foster growth and development. Our University has made great strides, with emphasis on *Development, Resilience, Innovation, Vision, Entrepreneurship and Renewal*, key drivers for the change that our society and the world needs.

I commend the various faculties and the University of Technology, Jamaica for amalgamating its resources in a bold effort to bolster science and research awareness in the region. Your commitment to positively impacting the landscape of our nations will undoubtedly foster unprecedented synergies and associations.

Dale Webber, Professor
Pro Vice-Chancellor and Principal
Mona Campus

President's Welcome



Professor Colin Gyles
Acting President, University of
Technology, Jamaica

It is my pleasure to join in warmly welcoming all participants and presenters to the FORECAST 2022 Conference. University of Technology, Jamaica is honoured to be partnering with The University of the West Indies Mona, Cave Hill and St. Augustine campuses for hosting this significant regional discussion forum. We wholeheartedly welcome this discussion concerning the transformative role that science and technology must play in the socio-economic development of our nations in the region.

This conference is timely and relevant, given that the year 2022 has been designated by the United Nations as the International Year of Basic Sciences for Sustainable Development. University of Technology, Jamaica is pleased to be part of this strategic partnership through the FORECAST conference and we anticipate that these discussions will serve to advance the objectives of this declaration by the United Nations.

As the Caribbean region and other global economies seek to rebound from the ravages of the COVID-19 pandemic, the deliberations that have been scheduled over the next two days of this conference are well poised to bring renewed regional focus on the challenges faced by the region. It is good that simultaneously, the conference will also offer innovative and sustainable solutions to these challenges and will underscore the role of current and emerging science and technology tools in this regard.

UTech, Jamaica over the course of its 64-year history has been a major contributor to regional development through research and innovation to provide solutions to numerous societal problems in the country and the wider Caribbean region. These have been in areas including science, health, engineering, architecture, information communication technologies and other areas.

We welcome the FORECAST conference discussions that will delve into the areas of **Development** for a sustainable future, **Resilience** and mitigation strategies, **Innovation** for productivity, **Vision** for greater harmony, **Entrepreneurship** for empowerment, poverty alleviation and progress and renewal, and **Research** as the cornerstone of a progressive society.

We look forward to the wealth of thoughts and ideas that will be shared by the cadre of expert speakers over the course of the two-day conference. The outcomes of the FORECAST Conference will undoubtedly add to the stock of new knowledge and practice in stimulating regional growth and development and an enhanced quality of life for our citizens.

I again offer warm welcome to all participants to FORECAST 2022 and wish for you an enriching and informative conference.

Professor Colin Gyles, PhD

Deans' Welcome (The University of the West Indies)

The Science and Technology Deans of the Cave Hill, Mona and St Augustine Campuses of The University of the West Indies (UWI) warmly welcome everyone to the *Frontiers of Research and Caribbean Science and Technology, FORECAST virtual conference, 2022*.

Forecast 2022 is the first joint conference of the Science and Technology Faculties of the UWI (Cave Hill, Mona and St Augustine Campuses) and the University of Technology, Jamaica. The theme of the conference is *Science and Technology: A Driver of Transformation*. This forum will showcase Caribbean researchers' focus on the challenges facing the region and the entire globe and the role of Science & Technology in providing sustainable solutions. We will showcase our passion for Science and its relevance in our communities. The use of innovative and creative approaches to shaping development through research and contributing to framing future-focused policy making will be on full display.

The next three days will include plenary lectures by invited experts, oral and poster presentations by participants including our students, workshops, the second grand student innovation challenge with a theme of *Water* this year for secondary and tertiary student teams, and a high-level panel on the third and final day on "*Post COVID-19 challenges facing CARICOM – Scientific solutions*". Participants would be provided with networking virtual spaces for engagement.

Our deep gratitude goes to our organizing committee and the many committee members who have worked tirelessly over the past few months to ensure the success of this conference. We also thank our many sponsors, speakers, moderators, presenters, chairpersons and participants as well as our high-level panelists for participating and ensuring these three days are scientifically and technologically exciting, engaging and impactful.

Welcome and do enjoy our conference!

Jeanese Badenock Michael Taylor Brian Cockburn



Dr. Jeanese Badenock
Dean, Faculty of Science and
Technology, UWI Cave Hill



Professor Michael Taylor
Dean, Faculty of Science and
Technology, UWI Mona



Dr. Brian Cockburn
Dean, Faculty of Science and
Technology, UWI St Augustine

Dean's Welcome (University of Technology, Jamaica)



Dr. Kamilah Hylton
Dean, Faculty of Science and
Sport, University of Technol-
ogy, Jamaica

Disease, conflict, poverty, climate change. . . The list of ills that prevail the global society are unending and beckon us to re-think and re-imagine our current approaches. Covid-19 has surely confirmed that as we are faced with new and emerging problems that are increasingly complex and know no boundaries – we must become increasingly agile and creative in our solutions.

Therefore, multifaceted and interdisciplinary research and collaborations must be a key component in evaluating problems and devising innovative and sustainable solutions that can impact society. Higher Education Institutions are expected to be the hubs for the creation of this new knowledge that should drive development and transform society.

Consequently, the Faculty of Science and Sport at the University of Technology, Jamaica is proud to be collaborating with the University of the West Indies in hosting the inaugural **Frontiers Of Research in Caribbean Science and Technology** (FORECAST) Conference.

As Jamaica seeks to position itself to simultaneously achieve Vision 2030 and Sustainable Development Goals, we are cognizant of the role to be played by research in providing critical data that must guide policy development and subsequent development imperatives. This conference seeks to provide participants with the opportunity to immerse themselves in critical discourse on the role science and technology must play in the design of a resilient, innovative and sustainable Caribbean future.

I therefore invite you to engage with us as we bring together some of the sharpest minds in the region to share new ideas and strategies for utilizing science and technology to disrupt the status quo and bring us closer to having well-developed societies and robust economies.

Kamilah Hylton, Ph.D.

Conference Chair's Welcome



Curtis Busby-Earle
Conference Chair

It is my pleasure and privilege today to extend to you all a very warm welcome to the Frontiers of Research in Caribbean Science and Technology, our FORECAST conference.

This conference is the first of its kind, a multi-institutional event orchestrated by the science and technology faculties of The UWI Mona, Cave Hill and St. Augustine campuses and the faculty of science and sport at the University of Technology in Jamaica.

FORECAST is the culmination of many months of collaborative activities among the members of the aforementioned faculties, and I would like to take this opportunity as the chair to express my deepest gratitude to all of my colleagues whose tireless efforts have led us to realise the staging of this momentous event, and to our deans and other members of our institutions' management teams for their support.

This is a timely gathering and meeting of the minds and it is our hope that FORECAST will provide opportunities for networking, discussing science, hypotheses, results and experiments all towards finding solutions to our region's most challenging problems.

As a D.R.I.V.E.R. of transformation I anticipate a most engaging conference as we had over seventy (70) abstracts submitted for either poster or oral presentations under the general topics of development, resilience, innovation, vision, entrepreneurship and renewal. Full paper versions of a few of these abstracts will be reviewed and subsequently included in a special issue of the Journal of Arts, Science and Technology.

We also have an excellent selection of keynote and plenary speakers, informative workshops and what promises to be a thought-provoking panel discussion with a few of our region's leaders. We also look forward to the presentations by the finalists of our grand innovation challenge.

I hope you find the conference to be a rewarding experience and upon reflection, that it was time well spent.

Curtis Busby-Earle, PhD
Senior Lecturer of Computer Science and Associate Dean for Graduate Studies and Research
Faculty of Science and Technology
The University of the West Indies
Mona, Jamaica

Timetable

All times listed are Eastern Caribbean time (e.g., for Barbados and Trinidad & Tobago)/EDT (UTC-4:00). For Jamaica time/CDT (UTC-5:00), please subtract one hour to obtain local time.

CT Contributed Talk, **GIC** Grand Innovation Challenge, **IS** Invited Speaker, **KL** Keynote Lecture, **PD** Panel Discussion, **PS** Poster Session, **WS** Workshop.

Tuesday, 9th August

17:00–19:00	Opening of Conference Space Orientation and Ice Breaker Activities in the Gather.Town space (with Michael Forde, UWI St Augustine)
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Wednesday, 10th August

9:00–9:30	Opening Ceremony		
9:30–10:25	KL	The Rt. Hon. D. Keith Mitchell Former Prime Minister of Grenada	Science and technology and its application to regional development
10:25–10:45	Coffee Break		
10:45–12:30	CT	Session 1: D – Development	Contributed paper session, see page 27 for details
12:30–13:30	WS	Tatiana Castro and Anthony Newman Elsevier	Workshop 1: How to write a great scientific paper, and have it published in a good journal
13:30–14:00	Lunch Break		
14:00–15:45	CT	Session 2: R – Resilience	Contributed paper session, see page 33 for details
15:45–16:00	Coffee Break		
16:00–17:00	WS	Priscilla Antunez and Lisa Miller Brookhaven National Laboratory	Workshop 2: Become a user and collaborator with BNL and CFN
17:00–19:00	PS	Poster Session (in Gather.Town)	An overview of the posters presented together with abstracts can be found starting at page 61

Thursday, 11th August

9:00–10:00	IS	Judith Lang Atlantic and Gulf Rapid Reef Assessment Program	Caribbean coral reefs are in enormous trouble, but it's not yet terminal
10:00–10:15	Coffee Break		
10:15–11:15	WS	Candice Wu Huawei	Workshop 3: Global 5G industry development and market insights
11:15–12:00	CT	Session 3: I – Innovation	Contributed paper session, see page 39 for details
12:00–13:00	WS	Peter Nelson LifeSavers Wipes	Workshop 4: Bench top to the conveyor belt: Steps toward the commercialization of scientific innovations
13:00–13:30	Lunch Break		
13:30–14:30	IS	Ishenkumba Kahwa UWI Mona	Are CARICOM countries innovating into the fourth industrial revolution?
14:30–16:15	CT	Session 4: V – Vision	Contributed paper session, see page 42 for details
16:15–16:30	Coffee Break		
16:30–18:00	GIC	Student Grand Innovation Challenge see page 26 for details	

Friday, 12th August

9:00–10:00	IS	Andrew Russell Nvidia	Innovation in the age of the metaverse
10:00–10:15	Coffee Break		
10:15–12:00	CT	Session 5: E – Entrepreneurship	Contributed paper session, see page 48 for details
12:00–13:00	WS	Tatiana Castro and Ibis Sánchez Serrano Elsevier	Workshop 5: Learn about the tool that can help you to find journals that could be best suited for publishing
13:00–14:00	Lunch Break		
14:00–15:45	CT	Session 6: R – Renewal	Contributed paper session, see page 54 for details
15:45–16:00	Coffee Break		
16:00–17:45	PD	Post COVID-19 Challenges facing CARICOM – Scientific Solutions see page 21 for details	
17:45–18:30	Closing & Awards Ceremony Chair & Summary of Conference: Andrew Lamm, UTech, Ja. Presentation of Awards: Samson Omoregie, UTech, Ja. Vote of Thanks & Closing Remarks: Michael Taylor, UWI Mona		

Keynote Speaker

Opening Ceremony & Keynote Lecture

9:00–9:30	<p>Wednesday, 10th August Opening Ceremony</p> <p>Chair: Curtis Busby-Earle Conference Chair, UWI Mona</p> <p>Greetings: Sir Hilary Beckles Vice-Chancellor, The University of the West Indies</p> <p>Greetings: Colin Gyles Acting President, University of Technology, Jamaica</p> <p>Introduction of Speaker: Kamilah Hylton Dean, Faculty of Science and Sport, UTech Jamaica</p>		
9:30–10:25	KL	<p>The Rt. Hon. D. Keith Mitchell</p> <p>Former Prime Minister of Grenada and Former Lead Head of Government in the CARICOM Quasi Cabinet with responsibility for Science and Technology, including ICT</p>	<p>Science and technology and its application to regional development</p>
	<p>Vote of Thanks: Jeanese Badenock Dean, Faculty of Science & Technology, UWI Cave Hill</p>		

Keith Mitchell

Former Prime Minister of Grenada and Former Lead Head of Government in the CARICOM Quasi Cabinet with responsibility for Science and Technology, including ICT

Wednesday, 10th August, 9:30–10:25

Science and technology and its application to regional development



Biography

Former Prime Minister, Dr. the Right Honourable Keith Claudius Mitchell was born to Dowlyn and Catherine Mitchell in Brizan, St. George.

He received his primary education at the Happy Hill R.C. School and the J.W. Fletcher Memorial School. He went on to the Presentation Brothers College then on to the University of the West Indies, Cave Hill Campus, where he gained a Bachelor of Science Degree in Mathematics and Chemistry in 1971, followed by a Master's Degree from Howard University in 1975 and a Doctorate in Mathematics and Statistics from American University in 1979.

As a young adult, Dr. Mitchell taught at the Presentation Brothers College, his alma mater and was also a Mathematics Professor at Howard University. He also started his own consulting firm in Washington, D.C., and provided consultancy services to many Government Departments and private corporations in the United States.

In 1984, Dr. Mitchell was elected Member of Parliament for St. George North West, and has held the seat in each subsequent election since then. He was elected Political Leader of the New National Party (NNP) in 1989.

In 1995, Dr. Mitchell successfully led the party to victory in general elections, winning eight of fifteen seats in the House of Representatives. He assumed office as Prime Minister on June 22 that year.

Election victories in 1999, 2003, 2013 and 2018, including an unprecedented sweep of the polls on three occasions, mean that Dr. Mitchell served as Prime Minister a record five times.

Dr. Mitchell also was the Minister of National Security, Public Administration, Youth Development, Home Affairs, Information and Communications Technology and Disaster Management.

In addition to his domestic responsibilities, Dr. Mitchell served as the Chairman of the OECS Authority and Chairman of the Regional Security System Council of Ministers.

Plenary Speakers

Overview of Plenary Talks

	Thursday, 11 th August		
	Chair: Mona Webber UWI Mona		Co-Chair: Shakira Banks Undergraduate Student, UTech, Ja.
9:00–10:00	IS	Judith Lang Atlantic and Gulf Rapid Reef Assessment Program	Caribbean coral reefs are in enormous trouble, but it's not yet terminal
	Vote of Thanks: Marcia Creary Ford, UWI Mona		

	Thursday, 11 th August		
	Chair: Michael Forde UWI St Augustine		Co-Chair: Michaela Edwin Graduate Student, UWI St Augustine
13:30–14:30	IS	Ishenkumba Kahwa UWI Mona	Are CARICOM countries innovating into the fourth industrial revolution?
	Vote of Thanks: Zeyar Min, UTech, Ja.		

	Friday, 12 th August		
	Chair: Mechelle Gittens UWI Cave Hill		Co-Chair: Yanique Morris Undergraduate Student, UTech, Ja.
9:00–10:00	IS	Andrew Russell Nvidia	Innovation in the age of the metaverse
	Vote of Thanks: Marcia Blair-Thomas, UTech, Ja.		

Judy Lang

Coral Scientist, Atlantic and Gulf Rapid Reef Assessment Program

Thursday, 11th August, 9:00–10:00

Caribbean coral reefs are in enormous trouble, but it's not yet terminal



Website of Judy Lang

Biography

Judith (Judy) Lang, a marine ecologist who has been energised by reefs in Jamaica and the wider Caribbean for over 60 years, provided the initial description of a mechanism by which coral compete for space in nature. She helped develop the Atlantic and Gulf Rapid Reef Assessment (AGRRA) protocols in the late 1990s and, as its Science Coordinator since 2005, has prepared many of its instructional materials. After a devastating stony coral disease spread from Florida to Caribbean in 2017-2018, AGRRA's efforts were diverted to helping our regional colleagues respond to this disaster. When long-spined sea urchins, the region's major reef herbivore, began dying across the eastern and northern Caribbean

(including Jamaica) in spring 2022, AGRRA remobilised to collaboratively create the open, inclusive, *Diadema* Response Network.

Ishenkumba Kahwa

Professor of Supramolecular Chemistry, The University of the West Indies

IS

Thursday, 11th August, 13:30–14:30

Are CARICOM countries innovating into the fourth industrial revolution?



Biography

Ishenkumba Kahwa served as a Professor of Supramolecular Chemistry at The University of the West Indies (The UWI), Mona Campus. He held several leadership positions at the University including Dean, Faculty of Science and Technology (formerly Faculty of Pure and Applied Sciences) from 2008 to 2013 and Deputy Principal, Mona Campus from 2013-2018. He served The UWI for 31 years and following his retirement in 2018, the title of "Professor Emeritus" was conferred upon him for the significant contributions he made to the development of the Department of Chemistry and The UWI as a whole.

Professor Emeritus Ishenkumba Kahwa, among his many achievements, established a laser laboratory at The UWI Mona, which at present includes powerful lasers, super-cold facilities and associated electronic and computational instruments. In addition, he led the development and establishment of a new suite of B.Sc, M.Sc, M.Phil and Ph.D. programmes in Occupational and Environmental Safety and Health (OESH). The programmes began in September 2006 at Mona and at the St Augustine Campus in 2009.

Prof. Emeritus Kahwa is very much engaged in the development of science, technology and innovation (STI) in Jamaica and the Caribbean and co-led the STI policy review/development in Jamaica. He also served as a member of the CARICOM STI Committee established by the Dr. the Rt Hon. Keith Mitchell, the CARICOM Prime Minister in charge of STI, to chart out the strategies needed by CARICOM to achieve rapid economic and social development using STI. He is the co-author of the CARICOM STI Chapter of the UNESCO World Science Report (2020), published every five years, since 2005.

Prof. Emeritus Kahwa is also Honourary Consul for Tanzania in Jamaica.

Andrew Russell

Principal Software Engineer, Nvidia

Friday, 12th August, 9:00–10:00

Innovation in the age of the metaverse



Biography

Dr. Andrew Russell grew up in Jamaica, went to MIT for undergrad and PhD. He has been doing research and development in the field of displays and image processing for the past 25 years. He is now at Nvidia, where he is part of the Black Nvidian Network. At Nvidia he works on making more beautifully rendered images by coupling traditional signal processing algorithms with the power of AI. At Magic Leap he improved their AR display by leading the system integration of the dimmer, which enables VR mode, as well as tracking and defining low-latency inputs paths from subsystems such as head-pose and eye-tracking. At Google, he played a key role in starting Project Starline, where he headed up the

creation of a retina-resolution autostereoscopic display for 3D video conferencing. He has also helped improve DLP displays at Texas Instruments and LCOS displays at Syndiant. He has 50+ patented inventions based on his contributions to making displays more beautiful.

Panel Discussion

Friday, 12th August, 16:00–17:45

PD

“Post COVID-19 Challenges facing CARICOM – Scientific Solutions”

Moderator

Mrs Paula-Ann Porter-Jones
Broadcaster &
Communications Consultant



Dr the Right Honourable
Keith Mitchell
Former Prime Minister of
Grenada and Former Lead
Head of Government in the
CARICOM Quasi Cabinet with
responsibility for Science and
Technology, including ICT



The Honourable Floyd Green
Minister without Portfolio in
the Office of the Prime Minis-
ter, Government of Jamaica



Professor Colin Gyles
Acting President, University of
Technology, Jamaica



Professor Dale Webber
Pro-Vice-Chancellor and Prin-
cipal of the Mona Campus, at
The University of the West In-
dies (UWI)



Professor Clive Landis
Pro-Vice-Chancellor and Prin-
cipal of the Cave Hill Campus,
at The University of the West
Indies (UWI)



**Professor Rose-Marie Belle
Antoine**
Pro-Vice-Chancellor and Prin-
cipal of the St Augustine Cam-
pus, at The University of the
West Indies (UWI)

Wednesday, 10th August

Wednesday, 10th August, 12:30–13:30

Workshop 1: How to write a great scientific paper, and have it published in a good journal

WS

presented by Tatiana Castro and Anthony Newman

Elsevier

Elsevier is a Netherlands-based academic publishing company specializing in scientific, technical, and medical content. Its products include a number of top-tiered international journals the online citation database Scopus, the SciVal tool for measuring research performance. This publishing house works across all areas of STEM and its products and services also include digital tools for data management, instruction, research analytics and assessment. The company runs several workshops aimed at capacity building with their stakeholders and users.

During this master class participants will acquire knowledge to improve their writing skills and confidence, understand better what editors look for in papers, and receive recommendations to increase the chances of being published in a peer-reviewed journal. The workshop will be presented by Anthony Newman who has a wealth of experience in training junior scientists to publish top quality research papers.

Wednesday, 10th August, 16:00–17:00

Workshop 2: Become a user and collaborator with BNL and CFN

WS

presented by Priscilla Antunez and Lisa Miller

Brookhaven National Laboratory

Brookhaven National Laboratory delivers discovery science and transformative technology to power and secure the nation's future. Primarily supported by the U.S. Department of Energy's (DOE) Office of Science, Brookhaven Lab is a multidisciplinary laboratory with seven Nobel Prize-winning discoveries, 37 R&D 100 Awards, and more than 70 years of pioneering research. The laboratory is open to users from all countries and areas of STEM. The workshop will give an introduction to the capabilities of the laboratory, how to access facilities and collaboration tips for working with BNL scientists.

Thursday, 11th August

Thursday, 11th August, 10:15–11:15

Workshop 3: Global 5G industry development and market insights

WS

presented by Candice Wu

Huawei

In this seminar, Ms. Candice Wu, 5G Solution Expert for the Latin America Region, will discuss the following topics with participants:

1. 5G industry development: Describe the 5G industry development in terms of the scale of 5G commercial networks, spectrum evolution direction, and terminal maturity, and introduce Huawei's special contributions to global 5G development.
2. 5G commercial applications: Introduce mature 5G application cases from the perspectives of 2C, 2B, and 2H, and analyze the application prospects of 5G in various industries.
3. Suggestions on 5G development in Jamaica: Provide suggestions on 5G industry development in Jamaica from aspects such as spectrum evolution, site reconstruction, and business development.

Thursday, 11th August, 12:00–13:00

Workshop 4: Bench top to the conveyor belt: Steps toward the commercialization of scientific innovations

WS

presented by Peter Nelson

LifeSavers Wipes

The majority of scientific discoveries remain confined to dissertations and peer review publications where they remain hidden from their possible industrial applications. Given the challenges offered by current global events like environmental pollution, climate change effects, and diseases, the need for more rapid transmission of scientific discoveries from the realm of postgraduate dissertations and research papers to industrial applications is most critical. Hence, the need for a clear road map, allowing the connection of both pure and applied scientific discoveries to their industrial applications is obvious. Of course, for this to be achieved, a clear understanding of the constituent steps of such a process is germane. Hence, this brief workshop aims to map a possible path for achieving the aforementioned central goal, using previous experiences and examples.

Friday, 12th August

Friday, 12th August, 12:00–13:00

Workshop 5: Learn about the tool that can help you to find journals that could be best suited for publishing

WS

presented by Tatiana Castro and Ibis Sánchez Serrano

Elsevier

Elsevier is a Netherlands-based academic publishing company specializing in scientific, technical, and medical content. Its products include a number of top-tiered international journals the online citation database Scopus, the SciVal tool for measuring research performance. This publishing house works across all areas of STEM and its products and services also include digital tools for data management, instruction, research analytics and assessment. The company runs several workshops aimed at capacity building with their stakeholders and users.

In this class you will learn about the tools that can help you to find journals best suited for publishing.

Grand Innovation Challenge

Thursday, 11th August, 16:30–18:00

Grand Innovation Challenge

GIC

Session Chair: Zeyar Min (UTech, Ja.)

Projects by Brittany Morris, Demoy Lindo, Floyd James, Juan McIntosh, Kemo Fong, Matthew Rahamut, Melissa Curtis, Nkrumah Fong, Tamika Allen (mentors: Dr Coneil Roye & Stephanie Parker)

Panel of Judges: Evan Cayetano (IDB), Andrew Canon (NWC), Peter Nelson (UWI Mona), and Shane Austin (UWI Cave Hill)

Clean water and renewable energy are essential resources for people and the environment throughout the world. To this end, the *United Nations Member States* have adopted the *2030 Agenda for Sustainable Development*, at the heart of which are the 17 *Sustainable Development Goals* (SDGs). Of these 17 goals, three are concerned with sustainable production, maintenance and consumption of **water**.



As the COVID-19 pandemic drags on, it becomes increasingly clear that safely managed drinking water, sanitation and hygiene services are vital to human health. Unless progress picks up speed – dramatically – billions of people will still lack these essential services in 2030. Today, our local, regional, and global resources are under pressure due to increasing water scarcity and population growth. Demand for water is rising due to climate change effects, urbanization and increasing pressure from agriculture, industry and the energy sector.



Decades of misuse, poor management and the over-extraction and contamination of freshwater and groundwater supplies have exacerbated water stress and deteriorated water-related ecosystems. This, in turn, affects human health, economic activities, and food and energy supplies. Urgent action is needed to shift the current trend. This year's *Grand Innovation Challenge* sees three finalists presenting their innovation, addressing the SDGs 6, 11 and 14, concerning water.



UN Sustainable Development Goals

Grand Innovation Challenge Guidelines

They will also pitch their innovations to a panel of academic and industry experts on **Thursday, 11th August, 16:30–18:00**, during the *Grand Innovation Challenge Session*. The three finalist teams and the respective title of their application are:

- “Conserving Every Drop: Innovative Water Resource Management Strategies” by Melissa Curtis and Matthew Rahamut (mentor: Stephanie Parker)
- “VECTOR-1” by Nkrumah Fong, Floyd James, Brittany Morris, Tamika Allen, and Kemo Fong
- “Vae Victis Piston Flush” by Juan McIntosh and Demoy Lindo (mentor: Dr Coneil Roye)

The winning team will be announced during the Closing and Awards Ceremony on Friday, 12th August, 17:45–18:30.

Contributed Talks (with Abstracts)

Wednesday, 10th August

Session 1: D – Development

CT

	Session 1: D – Development		
	Chair: Peter Ruddock UTech, Ja.		Co-Chair: Phillipia Morgan Undergraduate Student, UTech, Ja.
10:45–10:50	Introduction to Session		
10:50–11:10	CT	Sharad Maharaj UWI St Augustine	Proposal for the commercial production of essential oils in Tobago using supercritical fluid extraction
11:10–11:30	CT	Max Wellington Northern Caribbean University	Comparative nutritional and molecular characterization of <i>Themeda arguens</i> (Piano grass) from Central Jamaica
11:30–11:50	CT	Naailah Ali UWI St Augustine	Assessment of a small-scale cacao fermentation method for niche marketing
11:50–12:10	CT	Winnette Ayana Collimore UWI St Augustine	A dietary risk exposure assessment of pesticide residues found in commonly consumed foods in Trinidad and Tobago
12:10–12:30	CT	Delton A. Gordon Snr. UTech, Ja.	The effect of gruesome crime scenes on the personal and professional lives of forensic crime scene investigators in Jamaica
12:30–13:00	Extended Discussion in Gather.Town		

Proposal for the Commercial Production of Essential Oils in Tobago using Supercritical Fluid Extraction

Sharad Maharaj^{1*}, David R. McGaw¹, Marian Watson²

¹University of the West Indies, St Augustine, TRINIDAD AND TOBAGO.

²University of Trinidad and Tobago, Pt Lisas, TRINIDAD AND TOBAGO.

Background: The global essential oils market has been estimated to be US\$10.6b in 2021 rising to US\$16.0b in 2026 [(Markets, 2021)¹] as a result of growth in awareness to preventative healthcare, improvements in the standard of living, along with an increase in the demand for aromatherapy products. With the potential availability of relevant plant materials in Tobago, it is appropriate to develop a strategy for the introduction of Plant Extracts Industry in the island.

Aims: To carry out a pre-feasibility study for the introduction of a Plant Extracts Industry in Trinidad and Tobago. This is based on the use of bay leaves from an existing plantation, supplemented by the production of vetiver oil from vetiver roots supplied by local farmers.

Methods: The processing operation would comprise a Supercritical Fluid Extraction (SFE) facility with three 1500L extractors utilising carbon dioxide, a by-product from the ammonia plants at Point Lisas in Trinidad. Basic data on the extraction characteristics of the two materials were obtained from a bench scale SFE Unit with a 100ml extractor. This data was fed into an economic feasibility analysis to determine whether

such a plant would be economically viable.

Results: Basic data on the extraction characteristics of both bay leaves and vetiver roots are presented. These experiments showed that the yield of bay oil would be ~4% and vetiver oil ~2%, these yields being used in the commercial viability analysis.

The order of magnitude capital cost was estimated to be ~US\$4.5m and annual operating costs ~ US\$4.7m. The financial analysis indicated an IRR of 24% over a 10-year period. Sensitivity analyses showed that the financial viability was very sensitive to oil yields, plant utilisation and vetiver purchase price.

Conclusions: The financial analysis makes the proposal well worthy for further investigation towards the detailing of a Business Proposal.

References:

- [1] MARKETS, M. A. 2021. Plant Extracts Market [Online]. Markets and Markets. Available: <https://www.marketsandmarkets.com/Market-Reports/plant-extracts-market-942.html> [Accessed].

Comparative Nutritional and Molecular Characterization of *Themeda arguens* (Piano Grass) from Central Jamaica

Max Wellington^{1*}, Ted Rhoden^{1,2}

¹ Dept of Biology, Chemistry & Environmental Science, Northern Caribbean University, JAMAICA ² Dept of Life Sciences, Trent University, Ontario, CANADA

Background: Piano grass (*Themeda arguens*), reputed to have been introduced to Jamaica as packing material in an imported piano¹. There are about 27 varieties of this highly invasive grass/weed worldwide [1] and in Jamaica the species previously identified as *Themeda arguens* is of concern as it has progressively taken over lawns, pastures and roadsides [1]. The grass is of particular concern to livestock farmers due to its highly invasive and aggressive nature and the concomitant negative effect on livestock productivity, especially during its annual seeding period (November/December – April) [2], when the palatability of the grass diminishes significantly and the seed awns can cause severe damage to the mouth when consumed, and feet of livestock [2], sometimes requiring veterinary intervention. During the period April - November the grass presents morphologically as a normal pasture grass and is readily consumed by cattle, indicative of an increase in palatability. No literature was found that addressed the nutritional or molecular characterization of *Themeda* and so this comparative study was undertaken to investigate these parameters relative to some popular pasture forages so as to more effectively assess its impact on livestock productivity.

Aims: To compare the nutritional and some molecular characteristics of *Themeda arguens* with *Brachiaria decumbens* (Signal grass) and *Cynodon nlemfuensis* (African star grass) and their relative impact on livestock productivity..

Methods: Questionnaires were administered to Cattle farmers across Jamaica to assess the prevalence of *Themeda arguens* as well as the types of pasture grasses used. Leaf samples from all three grasses were collected in May, July and October using randomized blocks. These were then dried and analyzed for the following: Dry weight, ash, crude fiber, crude protein, phosphorus, protein, amino acids, minerals, fatty acids and dry matter digestibility. DNA was also extracted RFLP and RAPD analyses were carried out. All analyses were done in triplicate.

Results: From the survey of local livestock (beef cattle) farmers all cited *Themeda arguens* (Piano grass) that comprised an average of ca. 15.5% of their pastures (Range 1-40%) as a nuisance. with two other popular pasture grasses – *Brachiaria decumbens* (Signal grass) and *Cynodon nlemfuensis* (African Star) which comprising approximately 21% and 26% respectively, of the farms surveyed. Other major grasses encountered on the farms were *Panicum maximum* (Guinea grass- 13%) and *Bothriochloa pertusa* (Seymour grass -10%). Analysis of the leaves revealed that *Themeda* had the lowest dry weight, crude protein, amino acids (essential and non-essential) and mineral content when compared to *Brachiaria* and *Cynodon*. Total lipid content (ether extract) and pepsin/cellulase dry matter digestibility (DMD) of *Themeda* were comparable to the other grasses. GC/MS analysis of the ether extract revealed little difference in the relative amounts of saturated, unsaturated and essential fatty acids. RFLP analysis yielded similar banding patterns whereas some differences in banding were observed in the RAPD analysis.

Conclusions: Phylogenetically *Themeda* maybe more closely related to *Cynodon* but is nutritionally very poor forage quality compared to *Cynodon* and *Brachiaria* and as such negatively impacts livestock and dairy production.

Acknowledgments: We thank Northern Caribbean University (Graduate Studies) for the research grant given to support this project. Thanks also to the Bureau of Standards Jamaica, the Sugar Industry Research Institute Jamaica, AAA Service Lab (Oregon, USA), Dr. Karl Wellington, YS Farms Ltd, Jamaica and Dr. Michael Motta, Jamaica Broilers Ltd for their invaluable support.

References:

- [1] Motta MS. Piano Grass. Ext. Circ. 51. Dep. Agric., Jamaica. 1953:1-8. From: <http://krishikosh.egranth.ac.in/handle/1/2031071>.
- [2] Barkworth ME *Themeda* Grass Manual. Flora of North America; 2003

ASSESSMENT OF A SMALL-SCALE CACAO FERMENTATION METHOD FOR NICHE MARKETING

Naailah Ali^{1,2*}, Darin Sukha¹, Saheeda Mujaffar² and Pathmanathan Umaharan¹

¹Cocoa Research Centre, The University of the West Indies, St. Augustine Campus, TRINIDAD AND TOBAGO ²Food Science & Technology Unit, Department of Chemical Engineering, Faculty of Engineering, The University of the West Indies, St. Augustine Campus, TRINIDAD AND TOBAGO

Background: The burgeoning of small gourmet chocolate boutiques worldwide serves as a key driver for niche and ultra-niche marketing of cocoa (*Theobroma cacao* L.), branded as (a) geographical indication (b) estate origin or (c) based on unique genetics. Over 90% of the cacao farms globally, are small with an average size between 2 and 5 hectares and can benefit from supplying to the gourmet boutiques.

Fermentation of cacao is critical for expression of genetic flavour potential, cessation of germination and pulp removal. Typically, fermentation methods require ≥ 1000.0 kg of wet cacao beans. These quantities are difficult to achieve in small-holder farms/niche marketing scenarios.

Therefore, small-scale vessel prototypes (modular, insulated, 5.0 kg and 30.0 kg capacity); were compared and the better option tested against standard (large-scale) fermentation in terms of temperature, pH, external bean colour (L, a, b) and sensory data.

Aim: To assess a low cost, field-based, small-scale fermentation method capable of fermenting wet bean masses ≤ 30.0 kg, for use in niche marketing.

Methods: (i) Wet beans were derived from standard genetic groups, Amelonado and Refractario types. These were each subjected to fermentation side-by-side in two sizes of Styrofoam boxes, (a) 30.0 kg (SB-30) and (b) 5.0 kg (SB-5). The treatments (cacao types and fermentation box size) were arranged in a 2×2 factorial design, with two replications. Fermentation progression was monitored viz. temperature and pH measurements and final quality assessed by sensory analysis. Duration of fermentation spanned 0-7 days with turnings on days 3 and 5.

(ii) Simultaneous fermentations of a defined mix of Trinidad Selected Hybrids (TSHs) were carried out in (a) Commercial Wooden Box (CWB) (standard cascade design, 1000.0 kg) and (b) 30.0 kg Styrofoam box (SB-30). Temperature readings were taken at the same depth (16.0 cm) in the three zones of the boxes, daily (Digi-Sense 94460-40 thermometer). Samples for pH, bean colour and sensory profiling (Ali 2022; Sukha 2008) were collected from each zone at the same depth (12.0 cm) every two days and composited for assessments or further processing. Duration of fermentation spanned 0-7 days with turns on days 2 and 4.

Results: (i) SB-5 versus SB-30- temperatures crossed 44.0°C, SB-30 fermentations displayed overall higher temperature peaks. For SB-30 two temperature peaks were observed following the first (day 3) and second (day 5) turns. SB-30 temperature peaks were at 50.0°C, while SB-5 peaked at 45.0°C following first turn, with no peak after second turn. Average pH trends showed that by day 6, SB-5 fermentations had irregularly high average pH (5.7), while SB-30 was at 4.0, typical of effective fermentation. SB-30 favoured optimum expression of flavours (determined by sensory assessment).

(ii) CWB versus SB-30- average temperatures exceeded 44.0°C in both boxes by day 3, following first turn on day 2, albeit the peak temperatures were different, higher in CWB (47.2°C) than SB-30 (44.0°C). Average pH trends were equal in terms of testa pH and analogous in the terms of cotyledon pH. As anticipated, overall, the cacao beans decreased in lightness (L) as fermentation progressed, the decrease was accelerated in CWB compared to SB-30. There were no significant differences in terms of treatment on red (a) and yellow (b) hues ($P > 0.05$). Flavour attributes (determined by sensory assessment) were not significantly different between CWB and SB-30 at optimum fermentation time. However, SB-30 required longer fermentation, 7 days compared to 5 days in CWB.

Conclusions: When compared to SB-5, SB-30 fermentations exhibited temperature and sensory trends indicative of more complete fermentation. When managed properly, the SB-30 fermentation protocol gives results comparable to the CWB.

Acknowledgments: Staff of the International Cocoa Genebank Trinidad (ICGT).

References:

- [1] N.A. Ali. "Fermentation Behaviour and Quality of Selected Cacao (*Theobroma cacao* L.) Genetic Groups." PhD diss. The University of the West Indies, St. Augustine, Trinidad and Tobago, West Indies, 2022.
- [2] D.A. Sukha. "The Influence of Processing Location, Growing Environment and Pollen Donor Effects on the Flavour and Quality of Selected Cacao (*Theobroma cacao* L.) Genotypes." PhD diss. The University of the West Indies, St. Augustine, Trinidad and Tobago, West Indies, 2008.

A Dietary Risk Exposure Assessment of Pesticide Residues found in Commonly Consumed Foods in Trinidad and Tobago

Winnette Ayana Collimore^{1*}, Grace-Anne Bent¹

¹University of West Indies, St Augustine Campus, Trinidad and Tobago

Background: Pesticide usage in agriculture has occurred for centuries and led to significant positive outcomes in food production and noticeable reduction in crop losses. However, pesticide usage on food crops often results in the presence of toxic pesticide residues on food produce, which is the main route of exposure to pesticides in humans. The toxicity of the pesticide residues can potentially cause debilitating effects to major human organs and body systems. Pesticide residue analysis addresses the issue of pesticide residues in foods by screening and quantifying the levels of pesticides in food commodities. The next crucial step after pesticide residue analysis is dietary risk exposure assessment. Dietary risk exposure should be performed on the pesticide residue data to determine whether potential exposure to the detected pesticide levels in food commodities could pose a risk to human health. Dietary risk exposure assessment has gained international acceptance as a powerful evaluation tool for governing food safety issues

Aims: To conduct non-carcinogenic and carcinogenic dietary risk exposure on pesticide residue data from fruit and vegetables in Trinidad and Tobago

Methods: Non-carcinogenic risk assessment was determined using the hazard quotient (HQ) and hazard index (HI). The estimated daily intake (EDI) was determined for each pesticide using Equation (1). The hazard quotient was calculated as the ratio of the estimated daily intake (EDI, mg/kg/day) to the acceptable daily intake (ADI, mg/kg/day) using Equation (2). The hazard index was calculated by adding HQ values for individual pesticide residues that affect the same organ or organ system, as shown in Equation (3).

$$EDI = \frac{C * FC}{BW} \quad \text{Equation 1}$$

$$HQ = \frac{EDI}{ADI} \quad \text{Equation 2}$$

$$HI = \sum HQ \quad \text{Equation 3}$$

where C is the pesticide concentration (mg/kg), FC is the food consumption rate (kg/day) and BW is the body weight of the individual (kg). BW = 30 kg for children aged 0-6 years and 46 kg for children 7-17. BW = 90.6 kg for adult males and 77.5 kg for adult females >17 years.

Food consumption rates of 140 g/day (vegetables) and 210

g/day (fruits) were used for children, while 89.3 g/day (vegetables) and 106.9 g/day (fruits) were used for adults. The ADI values for pesticides were obtained from the Food and Agriculture Organization (FAO) and the World Health Organization (WHO).

Cancer risks were computed to evaluate the carcinogenic effects of pesticides using Equations 4 and 5.

$$\text{Cancer Risk} = CDI * CSF \quad \text{Equation 4}$$

$$\text{Chronic Daily Intake (CDI)} = \frac{C * CR * EF * ED}{BW * LT} \quad \text{Equation 5}$$

where C is the pesticide concentration (mg/kg), CR is the consumption rate of the food commodity (kg/day), EF is the frequency of exposure (days/year), ED is the duration of exposure (years), BW is the body weight (kg), and LT is the life time or life expectancy (days). ED is the exposure duration based on age groups: 0-6 years = 6; 7-17 years = 11 years; and adults = 52 years. The EF is 365 days per year and LT = 25, 550 days (70 years). The cancer slope factor was obtained from the United States Environmental Protection Agency.

Results: HI and HQ values below 1 are considered acceptable according to the guidelines of the United States Environmental Protection Agency. Twenty-nine percent of HQ values were above the acceptable limit. Meanwhile, 58% of the HI values exceeded the acceptable limit. Cancer risk values were used to evaluate the potential of carcinogenic effects from dietary exposure to pesticide residues. The calculated cancer risk values were above the acceptable limit of 1×10^{-6} for all pesticides in this study.

Conclusions: The discovery of HI and HQ values higher than the acceptable limit signifies potential undesirable health effects through consumption of pesticide-contaminated foods. Further discovery of cancer risk values for detected pesticides exceeding the acceptable limit suggests that there is a possibility of cancer development in the population due to pesticide exposure in the diet.

References:

- [1] Adeleye, A. O.; Sosan, M. B.; Oyekunle, J. A. O. Dietary exposure assessment of organochlorine pesticides in two commonly grown leafy vegetables in South-western Nigeria. *Heliyon*, **2019**, *5*(6), e01895.

THE EFFECT OF GRUESOME CRIME SCENES ON THE PERSONAL AND PROFESSIONAL LIVES OF FORENSIC CRIME SCENE INVESTIGATORS IN JAMAICA

*Delton A. Gordon Snr., Andrea B. Fender-Longman

University of Technology, JAMAICA.

Background: Forensic Crime Scene Investigators (FCSIs) are forensic practitioners who are key components to the investigative process within a legal framework. In fact, the criminal justice system considers the scientific evaluation and forensic evidence collection to be the most significant aspect of any criminal investigation and court cases. Despite this, limited literature exists on the psychological effects experienced by FCSIs from processing gruesome crime scenes on a regular basis. Instead investigations in the area, regarding crime exposure-related stress, mainly focuses on first responders, police officers, and victims. Reports indicate that repeated crime exposure can cause critical incidence stress, anxiety-based illnesses such as post-traumatic stress disorder (PTSD), reduction in productivity and emotional burnout. These factors often lead to the development of less than desirable coping mechanisms such as, drinking alcohol more frequently and mental hardening. In the Jamaican context, very little is known about the psychological effect on FCSIs of the Jamaica Constabulary Force (JCF) and the Independent Commission of Investigations (INDECOM). This problem is particularly significant since Jamaica's FCSIs are exposed to increased rates of crime and violence when compared to other countries. Jamaica accounts for one of the highest homicide rates in the Latin America and the Caribbean.

Aims: To identify behavioural trends among Jamaican FCSIs that are manifested from them witnessing gruesome crime scenes.

Methods: The study was conducted during the period of February to April 2020 using a multimethod data collection technique. Survey data was collected island-wide, from FCSIs of the JCF and INDECOM (quantitative). Interviews (qualitative) were conducted with supervisors of the Scenes of Crime Units.

Surveys-A total of one-hundred and thirty-seven (137) paper and online questionnaires were administered to FCSIs. Comprising of forty-one (41) open and closed ended questions, the questionnaire chiefly captured data related to demography, behavioural and personality trends of FCSIs before and after repeated exposure to gruesome crime scenes.

Interviews-A twenty-one (21) question interview was conducted with nine (9) supervisors of the Scenes of Crime

Units, and the responses recorded accordingly. Interview questions were designed to highlight the supervisor's observation and perspective of FCSIs exposed to repeated gruesome crime scenes and their associated behaviour. In addition, supervisors were asked to recommend strategies that should be implemented to facilitate coping mechanism of FCSIs. Due to the Coronavirus disease (COVID-19) pandemic as well as the location of a few Scene of Crime Units, three (3) interviews were conducted via telephone whilst the remaining six (6) were conducted by in-person interviews. Results were tabulated and illustrated with charts and graphs. Cross-tabulation of responses were also employed. In addition, responses from closed-ended questions were converted to numeric data for ease of comparison.

Results:

Quantitative-In summary, Jamaican FCSIs showed some significant before and after behavioural and personality changes after repeated exposure to gruesome crime scenes. To include increase aggression and irritability towards family members; being less happy and outgoing; more outspoken and emotionless to gruesome crime scenes or morgue visits. Sixty-eight and fifty-eight percent respectively experienced PTSD symptoms in the form of flashbacks and difficulty sleeping after processing postmortems or gruesome crime scenes. To deal with the repeated crime exposure stress, participants mostly employed socialization with friends as a coping mechanism, rarely participating in any form of therapy.

Qualitative-Supervisors indicated that exposure to gruesome crime scene had an impact on FCSI lives; reporting drastic changes in attitude, emotion and demeanor with time which later affected their work.

Conclusions: Jamaican Forensic Crime Scene Investigators (FCSIs) are psychologically affected from the effects of witnessing gruesome crime scenes on a regular basis. In some instances, FCSIs also exhibited signs of PTSD particularly after encountering gruesome crime scenes which has played a role in impacting their personal and professional lives.

Session 2: R – Resilience

CT

Session 2: R – Resilience			
		Chair: Kayon Barrett Tarleton State University	Co-Chair: Marco-Dean Brown Graduate Student, UWI Mona
14:00–14:05	Introduction to Session		
14:05–14:25	CT	Kayon Barrett Tarleton State University	Environmental modeling of organic pollutant distribution in Jamaica
14:25–14:45	CT	Deiondra Tai UWI Mona	Small-RNA next generation sequencing, a tool for the discovery of the virome of Jamaican crops
14:45–15:05	CT	Kerri-Ann Bennett UWI Mona	A survey of native and invasive alien livebearing fish species in Jamaican rivers
15:05–15:25	CT	Sylvia Adjoa Mitchell UWI Mona	Bioprospecting and biopiracy in the Caribbean: Challenges and opportunities
15:25–15:45	CT	Chelsea Frank UWI Mona	Investigating the use of natural extracts of Piperaceae in control of adult <i>Aedes aegypti</i> mosquitoes
15:45–16:15	Extended Discussion in Gather.Town		

Environmental modeling of organic pollutant distribution in Jamaica

Kayon Barrett^{1*}, Amy Stuart²

¹Tarleton State University, USA ²University of South Florida, USA.

Background: Numerous organic chemicals, either directly manufactured or formed as byproducts of other processes, are released into the environment. Once there, many cause adverse effects on environmental and human systems. Of particular concern are long-lasting impacts from those organic pollutants that remain in the environment for long periods of time. The development of appropriate management strategies to address this problem requires knowledge of the environmental distributions of these pollutants. Environmental monitoring is often infeasible due to cost and personnel requirements, and some hazard indicators cannot be obtained via monitoring. Multimedia modeling, especially when specifically tailored to and parameterized for the region, is a suitable alternative for estimating pollutant fate. However, high-resolution, site-specific environmental models often lack transparency, and/or require substantial computational resources and skilled personnel. Hence, they can be cost and resource prohibitive, especially for less-developed countries.

Aims: 1) To develop a dynamic, user-friendly, multi-compartment environmental model that can be used for screening evaluation of the environmental distribution of organics in mixed-landscape watersheds of tropical developing countries. 2) To apply the model, named RioShed, to investigate the fates of several organic pollutants in the Rio Cobre Watershed of Jamaica.

Methods: RioShed [1] was developed to include 16 compartments representing urban, agricultural, forested, and grassland land uses. By combining concepts and/or formulations of the regional models CalTOX (versions 1.5 and 2.3), GIM3 and MUM, the model is based on mass balance equations representing the fate and transport processes affecting each compartment. The resulting system of differential equations are solved using matrix methods, employing the backward Euler method for the dynamic solution. RioShed is applicable to most semi-volatile, nonionic, organic chemicals.

RioShed was applied to evaluate the comparative

environmental distributions of some PBDEs, dioxins, furans, and current-use pesticides in a forested area with a nearby clearing in the Rio Cobre Watershed, Jamaica. The outputs of the model simulations included the environmental hazard indicators of atmospheric long range transport potential (LRTP_a) and overall persistence (P_{ov}). High values of LRTP_a and P_{ov} indicate propensity to cause adverse effects at distant locations and long environmental presence, respectively. Some environmental distribution metrics, computed using RioShed, were also compared to those obtained from environmental monitoring data [2].

Results: As with the field data, RioShed simulated lower organic concentrations in the atmosphere of the forested area than in that of the clearing, as seen in Table 1. Additionally, both LRTP_a and P_{ov}, were reduced, by respective averages of 3.1% and 13%, when forests were modelled as being present in the environment, especially when the canopy included evergreen trees.

Conclusions: Results suggest that forests in Jamaica reduce the hazard metrics of some organic pollutants. These findings lend support to using environmental multimedia modeling to evaluate the fates, distribution, and/or exposure potential of harmful organic chemicals in Jamaica and in similar tropical developing regions, especially in the absence of monitoring data.

References:

- [1] Barrett, K.S.C., Stuart, A.L., "Forests effects on the environmental fates of organic pollutants in a tropical watershed" *Sci. Tot. Environ.*, 815:152577, 2022.
- [2] Barrett, K.S.C., Jaward, F.M., and Stuart, A.L., "Forest filter effect for polybrominated diphenyl ethers in a tropical watershed" *J Envir. Manag.*, 248: 109279, 2019.

Table 1: Forest to clearing atmospheric concentration ratios from modeling and field monitoring

Organic contaminant	Ratios	
	Modeled	Measured
PBDE-47	0.98	0.52
PBDE-99	0.96	0.93
PBDE-153	0.97	0.92
PBDE-209	0.95	0.45

Source: Supplementary data from Barrett and Stuart (2022)

Small-RNA Next Generation Sequencing, a Tool for the Discovery of the Virome of Jamaican Crops

Deiondra Tai, Syonni Holeness, Paula Tennant, Marcia Roye

The Biotechnology Centre, The University of the West Indies Mona, JAMAICA.

Background: Plant viruses are responsible for significant losses in crop production annually. Infections are often exacerbated by mixed infections. One strategy of combatting viral disease spread lies in swift diagnoses so that immediate interventions can be employed to slow or stop their spread. Sweet pepper, hot pepper, and tomato are among the most important cash crops in Jamaica and are constantly threatened by pathogens. Reduced production of these crops will result in their importation to supplement local demand, increased costs, and the loss of livelihood of local farmers. It is therefore crucial that these crops be monitored. Additionally, understanding the virome of these plants and the possible viral interaction of infecting viruses is important in understanding symptomology and subsequent management strategies. Small RNA sequencing is a useful tool in virome discovery, as it uses the plant's self-defense mechanism to elucidate the infecting virus.

Aims: To determine and characterize the viruses infecting hot pepper, sweet pepper and tomato using small-RNA next generation sequencing (siRNA-NGS) and determine the efficiency of the NGS tool in diagnosing viral infections in crops.

Methods: Total RNA was extracted from symptomatic and non-symptomatic Scotch bonnet, sweet pepper, and tomato samples from 8 parishes across Jamaica. A siRNA library was prepared by adding commercially synthesized 3' and 5' adapters to the isolated 23-25 nucleotide RNA fragments. These adapters simultaneously served as PCR primers for the enrichment of the siRNA sequences [2]. The siRNA fragments were sequenced using Illumina High Throughput Sequencing. The sequences were initially assembled and aligned to reference viruses by VirusDetect v1.1.07. For a more rigorous analysis, assembly short read assembler CAP 3 and assembly suite of Velvet 1.2.10 were used. The resulting assembled contigs were analyzed using the NCBI BLAST (National Centre for Biotechnology Information) nucleotide-nucleotide BLASTn database programme (<http://blast.ncbi.nlm.nih.gov/Blast.cgi>) for comparison with known sequences. The full-length viral sequences were analyzed with SeqMan, Lasergene version 7.0 (DNASTar Inc., Madison, WI). Sequences were analyzed to obtain the expected open reading frames using NCBI ORFfinder (<https://www.ncbi.nlm.nih.gov/orffinder>) and

phylogenetic analysis conducted via MEGA X (<http://www.megasoftware.net/>).

Results: Tomato was found to be infected by *Tomato yellow leaf curl virus* (TYLCV) and *Southern tomato virus* (STV). This is the first report of STV in Jamaica and the first full length recovery of the economically important TYLCV from Jamaica. The virome of sweet pepper and Scotch bonnet pepper was more complex. They were infected with *Cucumber mosaic virus* (CMV), *Tobacco etch virus* (TEV), *Potato Virus Y* (PVY) and viruses never previously identified in Jamaica, *Pepper yellow leaf curl virus* (PYLCV), *pepper veins yellow virus* (PVYV) and *Bell pepper endornavirus* (BPEV). The complete sequences of TYLCV (2,786 nt), CMV (RNA 1- 3,364 nt, RNA2- 3,045 nt, RNA 3 – 2,028 nt), TEV (9,539 nt), and BPEV (14,659 nt) were recovered. This is the first report of full-length sequences for TEV, BPEV, CMV and TYLCV in Jamaica.

Conclusions: The results suggest that strategies to better control plant viruses in the crops Scotch Bonnet pepper, sweet pepper and tomato are required as these viruses can significantly reduce the productivity. Additionally the use of sRNA and NGS to identify viruses associated with economic important crops is a useful strategy as no prior information as to the nature of the viruses present is necessary for the techniques to be successful.

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A SURVEY OF NATIVE AND INVASIVE ALIEN LIVEBEARING FISH SPECIES IN JAMAICAN RIVERS

Kerri-Ann Bennett^{1*}, Ingo Schlupp², Stefan Bräger³

¹The University of the West Indies, Mona, JAMAICA ²University of Oklahoma, UNITED STATES

³Deutsches Meeresmuseum, GERMANY.

Background: Invasive alien species (IAS) are implicated in the extinction or decline of numerous native aquatic species worldwide. Their negative impacts occur through mechanisms including habitat alteration, competition, predation, hybridisation, and the spread of disease (Strayer et al. 2006). Small island ecosystems are most susceptible to the impacts of IAS. Once established, freshwater IAS are difficult to eradicate without negatively impacting native species.

Jamaica has only four endemic freshwater fish species. Three species (*Gambusia wrayi* Regan, 1913, *Gambusia melapleura* Gosse, 1851, and *Limia melanogaster* Günther, 1866) are fishes from the family Poeciliidae. *Gambusia melapleura* is rare and only two populations were known to occur. *Gambusia puncticulata* Poey, 1854 is the only other native poeciliid. Poeciliids bear live young, and most species can tolerate a wide range of environmental conditions. They also grow quickly, and invasive members can colonise disturbed habitats. Consequently, the Poeciliidae is one of the families with a comparatively high number of invasive members (García-Berthou et al. 2007). In a 2013 US survey poeciliids accounted for 56% of the established exotic fish populations (Matlock 2014).

There is little information on the status, distribution, or biology of Jamaican freshwater endemic fishes. Also, there is no monitoring of freshwater fish fauna by either governmental or non-governmental agencies. Without this information it is impossible to effectively manage the island's freshwater ecosystems. This survey is the first step in work aimed at investigating the ecology of Jamaican poeciliids as well as investigating interactions between native and introduced poeciliids.

Aims: This survey seeks to investigate the distribution of native poeciliid species as well as determine the non-native poeciliid species present across Jamaica.

Methods: In June 2018 and June - August 2019 we conducted surveys of the poeciliid populations in

twenty-eight freshwater habitats across Jamaica. Each site was surveyed for 1- 1.5 hours by three to five persons. Fishes were caught using a 5mm mesh 12-foot minnow seine, an 8mm mesh minnow trap, and a small hand-net. Specimens were sacrificed in the field, preserved in 99% alcohol, and later identified in the laboratory. The abundance of each species was recorded for each site. Non-native species were considered invasive if the species was listed in a database of invasive species such as the Global Invasive Species Database (IUCN 2011).

Results: Only 9 of the twenty-eight sites were free of introduced species. Eight invasive alien species were encountered from the families Poeciliidae and Cichlidae. The abundance of the endemic *L. melanogaster* was low in most habitats. Two new populations of the rare *G. melapleura* were identified which brings the total number of known populations to four. The highly invasive *Poecilia reticulata* (guppy) was the most widely distributed poeciliid.

Conclusions: There is an alarming number of established populations of IAS present. There are now more non-native than native poeciliid species in Jamaica. In degraded habitats IAS were often the only fish present. The combination of poor habitat quality and the presence of invasive species could pose a serious threat to the long-term survival of native poeciliids.

Acknowledgments: Partial funding for was provided by the University of Oklahoma. A Research and Collecting Permit was granted by the National Environment and Planning Agency (NEPA).

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BIOPROSPECTING AND BIOPIRACY IN THE CARIBBEAN: CHALLENGES AND OPPORTUNITIES

Sylvia Adjoa Mitchell^{1*}, Kevel Lindsay², Anthony Richards²

¹The Biotechnology Centre, The University of the West Indies, Mona Campus, JAMAICA ²Wild Caribbean, CARIBBEAN
<https://www.facebook.com/groups/445396832297065/about>.

Background: The goal of harnessing our biodiversity to bring health and wealth to the people living in the Caribbean Region got a boost recently courtesy of a 2016 IUCN project entitled 'Advancing the Nagoya Protocol in Countries of the Caribbean Region' that had five components. This project was commissioned by eight governments (Antigua and Barbuda, Barbados, Grenada, Guyana, Jamaica, Saint Kitts and Nevis, Saint Lucia, Trinidad and Tobago) with GEF funding, had UNEP as its Implementing Agency and the International Union for the Conservation of Nature (IUCN) as the Executing Agency.

The Caribbean is of critical importance for global biodiversity conservation due to the high percentages of endemism in the region, for particular islands or even parts of islands (eg Cockpit Country, Jamaica), for plants and animals. The Caribbean is the 7th largest of the 25 top 'hotspots' in the world. These highly valued genetic resources in the Caribbean are under threat due to land degradation, climate change, pollution from nutrients, unsustainable use and biopiracy. The Nagoya Protocol (NP) of the CBD offers an important opportunity to ensure use of our genetic resources generates and shares benefits derived from their utilization with the region, by returning some of the revenue generated from these activities to the protection of the resources and the development of the countries where they were accessed.

Aims: To report on a Caribbean project on ABS-Bioprospecting in the Caribbean Region.

Methods: A 3-member team from the Caribbean carried out one component entitled 'ABS – Bioprospecting in the Caribbean Region' of the IUCN project described above, the outputs of which are being shared here. Information was gathered via seven project workshops, country visits, questionnaires, and internet searches.

Results: Our team was able to unearth several examples of Caribbean biodiversity which have been made into products benefitting companies outside of the region, with no benefit accruing to any Caribbean country. Other examples unearthed by the project show how some countries such as the Bahamas have been able to retain earnings from bioprospecting. Via seven workshops etc the following outputs were developed: information sheets for tour guide operators, standard biodiversity registers, a roster of regional ABS experts and institutions, biodiversity summaries for the named countries, stocktaking of traditional knowledge in the Caribbean and development of a standardized methodology for creation of Caribbean national registers for terrestrial and marine biological resources.

The Project Objective seeks the uptake of the Nagoya Protocol and implementation of key measures to make the protocol operational in Caribbean countries. So far only the Dominican Republic (2015) and Antigua and Barbuda (2017) have ratified the Nagoya Protocol while only Guyana (2014), Cuba (2015), St Kitts and Nevis (2018), Bahamas and St Lucia (2022) have acceded.

Conclusions: It is hoped that the outputs of this project will assist the Caribbean to ratify the Nagoya Protocol so as to reap benefits for our region, for conservation and development purposes, so we can protect our Caribbean resources for future generations.

Acknowledgments: We thank IUCN for this consultancy and guidance through this process.

Reports:

- [1] **Mitchell SA**, K Lindsay, A Richards (2018) Bioprospecting in the Caribbean region: Caribbean ABS Institutional Mapping, IUCN, 142 pgs.
- [2] **More reports and other outputs are available on request from sylvia.mitchell@uwimona.edu.jm**

INVESTIGATING THE USE OF NATURAL EXTRACTS OF PIPERACEAE IN CONTROL OF ADULT *Aedes aegypti* MOSQUITOES

Chelsea Frank^{1,2*}, Sheena Francis², Rupika Delgoda²

¹Department of Life Sciences, The UWI Mona, JAMAICA ²Natural Products Institute, The UWI Mona, JAMAICA.

*Contact Author Email: cayannafrank@gmail.com

Background: Vector-borne diseases have since the 17th century been the leading cause of death by disease more than any other causes combined, even preventing development in the tropics (Gubler 1998). Of all insect vectors, *Aedes aegypti* proves to be the deadliest as it is the primary vector of the four most notorious vector-borne diseases – chikungunya (chik-V), Zika (Zik-V), dengue fever and yellow fever viruses. Control of the spread of *Aedes*-borne diseases is primarily reliant on the control of the vector responsible for their spread. Traditionally, vector control relied on environmental hygiene and the elimination of breeding sites (Gubler 1998), shifting only in the 1980s to the use of synthetic chemicals in the form of carbamate, organochloride, organophosphate and pyrethroid insecticides (Norris, et al. 2015). However, the evolution of *Aedes aegypti* resistance to synthetic chemicals have made control of the spread of the vector and its diseases increasingly difficult. This led to the exploration of innovative and alternative methods in the control of *Aedes aegypti*.

Aims: This present study seeks to explore the use of natural extracts from Piperaceae in control of the *Aedes aegypti* vector.

Methods: Samples of the leaves and stem of Piperaceae, coded CFPA, were dried, blended and suspended in ethanol or hexane over 7 days. The suspended solution was filtered and concentrated via rotary evaporation with suction attached to produce the final products used in experimenting.

Aedes aegypti larvae and pupae were collected from breeding sites in Kingston, Jamaica (KSA) and lab reared to adult stages.

Insecticide resistance testing was conducted using the Centers for Disease Control and Prevention (CDC) bottle bioassay method where Wheaton bottles were pre-coated with deltamethrin at concentration 10 µg/bottle.

The insecticidal properties of the extracts were tested by topically applying the extract to the thorax of two to five days old adult female *Aedes aegypti* while they were briefly anaesthetized on ice. Mosquitoes were then observed hourly for five hours and again at 24 hours to determine knockdown (KD₅₀) and lethal dose necessary to achieve 50% mortality (LD₅₀), respectively.

Using the most potent extract, the synergistic ability of the extract was determined by topically applying the extract, at the LD₂₅ concentration, to the thorax of two to five days old adult female mosquitoes. Mosquitoes were observed for one hour then transferred to deltamethrin pre-coated bottles and observed for their mortality at intervals up to two hours.

Results: All extracts of Piperaceae showed efficacy against KSA *Aedes aegypti*, however, the stem in ethanol extract was most effective with LD₅₀ = 0.008 mg/mg of mosquito. Further, synergistic studies showed that when the most potent extract at the LD₂₅ concentration was used in combination with deltamethrin, mortality was improved from ~20% to 98%.

Conclusions: Natural extracts derived from Piperaceae present a suitable alternative to synthetic chemical insecticides and enhances vector susceptibility to deltamethrin.

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Thursday, 11th August

Session 3: I – Innovation

CT

	Session 3: I – Innovation		
	Chair: Sylvia Mitchell UWI Mona		Co-Chair: Desireina Delancy Graduate Student, UWI Mona
11:15–11:20	Introduction to Session		
11:20–11:40	CT	Alana Clare UWI St Augustine	Discovery of rare and novel variants associated with breast cancer in Trinidadian families using whole-exome sequencing
11:40–12:00	CT	Winston De La Haye UWI Mona	Psychedelic assisted psychotherapy – preparing your target using psychohistoriography: A Jamaican perspective
12:00–12:30	Extended Discussion in Gather.Town		

DISCOVERY OF RARE AND NOVEL VARIANTS ASSOCIATED WITH BREAST CANCER IN TRINIDADIAN FAMILIES USING WHOLE-EXOME SEQUENCING

Alana Clare^{1*}, Sylvia Keigwin², Dr. Rajini Haraksingh¹

¹University of the West Indies, St Augustine, TRINIDAD AND TOBAGO ²Genetics Trinidad, Port of Spain, TRINIDAD AND TOBAGO.

Background: Breast Cancer (BC) is a group of diseases that occur when epithelial duct cells or lobules in the glandular breast tissue undergo abnormal and uncontrolled cell division [1,2]. It is prevailing cancer that affects women worldwide and is the leading cause of mortality in transitioning and transitioned countries [1, 3, 4, 5, 6 7]. The World Health Organization estimated that in 2020 BC accounted for 15% of worldwide cancer mortality cases [7]. Trinidad and Tobago has significantly increased mortality due to BC [6]. Approximately 15 genes that have been found to be associated with BC susceptibility have been used in multigene genetic screening panels provided locally. However, these panels do not adequately explain the cause of hereditary BC within this population. As such we believe that there may be novel genetic contributors to hereditary BC present in this population or present in select families.

Aims: To determine whether novel genetic contributors to BC development are present in select Trinidadian families. The secondary aim is to try to understand the frequency in which these mutations occur within these families.

Methods: Ethics approval was obtained from the University of the West Indies St Augustine, Campus Research Ethics Committee (CEC576/04/18). De-identified patient information from multigene screening panels (Invitae/Color Health) were collected from the St. James Medical Complex (Trinidad and Tobago) and an independent collaborator who facilitates the distribution of the panel locally. Descriptive statistics including frequencies and percentages were calculated. Adjusted P-values of less than 0.05 were considered statistically significant.

We also performed Whole Exome Sequencing on two members of a family with evidence of hereditary BC. The proband was screened using a multigene panel (Color Health) and did not carry any mutations relating to BC. Subsequent bioinformatic analysis revealed potential novel and understudied genetic variants associated with this family's condition. PCR and Sanger sequencing were used to track these variants within the affected and nonaffected family members.

Results: 188 patients in Trinidad have undergone genetic screening using either a 30 gene Color Health or an 84 gene

Invitae general cancer screening panel. Of these, 95 patients had a confirmed diagnosis of BC, and 87.4% of these patients were found to not carry any likely pathogenic or pathogenic mutations in genes associated with increased BC susceptibility.

Candidate variants in 10 genes were determined using Whole-exome sequencing and bioinformatic analysis. Subsequent PCR and sanger sequencing revealed that candidate variants in the Fanconi anemia complementation group M (FANCM) gene had the highest probability of contributing to BC susceptibility in this family.

Conclusions: This study demonstrates the importance of including understudied populations in medical research and reveals novel molecular points of entry for developing new BC diagnostics and therapeutics for this understudied population.

Acknowledgments: We thank St James Medical Center for providing de-identified data for our statistical analysis.

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Psychedelic Assisted Psychotherapy - Preparing your Target Using Psychohistoriography: A Jamaican perspective

Winston De La Haye^{1*}, Geoffrey Walcott¹, Jordan Eaton¹, Jhoelle Beckford²,
Janelle Greene¹

¹The University of the West Indies, Mona Campus, JAMAICA ²Kingston Public Hospital, Kingston, JAMAICA.

Background: In recent years there has been a resurgence in interest in psychedelic assisted psychotherapy (PAP) [1]. Initial scientific research into the utilization of these compounds were eventually suspended due to concerns related to increasing recreational use of psychedelics and their association with the rise of the “counterculture movement” in the United States [2]. However, the use of psilocybin and other psychedelics have shown promise in the treatment of mental illnesses. The efficacy of this modality of treatment has been demonstrated through clinical trials and other studies in the management of a number of mental illnesses, including some treatment resistant cases [3].

Psychedelics catalyze or enhance the experience fostered by existing psychotherapeutic methods, including cognitive restructuring and other dynamic modalities [4]. Psychohistoriographic Cultural Therapy (PCT), conceptualized by the late Professor Frederick Hickling in the 1970’s in Kingston, Jamaica, offers a pathway for exploration in the Jamaican context. Applied to individuals, Psychohistoriographic Brief Therapy (PBT) has already shown success in patients with personality disorders in Jamaica through a process which includes documenting life experiences in a Psychohistoriogram [5]. In the De La Haye Psilocybin Treatment Protocol (DPTP) (Fig. 1), micro-doses of Psilocybin mushrooms are taken throughout an 8-week outpatient process of documenting the components of the Psychohistoriogram, making use of the increased openness and empathy associated with the use of psychedelic agents. These sessions are followed by supervised in-office therapeutic doses of psilocybin.

As of February 2, 2022, indications suggest that the

local industry is poised for further developments in the use of psychedelics for mental illnesses in Jamaica. This was signaled in an announcement by the Manager of Tourism at Jamaica Promotions Corporation (JAMPRO), stating that the agency had identified opportunities in the development of facilities for treatment, and research and development with Psilocybin mushrooms.

Conclusions: These are interesting times for PAP in the Caribbean in general and Jamaica in particular, benefiting clients as we venture into this New Frontier in Psychiatry, both in clinical practice and research. We should ensure that the Caribbean's rapidly expanding psychedelic wellness and medical programmes are safe, while maintaining the highest ethical standards in the therapeutic use of psychedelics.

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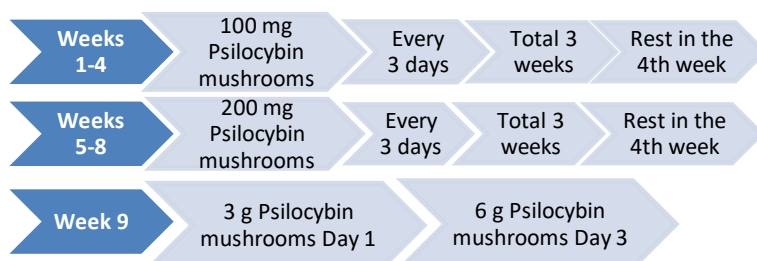


Figure 1: *The De La Haye Psilocybin Treatment Protocol*

Session 4: V – Vision

CT

Session 4: V – Vision			
	Chair: Samson Omoregie UTech, Ja.		Co-Chair: Jason Solomon Graduate Student, UTech, Ja.
14:30–14:35	Introduction to Session		
14:35–14:55	CT	Craig Rattray UWI Mona	Development of a simple automated image-based sun position tracking algorithm
14:55–15:15	CT	Andrea Barrett UTech, Ja.	Science, technology and innovation (STI) policy: A necessary artefact for the SIDs of the Caribbean
15:15–15:35	CT	Anthony Dellinger AT Research Partners	West Indies originated USPTO invention with <i>pro se</i> prosecution are a competitive missing link in regional and global science and industry
15:35–15:55	CT	Lisa Myers Morgan Rural Agricultural Development Authority	The impact of areawide integrated pest management programmes in Jamaica
15:55–16:15	CT	Tillack Hardeen Church Teachers' College & Northern Caribbean University	A preliminary investigation into the local management of isolated bacteria implicated in malodour (halitosis) in Mandeville, Jamaica
16:15–16:45	Extended Discussion in Gather.Town		

Development of a Simple Automated Image-based Sun Position Tracking Algorithm

Craig Rattray^{1*}, Kert Edward², Marhoun Ferhat¹

¹Department of Physics, The University of the West Indies, Kingston 7, JAMAICA

²Thorlabs Inc, Newton, New Jersey, UNITED STATES OF AMERICA

Background: At the inception of automated solar tracking in the 1970's, geometric architectures with pair(s) of solid-state photo-sensitive devices were constructed and used to detect the sun's position. As an alternative in recent years, cameras have been used to capture and process live sky images to detect the sun's position. When the sky is cloudy however, both approaches are prone to errors and sometimes require human intervention which tend to reduce the trackers' economic viability [1].

Aims: To develop a fully automated dual-axis image-based solar tracking algorithm that achieves optimal gains in solar radiation collection.

Methods: The primary cause of solar tracking errors is sun sensors failing to consistently detect the sun's position or at least appropriately respond to occasions when view of the sun is significantly obscured by clouds [2]. Whether tracking is reliant on image processing or the response of solid-state photo-sensitive devices, they are prone to errors; although in cloudy conditions, the former is more reliable than the latter [3]. Subsequent to this, an algorithm was developed to eliminate sun position detection errors. This was achieved by determining and exploiting a group of camera settings that consistently produced appropriately exposed images in which the sun is identifiable by a specific intensity value. To evaluate the algorithm's performance, the sun position tracker shown in Figure 1 was constructed and operated using the algorithm. The tracker components include; (a) the sun-tracking photo-voltaic (PV) module, (b) the vertical-axis tracker-arm, (c) the camera viewing window, (d) a plastic enclosure with the tracker's electronic control system components, (e) the fixed-mounted PV module, (f) the dual axis support column, (g) a metal enclosure with a DC Power Supply and Data Logger, (h) a splash shield with the vertical-axis actuator inside, (i) the horizontal-axis actuator and (j) the horizontal-axis tracker-arm.

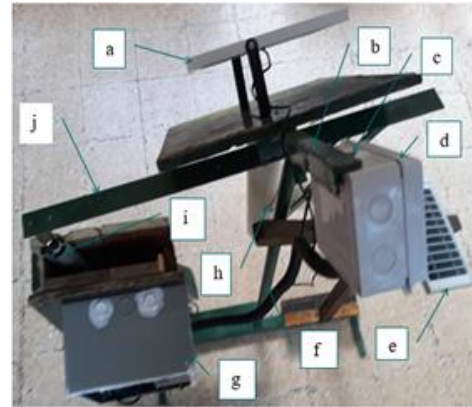


Figure 1: Showing constructed dual-axis solar tracker used to evaluate the solar tracking algorithm's performance.

Results: For active sun tracking between 9:30a.m. and 3:30p.m. daily and a duration totaling 79.5 hours, there were no detection errors; and mean tracking error, accuracy and precision were 0.875° , 1.608° and 0.32° respectively. The tracker's response to heavy cloud cover and night-fall was appropriate and on average, orientation adjustments were done at intervals of approximately 35 minutes. Between 8:00a.m. and 5:00p.m., approximate gains of sun tracking compared to a fixed polar-mount orientation—regarding solar radiation collection and electricity generation from solar photovoltaic modules connected to fixed load resistances—were respectively 40% and 20%.

Conclusions: Mean solar radiation collection efficiency was 99.96%; thus the solar tracking algorithm satisfied the main requirement for solar photo-voltaic systems.

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Science, Technology and Innovation (STI) Policy : A necessary artefact for the SIDs of the Caribbean

Andrea Barrett^{*1},

¹ University of Technology, JAMAICA ²

Background: Economic development theorists ((Schumpeter 1942), (Romer, 1994), (Solow, 1956)) have established the theoretical constructs of scientific and technological developments as foundations to innovative solutions in the form of products, processes and services to long-term socio-economic development and prosperity to high-end economies around the world. It is through the pervasiveness of these innovations within markets which then spurs a sustainable social transformation and long term economic growth within nations. The perspectives presented in this research paper, are that within the context of small island developing states (SIDs); social and economic transformation is attainable through the formulation and execution of robust science and technology (S&T) policy. However, this researcher posit that a S&T policy must include the (I) - innovation to become a STI policy. The output of this concatenation is a science, technology and innovation (STI) policy which then establishes the foundation for the formulation of appropriate artefacts -legislative and regulatory as well as systems of innovation namely sectoral systems of innovation (SSI)(Malerba,2004), national systems of innovation (NSI) (Nelson, 1993, Lundvall 1992), and regional systems of innovation (RSI) (Cooke, 2001) - to simulate innovative solutions within strategic sectors both nationally and regionally. Scientific discoveries facilitate the creation of new technologies; the outputs of which integrate and/or the application of scientific and technological development generates innovative solutions to be absorbed by civil society. Therefore, the crafting of an STI capacity in any systems of innovation is a function advances in science, technology, and an innovative-centric society. The opportunities for innovation through scientific discoveries and technological advances are endless. This researcher is postulating that, given the significance of innovation in promoting economic growth and social transformation, then policies supporting innovation initiatives are necessary in all shifts in paradigm involving socioeconomic transformation and national development.

Aims: To introduce additional dimensions to the STI policy for the Region and individual countries within the region.

Methods: Literature review on new scholarly articles related to STI contributing to socioeconomic transformation of developed and developing economies. Revisit evidence-based cases on STI contributions to robust socioeconomic growth in other emerging economies and regions. A review of the role, (if any) of influencers such as history, location, cultural etc may have on STI policy dimensions.

Results: A framework for adoption by countries within the Caribbean to advance their respective STI agenda towards sustainable socioeconomic growth within respective pillar sectors, nationally and regionally.

Conclusions: The need for Science, Technology and Innovation policies targeting the primary sectors within respective nations of the Caribbean Region is an imperative. The required collaborative efforts from all stakeholders in the implementation and governing these policies is critical to ensure sustainable progress and prosperity of all Caribbean citizens.

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WEST INDIES ORIGINATED USPTO INVENTION WITH *PRO SE* PROSECUTION ARE A COMPETITIVE MISSING LINK IN REGIONAL AND GLOBAL SCIENCE AND INDUSTRY

Lowell Hughes, MD¹, Voss Harrigan², and Anthony Dellinger, PhD^{3*}

¹Hughes Medical Center, Lower South Hill, ANGUILLA, BWI, ²University of District Columbia, Department of Mechanical Engineering, WASHINGTON DC, USA. ³AT Research Partners, Greensboro, NORTH CAROLINA, USA.

Background: Globally, STEM scientists are the apex of novel innovation and cutting-edge research and development. While, patents are inextricably linked to innovation, research, and development, both undergraduate and graduate STEM students rarely invent, and those that do almost never invent twice. The thesis of this presentation is three-fold: (1) The understanding, value, benefits, and basics of intellectual property (IP) creation and invention are fundamentally missing in STEM curricula; (2) There are few (if any) incentives for STEM researchers to create and file patent applications within the University environment; and (3) Patent filling assistance programs (*pro se*) provide *pro bono* outreach and education to applicants. The key tenants of this presentation are reduced to practice as it relates to *pro se* patent filings of West Indies inspired invention to the United States Patent and Trademark Office (USPTO) in 2021 and 2022. Three examples of West Indies conceived and awarded IP by a lead inventor domiciled in Anguilla, BWI (Patent Nos. 10,934,168, 11,219,255, and 11,298,375). Further, a permanent patent filling, titled: “Innocuous Sterilant using Hemocyanin and Functionalized Fullerenes with Broad-Spectrum Intracellular and Interstitial Microbiocidal and Radical Scavenging Effects for Packaged Matter, Biologics and Organics including Liquids, Gases, Tissue, Organs, Cells, and Limbs with Copper Mediated Oxygenation for Viability and Preservation” is under review and awaiting a first office action offering broad evidence of origination of IP in the West Indies. As case studies for this presentation, two pieces of IP are examined: The permanent patent and a recently filed provisional application that teaches a minimally invasive and unassisted robotic surgical method for atomic scale manipulation of functionalized nanoparticles to perform high precision “nano surgery”.

Aims: To introduce a STEM model for innovation, research and development. Articulate that invention using novelty, scholarship and teachable *pro se* skills are

within the scope of STEM programs. Science and innovation alone are not sufficient to satisfy invention. This statement is evidenced by the statistic that only 13% of patents originate from scientists and engineers. The key aim of this presentation is to teach STEM scholars that a rich scholastic understanding and knowhow of the USPTO are dynamically helpful for students during their academic tenure and beyond.

Methods: We have created an approach that fuels the global imperative of innovation through scholarship and strategic IP formation. A recent provisional application originating from West Indies resident, a U.S. citizen and an Anguillan-based Plastic and Reconstruction Surgeon will be discussed. A secondary, permanent patent undergoing prosecution will be used as a process example. The *pro se* inventor process enables bootstrapped innovation and invention which is otherwise fiscally challenging for the academic sector and the entrepreneurial circumstance. Finally, the provisional patent personifies global collaboration and alignment through inclusion of three Anguillan residents (origination) and three United States inventors (North Carolina and New Jersey) that aggregate legitimizing talent circumspect to the technology and innovation when a complex utility patent is sought.

Results: The journey, filing, office actions and *pro se* responses to examination for a provisional patent are presented for interested FORECAST parties and conference attendees.

Conclusions: The *pro se* framework and educational platform provided herein creates scholastic benefit for IP interested students, professors, entrepreneurs, and professionals. Fundamental knowledge and IP process understandings builds a mindset of innovation origination that subtly improves science and the scientists. However, few Universities support efforts or incentives for academics and STEM students, despite inventorship being a rationale aspect of STEM education, innovation and work force development.

THE IMPACT OF AREAWIDE PEST MANAGEMENT PROGRAMMES IN JAMAICA

Lisa Myers Morgan^{1*}, Michelle Sherwood², Sheldon Elliott², Karen Christie³

¹Rural Agricultural Development Authority, Hope Gardens JAMAICA ²Research and Development Division MOA&F, Bodles Research Station, JAMAICA ³ Plant Quarantine Produce Inspection Branch MOA&F, JAMAICA

Background: The control of invasive species in crops with low tolerance are seen as a public good. This makes it a collective responsibility led by government. This is done directly through public expenditure on control measures or indirectly through incentives to people whose actions may be a contributing factor to the problem. The risks associated with invasive species have been increasing especially with globalization but are changing in nature thus warranting novel strategies for their management. The invasive species problem tends to impact the most vulnerable such as our small farmers who are least likely to be in a position to take precautionary, preventative action or deal with the consequences. Management of localized populations has been the conventional or most widely used strategy, wherein individual farmers practice independent pest control against only a subset of the pest population. However, without collective action farmers would be faced with the costs of eradication of these invasives or to live with the costs associated with their management on a per farm basis, which is often ineffective, as managed farms become re-infested by neighbouring unmanaged farms. Hence, the need for areawide pest management programmes to address the constraint of Jamaican farmers in geographical locations. Presented here will be local examples of Areawide Integrated Pest Management programmes (AW-IPM) and their impact on invasive species such as the pink hibiscus mealybug (PHMB), *Maconellicoccus hirsutus*, the red palm mite (RPM), *Raoiella indica*, the Lime Swallowtail butterfly *Papilio demoleus*, the Asian citrus psyllid (ACP), *Diaphorina citri* vector of *Candidatus liberibacter asiaticus* causal agent of Huanglongbing (HLB)/Citrus greening disease, and the Beet armyworm (BAW), *Spodoptera exigua*.

Aims: To give an overview of the collective action and impact of AW-IPM programmes that have been implemented in Jamaica, to highlight the diversity of pests addressed by the AW-IPM approach and the various tactics used in the programmes and their impact.

Methods: The design and development approach to the AW-IPM programme included the integration of

cultural, biological and chemical pest suppression technologies, in targeting the populations of the invasive species in a geographical area. This involved the coordination of the interventions with support from key stakeholders. Data collected from population dynamic studies using sampling and trapping methodologies were utilized in the determination of the impact of the interventions.

Results: Reductions in the target pest populations were realized. Population dynamic studies were an effective tool in determining the impact of interventions. Biological control was an effective strategy in suppressing the target species. The integration of biological, cultural and chemical control strategies was effective in realizing as high as 95.58% reductions in the populations of the target organisms and in limiting their spread. The AW-IPM approach facilitated more farmers collectively benefitting from the programme.

Conclusions: AW-IPM is a more efficient approach to traditional methods to effectively limit the spread and damage incurred by invasive species. However, the level of impact of the intervention can be influenced by the perceived risk of the stakeholders and the availability of economically sustainable management options. The integration of biological control has the potential as a sustainable strategy for small island states in reducing the impact of invasive species.

Acknowledgments: We thank the National Plant Health Coordinating Committee members, the FAO, IICA, the University of Florida, the USDA and the various stakeholders who contributed to the success of the programme.

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A Preliminary Investigation into the Local Management of Isolated Bacteria Implicated in Malodour (Halitosis) in Mandeville, Jamaica

Tillack Hardeen*^{1,2}, Samson Omoregie³

¹Science Department, Church Teachers' College, Mandeville, JAMAICA. ²College of Natural and Applied Sciences, Allied Health and Nursing, Northern Caribbean University, Mandeville, Jamaica ³School of Natural and Applied Sciences, University of Technology, Kingston 6, JAMAICA.

Background: Oral malodour called halitosis, and commonly referred to as 'bad breath', is a socially offensive and discriminating occurrence that requires effective management for health improvement and avoidance of debasing stratification of sufferer. Halitosis has been reported to be prevalent in up to 50% of the general population in the USA, and about 6-23% in China. Between 80% and 85% of halitosis cases are caused by intraoral conditions. Literature on halitosis in Jamaica is either scarce or non-existent. Prior to the COVID-19 pandemic, a common malodour that seemed to be spreading among persons through oral interaction by face-to-face contact with a sufferer was observed among the general populace in Mandeville, Manchester, Jamaica.

Aim: To isolate and identify oral malodour bacteria from individuals in Mandeville, Manchester, Jamaica, and investigate their response to common oral hygiene products in the market and some applied antibiotics.

Method: Oral gargle samples were collected from individuals in the morning and evening before any personal hygiene interventions, in Mandeville, Manchester, Jamaica by convenient sampling. The collected samples were grown on different culture media which included the nutrient agar, blood agar, chocolate agar and MacConkey agar. Bacteria isolated with observed malodour were subjected to Gram staining and to various oral health products, which included mouthwashes, common toothpastes with fluoride, and a local chewing stick, and to five antibiotics, to determine their susceptibility. The mouthwashes included listerine, corsidine (chlorhexidine gluconate, 0.125%) and vinegar (acetic acid, 5%). The antibiotics included gentamycin, erythromycin, ofloxacin, cefuroxime, and nitrofurantoin.

Results: The growth of six of the Gram-negative bacteria isolated from the samples, which were observed to have

malodour, was inhibited in the culture agar plate media by some of the oral health products and antibiotics to different extents. Isolate AA showed the highest susceptibility, with a zone of inhibition of 39 ± 0.8 mm inflicted by Cefuroxime. Ofloxacin and Cefuroxime were the most effective antibiotics across the samples in bacterial growth inhibition. Among the oral health products, Lasco toothpaste with triclosan showed the greatest inhibition across the microbes with zones of inhibition up to 35 mm in three of the six samples.

Conclusion: Generally, antibiotics Cefuroxime and Ofloxacin, Lasco (advanced fluoride) toothpaste with triclosan, Corsidine (chlorhexidine) mouthwash, and vinegar were most effective in mitigating the growth and proliferation of the bacteria isolated. Colgate, Pronamel and Aquafresh toothpastes, Listerine mouthwash and chewing stick extract were ineffective in preventing the growth of the isolated bacteria. Erythromycin was the least effective of the antibiotics used in the study. The isolated bacteria with malodour are being prepared for identification by use of 16S rDNA sequence analysis.

Acknowledgments: We thank the Northern Caribbean University for providing the environment for the conduction of this study.

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Friday, 12th August

Session 5: E – Entrepreneurship

CT

	Session 5: E – Entrepreneurship		
	Chair: Marcia Blair-Thomas UTech, Ja.		Co-Chair: Melinda Levy Graduate Student, UTech, Ja.
10:15–10:20	Introduction to Session		
10:20–10:40	CT	Deneikah T. Jackson UWI Mona	Functional group gating of Dibenzo-18-crown-6 towards the development of lead (II) ion sensing electrodes
10:40–11:00	CT	Kumar Sookram UWI St Augustine	A token-based smart contract management (TSM) DApp for vehicle loans
11:00–11:20	CT	Jeffrey Elcock UWI Cave Hill	An ACO-based algorithm for heterogeneous computing environments using priority queues
11:20–11:40	CT	Jeff Von Kuster College of Agriculture, Science and Education	Using sea surface temperatures in the Pacific Niño zones to predict dry weather during the optimal growing season in Portland
11:40–12:00	CT	Marcia J. Blair-Thomas UTech, Ja.	Utilizing geographic information processing systems for analysis, management and repositioning of the Jamaican ginger industry
12:00–12:30	Extended Discussion in Gather.Town		

FUNCTIONAL GROUP GATING OF DIBENZO-18-CROWN-6 TOWARDS THE DEVELOPMENT OF LEAD (II) ION SENSING ELECTRODES

Deneikah T. Jackson¹ and Peter N. Nelson²

Faculty of Science and Technology, The University of the West Indies, Mona, Jamaica, West Indies.

Background: Lead, a well-known neurotoxin, remains environmentally abundant, arising from many natural and synthetic processes which encourage its environmental accumulation and hence, increased interactions with flora and fauna. Therefore, tremendous research efforts have been invested into developing various methods for its analysis and sequestration, however, affordability, sensitivity and selectivity still remain formidable challenges in this area and hence here is room for further exploration.

Aims: To synthesize and determine the Pb²⁺ binding behavior of Dibenzo-18-crown-6 (DB18C6) and four strategic derivatives (-COCH₃, -NO₂, -Br and -N=NC₆H₅)

Methods: Dibenzo-18-crown-6 (DB18C6) was synthesized from catechol and bischlorodiethylether then utilized for the synthesis of four strategic derivatives (-COCH₃, -NO₂, -Br and -N=NC₆H₅). Dibenzo-18-Crown-6 and its' derivatives were then probed via Density Functional Theoretical (DFT) modelling, Fourier Transform Infrared (FT IR) and absorption spectroscopies (UV-Vis), Differential Pulse Anodic Stripping (DPASV), Cyclic (CV) and Square Wave (SWV) voltammetries to determine their Pb²⁺ binding properties.

Results: The interactions between DB18C6 derivatives and Pb²⁺ are such that they form 1:1 metal-ligand complexes via coordination with the ether cavity, in the case of -H and -COCH₃ derivatives but 1:1 exo-cavity binding with the -NO₂ derivative and 2:1

complexes via the crown cavity as well as the high electron density exo-cavity bromine and nitrogen atoms of the -N=NC₆H₅, and -Br derivatives, allowing the preparation of modified electrodes capable of quantifying aqueous Pb²⁺ via DPASV, at concentrations below 10 mg L⁻¹ with minimal interferences from Al³⁺ and Hg²⁺.

Conclusions: The exergonic, entropy driven interactions between DB18C6 derivatives and Pb²⁺ are such that they form 1:1 or 2: 1 metal-ligand complexes via coordination with the ether endo and/ or exo-cavities allowing for the preparation of modified electrodes capable of quantifying aqueous Pb²⁺ via DPASV, at concentrations below 10 mg L⁻¹.

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A token-based smart contract management (TSM) DApp for vehicle loans

Wayne Goodridge^{1*}, Koffka Khan¹, Kumar Sookram¹, Kwasi Edwards¹

¹ Department of Computing and Information Technology, The University of the West Indies, St. Augustine Campus, TRINIDAD AND TOBAGO.

Background: Loan management is a complex process that coordinates agreements among multiple stakeholders in such a way that each party benefits from the arrangement [2]. At the core of our work there is the Asset Token (ATK) which is a compliant ERC-20 token and used for all financial transactions in our proposed system. With this token in our private blockchain network [1], stakeholders can interact in a digital market. Our work includes a Non-Fungible Vehicle Token (VTK) and represents the physical vehicle. Users has access to the ownership of this NFT which prevents fraudulent transactions.

Aims: We introduce an architecture that facilitates the financial and asset management of vehicle loans, starting from the point of the Dealership tokenising the vehicle asset, customer application of loans, the loan approval process, the licensing and insurance of the vehicle asset, the online payments of the loans and the transfer of the vehicle asset to the customer once all payments are made.

Methods: Figure 1 illustrates and describes the steps that may be involved in the purchase of a vehicle. We repeat the steps here for completeness. In step 1.0 the Dealership registers the vehicle with the license authority. The Customer and Dealership agrees on the Sale Contract in step 1.1. In step 2.0 the customer seeks financing via the Bank. The Customer receives financing and ATKs is deposited into the Dealership in step 2.1. In step 3.0 the Customer insures the Vehicle. The Dealership redeems ATK for TTD in step 4.0. In step 5.0 the Customer purchase ATK. Finally, in step 6.0 the Customer pays installment in ATK.

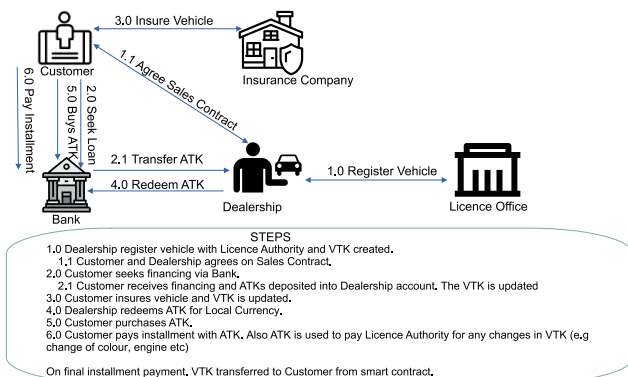


Figure 1: Steps in TSM.

Results: The tokens were written using Solidity and are implemented as contracts on a private Ethereum

blockchain. The DApps are written in Angular and employ web3 libraries that allow the various parties to interact with the contracts on the blockchain. The bank application is implemented using a sidechain. We implemented blockchain functionality in a PostgreSQL database and connected it to the main private blockchain. Loans and payments that occur in either blockchain are synchronized between each other. As a proof of concept (POC) we have implemented the following distributed applications (DApps): Initial Coin offering (see Figure 2), Asset Token DAPP, Dealership DAPP, Insurance DAPP, Licensing DAPP, and Customer DAPP. See example of Initial Coin offering DAPP below.

Name: Initial Coin offering

Description: Initial coin offering webpage that informs the general public about the ATK Token. As well as ICO information



Figure 2: CIBC initial coin offer.

Link: [CIBC CO App](#)

Conclusions: Our proposed TSM system was implemented as a proof of concept (POC). Further, it will benefit the FinTech industry with new government regulations.

Acknowledgments: We thank CIBC-FirstCaribbean International Bank for project grant funding.

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AN ACO-BASED ALGORITHM FOR HETEROGENEOUS COMPUTING ENVIRONMENTS USING PRIORITY QUEUES

Jeffrey Elcock^{1*}, Nekiesha Edward²

^{1,2}University of the West Indies, Cave Hill, BARBADOS

Background: In parallel and distributed computing environments, task scheduling, where the basic idea is minimizing time loss and maximizing performance, is an absolutely critical component. Scheduling in these environments is NP-hard, so it is important that we continue to search and find the most efficient and effective ways of mapping tasks to processors. One such effective approach is known as Ant Colony Optimization (ACO). This popular optimization technique is inspired by the foraging behavior of ants in their colonies to find the shortest paths between their nests and food sources.

Aims: To identify a good scheduling algorithm that should be able to efficiently assign a priority to each task and subtask depending on the resources available, to minimize completion time or makespan.

Methods: A program or parallel application may be modeled by a task graph in the form of a weighted directed acyclic graph (DAG), $G = (V, E)$, where V denotes the set of nodes (n_i) which represent the tasks of the application and E denotes the set of edges that indicate the data dependencies between the various tasks.

In an instance where $(n_i, n_j) \in E$ then n_i is called the immediate predecessor or parent of n_j , and n_j is called the immediate successor or child of n_i . If a task n_a has two or more immediate predecessors, then n_a is referred to as a joined task. The immediate successors of n_a is denoted by $isucc(n_a)$ and is defined as $\{n_j \mid (n_a, n_j) \in E\}$, while its set of immediate predecessors, denoted by $ipred(n_a)$, is defined as $\{n_j \mid (n_j, n_a) \in E\}$. Before task n_a , can be scheduled, all of its parent nodes must first be scheduled [1]. It is assumed that there is one entry task (n_{entry}) which has no predecessor nodes, and one exit task (n_{exit}), which is a node with no successors for the DAG. For our scheduling system model, the target computing environment

consists of a set of processors P , where $P = \{p_1, p_2, p_3, \dots, p_{|P|}\}$, and $|P|$ denotes the number of processors.

Each ant therefore selects a ready task and processor based on a set of state transition rules. During each iteration, an ant either finds a better solution or improves on the best found so far, if possible. For example, if $n_{entry} \rightarrow p_2 \rightarrow n_3 \rightarrow p_1 \rightarrow n_2 \rightarrow p_{|P|} \rightarrow \dots \rightarrow n_{exit} \rightarrow p_1$ is the best solution selected so far, then pheromone is deposited along this path so as to bias preceding ants to use it with the intention to improve. We therefore created two algorithms using the ACO technique and compared them with the well-established HEFT [2] algorithm.

Results: The Schedule Length (SL) is the main performance measure of a scheduling algorithm. In our experiment, a large set of task graphs (13, 500) with varying properties is used and therefore it becomes necessary to normalize the schedule length to the lower bound. This is called the Schedule Length Ratio (SLR). As seen in figure 1.

Conclusions: In order to fully exploit high performance heterogeneous computing environments, versatile and robust scheduling strategies are required. We proposed two scheduling algorithms which incorporated the ACO technique to produce efficient schedule lengths.

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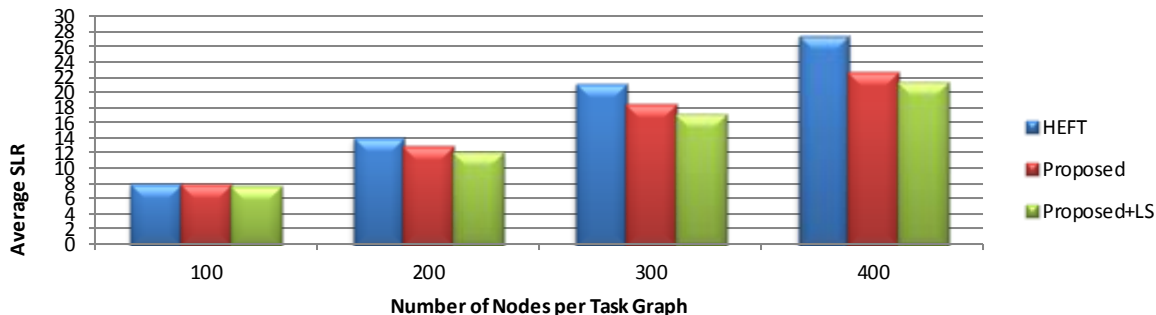


Figure 1: RESULTS FOR AVERAGE SLR FOR VARYING NUMBER OF NODES.

USING SEA SURFACE TEMPERATURES IN THE PACIFIC NIÑO ZONES TO PREDICT DRY WEATHER DURING THE OPTIMAL GROWING SEASON IN PORTLAND

Jeff Von Kuster*

College of Agriculture, Science and Education, Portland, Jamaica

Background: A major challenge facing farmers in Portland, Jamaica is dry weather, especially during the optimal growing season from April through August. During this five-month period Portland suffered from severe dry spells during the years 2014, 2015, 2018 and 2020. A second challenge is the damage to crops and land as well as loss of livestock due to tropical storms or hurricanes and the associated flooding. Portland farmers have suffered losses due to an active hurricane season numerous times and most recently in the years 2004, 2005, 2012 and 2020.

Aims: To show how a Portland farmer with access to the internet and a calculator can use sea surface temperatures (SSTs) in the Pacific Niño zones to forecast dry spells during the optimal growing season. In addition, it will be shown how monitoring the change in these SSTs from month to month allows for a prediction regarding the activity level of an Atlantic hurricane season.

Methods: Rainfall data was collected from January 1, 2001 – December 31, 2020 at the Meteorological Service of Jamaica weather data collection station on the West Campus of the College of Agriculture, Science and Education (CASE) in Portland, Jamaica. The coordinates of the station are 18°12'17.1"N and 76°29'13.5"W. A twenty year mean monthly rainfall profile was created for the CASE campus. To identify when dry periods have occurred calculations were done to find the percentage above or below the mean for each month's measured rainfall over the two hundred and forty months of this study.

Monthly SSTs along with the positive or negative anomaly from the mean for the four Niño zones in the equatorial Pacific are posted online by the National Oceanic and Atmospheric Administration (NOAA) of the United States. The four SST anomalies across the four Niño zones were combined to find a mean anomaly for each one of the two hundred and forty months.

A table was created with two rows of data for each of the years 2001 through 2020. The first rows of each year shows the SST mean anomaly for each month January through August. The second rows show the

percentage difference from the mean for the rain recorded each month from April through August. This table shows the correlation between elevated SST anomalies and dry spells at the CASE campus.

The change in SST from one month to the next was found for each of the four zones and the mean change calculated. The cumulative sum of changes from January through July of each year was found. This sum was compared to the value of the accumulated cyclone energy, used by NOAA to determine the intensity of a hurricane season, for the twenty seasons discussed in the study.

Results: Over the twenty-years of this study, whenever the mean SST anomaly approached or exceeded 0.5°C dry weather followed at the CASE campus in the period April through August. The January through July sums of the mean changes in SSTs were negative in nine of the twenty years and seven of those nine years experienced extremely active or above normal hurricane seasons.

Conclusions: Monitoring the SST anomalies in the Pacific Niño zones enables a person to predict dry weather in Portland during the optimal growing season. Dramatic drops in the SSTs in the months leading up to hurricane season forecast an above normal or extremely active season.

Acknowledgments: I thank the Meteorological Service of Jamaica for technical support and the equipment provided. I also thank the CASE for providing the land space and other infrastructure for the weather station.

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Utilizing Geographic Information Processing Systems for Analysis, Management and Repositioning of the Jamaican Ginger IndustryMarcia J. Blair-Thomas^{1*} and Luke A. Lawrence^{*2}¹Division of Biology, University of Technology, Jamaica¹ and ²Newracle Technologies, Florida, USA²

Background: The worldwide ginger market was valued at US\$6.82 billion in 2020, with India, Nigeria and China being the top global producers (Global Ginger Market Report, 2021). Jamaican ginger once held pride of place in the global market, with its widely accepted superior quality, uniqueness of flavor and high oil content. However, since the initial outbreak of the ginger rhizome rot disease in 1995, production has drastically plummeted to insignificant levels and the industry has not yet recovered. In this regard, a number of intervention strategies have been implemented by the Government of Jamaica over the years, including the Eastern Jamaica Agricultural Support Project of 1993 under RADA, the Ginger Agricultural Science, Technology and Innovation Working Group initiative supported by the CTA ACP-EU under the National Commission and Science and Technology in 2005, the Ginger Resuscitation and Expansion Programme of 2011 led by the Export Division of the Ministry of Agriculture, the Ginger Value Chain Study supported by the FAO, the Ginger Varietal Study funded through the Jamaica Business Development Fund in 2018 and the ongoing Ginger Value Chain and Certification Programme supported by the FAO, with propagation and production of disease-free planting materials. These programmes, amounting to investments of millions of dollars, through partnerships with the key private, governmental and international stakeholders, have been met with varying degrees of success.

In order to quickly reposition Jamaica as a serious, globally competitive player in this multibillion dollar industry, it is imperative that the available data and lessons learnt over the last four decades be scientifically analyzed and presented, to assist the process of re-visioning, re-pivoting and retooling of the industry in the short-term. A very useful technological tool in this regard, is geographical information processing systems, which is a type of database containing spatially referenced geographic data, combined with software tools for managing, analyzing and visualizing those data sets.^[1] Recent advances in geospatial technologies, including Global Positioning System, Satellite Imaging and Geographic Information Systems have dramatically shortened the time needed for georeferenced data acquisition and processing ^[2] and can therefore be effectively applied to available data on Jamaican ginger.

Aims: This paper therefore aims to present a simulated georeferenced representation of localized production data over the past four (4) decades and provide technology-based recommendations for the strategic management and development of the Jamaican ginger industry.

Methods: Production data of Jamaican ginger, provided by the Ministry of Agriculture and Fisheries, was collated, analyzed and charted over time to identify the most crucial points for geographically modeling of the data sets from selected time slices. Well established GIS modeling methodologies such as Rasterized Topology, Vectorized Data Points, Satellite Imagery and Aerial Photography as implemented by the Geographical Resources Analysis Support System (GRASS), were applied in the processing and presentation of the analyzed data. This modelling was distributed over a period of time ranging from 1981 to 2021, with a focus on at least four (4) determinable crucial points.

Results: A visual and statistical analysis of various associations between production levels, disease incidence patterns and overlapping environmental and ecological factors are presented and this approach to the future management and development of the sector is suggested. Finally, critical recommendations are proffered and commended to policy makers, researchers and private actors, for inclusion in the ongoing management and development approaches.

Conclusions: The visual overlaying of key factors in the production of Jamaican ginger and analysis of possible interactions has not only clarified the current state but provides a strategic compass for moving the ginger industry forward. The recommendations are not exhaustive, but point to the type and scope of more in-depth research that needs to be done.

Acknowledgments: We thank the Export Division, RADA and the MOAF for the data provided.

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Session 6: R – Renewal

CT

Session 6: R – Renewal			
	Chair: Alexa Redway UWI, Mona		Co-Chair: Freida Kauffmann Graduate Student, UWI St Augustine
14:00–14:05	Introduction to Session		
14:05–14:25	CT	Tahjna Robertson UWI St Augustine	A DFT and experimental study of the hydrolytic degradation behaviour and spectroscopic properties of some benzylideneanilines
14:25–14:45	CT	Alexa Redway UWI Mona	Synthesis and antiplasmodial evaluation of pyridine carboxamides and thiocarboxamides
14:45–15:05	CT	Marco-Dean Brown UWI Mona	First record of exotic terrestrial flatworms (Tricladida: Geoplanidae) <i>Bipalium vagum</i> and <i>Dolichoplana striata</i> with confirmation of <i>Platydemus manokwari</i> in Jamaica
15:05–15:25	CT	Tamika Royal-Thomas UWI Mona	Emerging trends in data utilising longitudinal analysis
15:25–15:45	CT	Zeyar Min UTech, Ja.	Excited-state intermolecular proton transfer (ESIPT) and intramolecular energy transfer (IMET) in a novel Lanthanide Metal-Organic Framework (Ln-MOF) material with ratiometric tunable photoluminescence and sensing capabilities for metal ions and nitroaromatic pollutants
15:45–16:15	Extended Discussion in Breakout Rooms		

A DFT AND EXPERIMENTAL STUDY OF THE HYDROLYTIC DEGRADATION BEHAVIOUR AND SPECTROSCOPIC PROPERTIES OF SOME BENZYLIDENEANILINES

Tahjna Robertson^{1*}, Peter Nelson¹

¹ Faculty of Science and Technology, The University of the West Indies, Mona, Jamaica, West Indies, JAMAICA

Background: Benzylideneanilines, the condensation products of benzaldehyde and aniline derivatives, have enjoyed significant success as optical metal ion sensors due to their ability to form stable metal complexes which exhibit distinct spectral features compared to the unbound compound. However, their use in aqueous media is limited by the hydrolytic susceptibility of the C=N moiety. Hence, an in-depth investigation into the hydrolytic degradation mechanism of a series of 2-aminophenol derived N-benzylideneanilines was conducted wherein molecular modelling techniques were applied to elucidate the “step-by-step” transformation mechanism of these compounds from a fundamental perspective.

Aims: To study the thermodynamics and kinetics of the mechanistic pathways through which 2'-hydroxybenzylideneanilines hydrolyse using experimental and molecular modelling techniques

Methods: All compounds were synthesised via a condensation reaction between the appropriate benzaldehyde and aniline derivative in ethanol. And their identities and purities adduced using Nuclear Magnetic Resonance (NMR) and CHN elemental analysis, respectively. Further characterization of compounds were done using FT-IR and UV/ Vis spectroscopy

Molecular modelling calculations were carried out using a Gaussian 16 software package [1]. All structures: reactants, transition states, intermediates, and products, were optimized using the B3LYP [2] hybrid functional. Additionally, an augmented form of this electron exchange and correlation functional was explored; that is, the coulomb attenuating form: (CAM-B3LYP) [3] The doubly split valence basis set with diffused and polarisation functions on all atoms: 6-31++G(d,p), was also used in all optimizations. All solution-phase calculations were carried out using the popular and well-regarded C-PCM (conductor-like polarizable continuum model) [4].

Results: All compounds undergo complete hydrolysis

within 24 hours in aqueous media via one of two pathways. For N-benzylideneanilines, not possessing a 2'-hydroxy group, hydrolysis is initiated by the rate-limiting hydration of the C=N moiety which occurs via a four-membered cyclic transition state complex to yield a carbinolamine intermediate which decomposes through another four-membered cyclic transition state to give the lysis products: the parent amine and aldehyde. However, for the 2-aminophenol derived N-benzylideneanilines, formation of a zwitterionic intermediate precedes formation of the carbinolamine intermediate, formed via a highly stable seven-membered cyclic transition state. This pathway is limited by the lysis step which transitions to the final products via a high energy bicyclic transition state complex. The latter mechanism proposed is associated with a more negative free energy change and its rate-limiting step with a lower free energy of activation when compared to the former mechanism.

Conclusions: 2'-Hydroxybenzylideneanilines are significantly more hydrolytically labile than other compounds of the benzylideneaniline class due to the presence of the 2'-OH group which participates in an alternative hydrolytic degradation pathway, distinguished from the general imine hydrolysis mechanism in that it is more kinetically and thermodynamically feasible.

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SYNTHESIS AND ANTIPLASMODIAL EVALUATION OF PYRIDINE CARBOXAMIDES AND THIOCARBOXAMIDES

Alexa Redway,^{1,2} Ainka Brown,¹ Christina Spry,³ Ursula Wiedemann,³ Imam Fathoni,³
Kevin Saliba,³ Yvette Jackson,¹ Nadale Downer-Riley,^{1*}

¹The University of the West Indies, Mona, Kingston 7, JAMAICA.

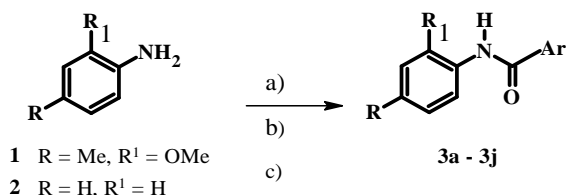
²University of Technology, Kingston 6, JAMAICA.

³Australia National University, Canberra, 2601, AUSTRALIA

Background: The malaria epidemic was responsible for about 241 million infectious cases and 627,000 deaths worldwide in 2020.[1] This infectious disease, transmitted by the female *Anopheles* mosquito, is caused by parasites of the genus *Plasmodium* namely *P. falciparum*, *P. vivax*, *P. malariae*, *P. knowlesi*, *P. ovale curtisi* and *P. ovale wallikeri*. [2,3] Also, malaria is found predominantly in the highlands of Africa which accounts for more than 90% of infections worldwide. While there has been some success in the treatment of malaria, its eradication has been negatively impacted by insecticide and drug resistance. With emergence of thiosemicarbazone as antimalarial agents, the combination of pyridine and amide or thioamide moieties into one scaffold makes for an interesting target.[4]

Aims: The goal of the study was to synthesize pyridine carboxamides and their thiocarboxamide derivatives and to evaluate their antiplasmodial activities.

Methods: Ten amides (**3a-j**) were synthesized from the coupling of aniline or its derivative with various acids or acid chlorides (Scheme 1).



Scheme 1. a) EDCI (HOBt), DCM/DMF, rt, 1-6 days; b) (COCl)₂, ArCOOH, DMF, 0°C then amine, DCM, Et₃N, rt, 16-18 h; c) Et₃N or pyr, DCM/ PhMe, ArCOCl, 0°C then amine, rt, 18 h.

Two additional amides were accessed in fair yields from an isoquinoline carboxamide via protonation and reductive protection respectively. The amides were then thionated using 1.2 – 3 molar equivalents of Lawesson's reagent in toluene under an atmosphere of nitrogen.

All compounds were dissolved in DMSO to a concentration between 10 and 200 mM and subsequently diluted in culture medium with the final concentration of DMSO present in the assays not exceeding 0.1% (v/v). Activity

against HFF cells was assessed over a period of four days using a SYBR safe-based assay. Assays were performed in 96-well plates, initiated with HFF cells and incubated with the protein synthesis inhibitor cycloheximide (at 10 μM). After 4 days, a sample of the supernatant was carefully removed from each well and discarded, prior to storage of the plates at -80°C. After thawing, the SYBR Safe lysis solution also used for the antiplasmodial assays was added to each well and mixed via pipetting to ensure the HFF cells were detached from the plate and lysed. The plates were then processed for the antiplasmodial assay.

Results: Twelve (12) of the twenty-two (22) compounds that were investigated showed *in vitro* anti-proliferative activity against the *P. falciparum* (strain 3D7) at the intraerythrocytic stage.

Conclusions: Of the twelve (12) compounds that have been found to display antiplasmodial activity, two compounds possess IC₅₀ values below 10 μM, and one of those having a sub micromolar IC₅₀ of 0.142 μM and >350-fold selectivity.

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FIRST RECORD OF EXOTIC TERRESTRIAL FLATWORMS (TRICLADIDA: GEOPLANIDAE) *BIPALIUM VAGUM* AND *DOLICHOPLANA STRIATA* WITH CONFIRMATION OF *PLATYDEMUS MANOKWARI* IN JAMAICA

Marco-Dean Brown^{1*}, John Lindo², Ralph Robinson¹

¹Department of Life Sciences, The University of the West Indies at Mona, Kingston, JAMAICA ²Department of Microbiology, The University of the West Indies at Mona, Kingston, JAMAICA.

Background: In recent years, there have been numerous reports of species of invasive predatory flatworms (Geoplanidae) across several islands of the Caribbean. Terrestrial planarians and their cocoons are believed to be dispersed to new territories mainly through plant trades; the worms/cocoons may be accidentally transmitted in the soil of potted plants or within the foliage. The exotic terrestrial flatworm, *Bipalium kewense*, was first reported in Jamaica in 1897 [1]. Later, the suspected sightings of *Platydemus manokwari* and *Bipalium vagum* [2] were documented, in 2019 and 2020, respectively. Terrestrial flatworms were collected as part of a wider study of the epidemiology and transmission of zoonotic parasite, *Angiostrongylus cantonensis*, in Jamaica. This nematode is the most common causal agent of human eosinophilic meningitis in the world. Humans are involved in the life cycle only as accidental hosts and may become infected through the ingestion of infective larvae (L3) contained within raw or undercooked intermediate (snail and slugs) or paratenic host (e.g., flatworms) tissues. The role of intermediate host species has been studied in Jamaica. However, the epidemiological risk associated with potential paratenic hosts has not yet been assessed. This paper focuses on the introduction of *P. manokwari*. This species is a known paratenic host of a zoonotic parasite and according to the ISSG Global Invasive Species Database, is among the world's 100 worst invasive species.

Aims: 1. To identify exotic species of land planarians in Jamaica. 2. To discuss the potential economic, environmental, and social implications of exotic terrestrial flatworms in Jamaican ecosystems.

Methods: During the rainy season (September to November) 2020, 439 land planarians were collected from five of 14 parishes in Jamaica. The samples were collected predominantly after bouts of heavy rainfall and or from areas with regular irrigation. Live specimens

were euthanized and then preserved in 95% ethanol. Morphometric details were measured, and these specimens were photographed, and or illustrated and identified using morphologically distinguishing features. An article was also placed in a local newspaper to engage citizen scientists to submit photographs and locations of sightings of terrestrial flatworms across the island. Molecular diagnostic tools were also used to assess infection of *A. cantonensis* among the terrestrial flatworms.

Results: Species of non-native flatworms were noted across eight of 14 parishes in Jamaica. These worms were concentrated predominantly along the northern and eastern sections of the island. The most frequently observed species was *Dolichoplana striata* (364 of 439 samples) which was collected from four parishes; photographs of sightings of this species were submitted from three additional parishes. Individuals of *B. vagum* (21 of 439 samples) were collected from three parishes from eastern Jamaica; photographs from citizen scientists confirmed the presence of this flatworm from an additional five parishes. Samples of *P. manokwari* (54 of 439 samples) were collected from two parishes; photographs of sightings were confirmed for two additional parishes.

Conclusions: Three invasive species of terrestrial flatworms were identified in eight of 14 parishes in Jamaica.

Acknowledgments: We extend sincere gratitude to the numerous citizen scientists across Jamaica for their participation in the study.

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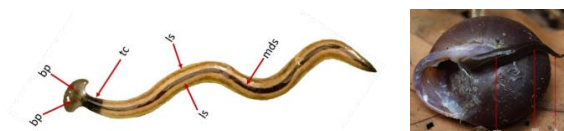


Figure 1: (left) *Bipalium vagum* and (right) *Platydemus manokwari* feeding on *Pleurodonte* sp.

EMERGING TRENDS IN DATA UTILISING LONGITUDINAL ANALYSIS

Tamika Royal-Thomas^{1*}, Daneel Nichol¹, Josanne Bingham¹, Savanah Grant¹, Tracy-Ann Soley¹

¹ The University of the West Indies, Mona, JAMAICA

Background: In this paper, the authors are exploring emerging trends in data utilising longitudinal analysis. Longitudinal studies are typically observational studies wherein a participant's outcomes, and possible treatments or exposures, are collected at multiple times on the same individual. These studies have no limit on the timespan and as such, can last up to several decades. Though shorter time frames are not recommended, the key is for the study to extend beyond a singular time point, ideally three or more [1]. Conducting longitudinal studies are beneficial as it allows one to follow subjects in real time, which allows researchers to have a better understanding of the sequence of events [1]. Furthermore, they provide the researcher with a clear timeline of how they reached a specific conclusion. The longitudinal analysis models explored in this study include the Generalized Estimating Equations (GEE), Fixed Effects Model, Random Effects Model, Linear Mixed Model among other models. In this paper, the focus will be on two data applications. The data applications are: "divorce rates versus success in school" and "Sustainable Development Goals (SDG) versus incidence of multidrug resistant tuberculosis (MDR-TB)".

Aims: To analyse trends in data utilising longitudinal data analysis.

Methods: There were various methods that were used to analyse the two datasets. For the data application: "What are the effects of parental divorce on students' academic performance?" Linear mixed model (LMM) and an unconditional means model were utilized. In this paper LMM will be expounded on. LMM is used to display continuous outcome measures as a function of fixed effects while modelling individual subject parameters as random effects. This model also assumes that the error term is structured according to a known hierarchy and thus may be called a multilevel model.

LMMs are probably one of the most widely used techniques for any form of longitudinal data analysis. The LMM, which contains both fixed and random effects is given by [2],

$$Y_i = x_i\beta + z_id_i + e_i$$

Where, $y_i = n_i \times 1$ vector of n observations on the i th subject

$\beta = p \times 1$ vector of unknown, fixed population parameter

$x_i = n_i \times p$ known, constant design matrix for the i th subject

$d_i = q \times 1$ vector of unknown, random individual parameters

$z_i = n_i \times q$ known, constant design matrix for the i th subject corresponding to the random effects d_i

$e_i = n_i \times 1$ vector of random effect terms

For the data application: "Do SDG indicators influence the incidence of multidrug resistant tuberculosis?", data analysis was carried out using fixed and random effects models.

Results: Given that there was no single variable to assess students' academic performance, the subject based standardized scores were used. As such, there were four final models that were fitted in an effort to answer the hypothesis: "what are the effects of parental divorce on students' academic performance?" The two models involving reading ($p=0.035$) and history ($p=0.0271$) scores indicated that marital status impacted these scores significantly while the math and science scores did not have a significant statistical association with marital status.

For the data application: "Do SDG indicators influence the incidence of MDR-TB?", the full random effects model indicated that the percentage of the population living below the international poverty line ($\beta=254.276$, $p=8 \times 10^{-6}$) and the percentage of the population suffering from undernourishment ($p=0.032$) were statistically significant in their association with the incidence of MDR-TB.

Conclusions: Increased divorce rates has a negative effect on academic success and Sustainable Development goal indicators influence the occurrence of multidrug resistant tuberculosis cases.

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Excited-state intermolecular proton transfer (ESIPT) and intramolecular energy transfer (IMET) in a novel Lanthanide Metal-Organic Framework (Ln-MOF) material with ratiometric tunable photoluminescence and sensing capabilities for metal ions and nitroaromatic pollutants

Zeyar Min^{*1}, Marvadeen Singh-Wilmot², Richard Taylor³

¹University of Technology, Jamaica. ²University of the West Indies, Mona Jamaica. ³University of the West Indies, St. Augustine, Trinidad and Tobago.

Background: There is a significant need for novel functional materials to combat new and increasing problems arising from the growth of industrialization. The main driving force for the development of sustainable applications is the 2030 Agenda for Sustainable Development, which addresses the urgent environmental, political and economic challenges facing our world. The rapid development of technology and science, fosters the advancement in the innovation of several new products and materials that can perform in sustainable applications. Lanthanide Metal-Organic Frameworks (Ln-MOFs) have emerged as one of the most promising and versatile materials to address these concerns. [1]

Aims: To synthesize a novel Ln-MOF and explore its luminescence properties for potential sensing of emerging pollutants.

Methods: The novel structures, $\text{Ln}_2(\text{htp})_3\text{DMF}$ [$\text{Ln} = \text{Eu}, \text{Tb}, \text{Gd}, \text{La}$ and Er ; $\text{htp} = 2\text{-hydroxyterephthalate}$, $\text{DMF} = \text{Dimethylformamide}$], were synthesized under reflux conditions and characterized by single crystal X-ray diffraction, powder X-ray diffraction and elemental analysis. The tunable luminescence properties were measured using spectrophotometry and luminescence sensing studies were carried out by measuring the Quenching Efficiency (QE) of an array

of nitroaromatics and metal ions in a suspension of the Ln-MOF.

Results: The synthesis and characterization of $\text{Ln}_2(\text{htp})_3\text{DMF}$ with an open framework topology and interesting luminescent properties is presented. The emission color of these materials can be ratiometrically tuned by varying the europium and terbium concentrations and arise from multiple excitation pathways including intramolecular energy transfer (IMET) and excited-state intermolecular proton transfer (ESIPT). Furthermore, these materials have shown significant sensing capabilities through luminescence quenching in the presence of Al^{3+} , Fe^{3+} and nitroaromatic pollutants.

Conclusions: Novel Ln-MOFs, $\text{Ln}_2(\text{htp})_3\text{DMF}$, with tunable luminescent properties were synthesized and characterized. Tunability and understanding of photophysical pathways such as **IMET** and **ESIPT** in MOFs will allow for development of more versatile luminescent sensors for metal ions, nitroaromatics as well as other emerging pollutants towards Sustainable Development Goals (SDG).

References:

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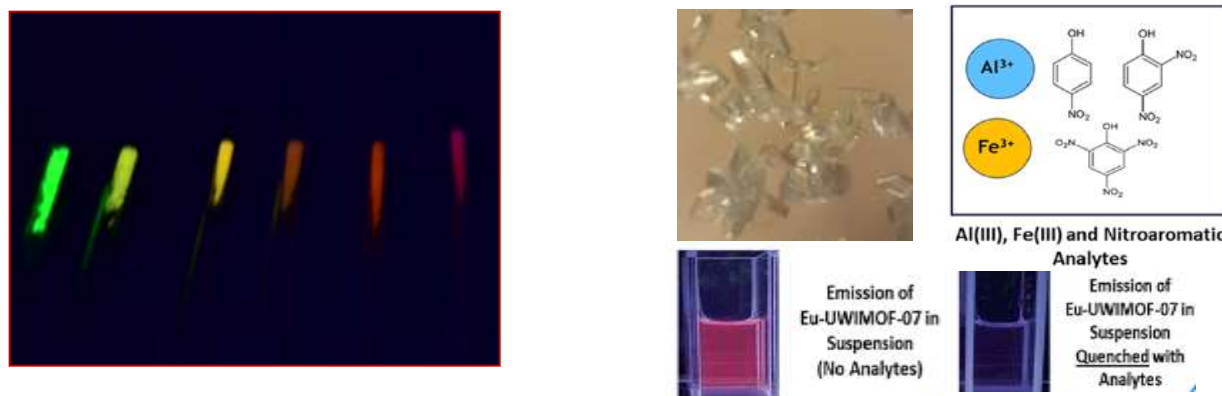


Figure 1: (left) Ratiometric tunable luminescence of $\text{Ln}_2(\text{htp})_3\text{DMF}$. (right) Luminescence sensing of pollutants by $\text{Ln}_2(\text{htp})_3\text{DMF}$.

Contributed Posters (with Abstracts)

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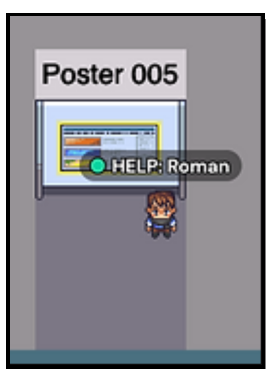
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






















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003		Rohanie Maharaj	A comparison of the quality of commercially...
004		Rohanie Maharaj	Preliminary evaluation of hygienic practices of...
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COMPARATIVE GC-MS ANALYSIS AND BIOLOGICAL ACTIVITIES OF FRUIT EXTRACTS OF *MELOTHRIA PENDULA* L. AND *COCCINIA GRANDIS* (L.) VOIGT (CUCURBITACEAE) FROM TRINIDAD

Farrah Mathura^{1*}, Marian Watson², Milena Mechkarska¹

¹UWI, St. Augustine, TRINIDAD AND TOBAGO ²UTT, Point Lisas, TRINIDAD AND TOBAGO.

Background: The Cucurbitaceae family comprises about 1000 species distributed in around 96 genera¹. Two local, edible plants, belonging to the Cucurbitaceae family: *Melothria pendula* L. (creeping cucumber) and *Coccinia grandis* (L.) Voigt (ivy gourd), were selected based on their traditional applications in the management of skin conditions, wound healing, and the treatment of diabetes mellitus^{2,3}. They are perennial climbers with climacteric fruits, which change colour from green to dark green (*M. pendula*) and from green to red (*C. grandis*).

Aims: To compare the phytochemical composition, as well as the antibacterial and antioxidant activities of crude methanol (MeOH) extracts of *M. pendula* fruits (MPF) and *C. grandis* fruits (CGF) collected in Trinidad.

Methods: Plants were grown from seeds over three months, the green fruits were collected, and oven dried. The fruit powder was macerated in MeOH, and the crude extracts were analyzed by Gas Chromatography-Mass Spectrometry (GC-MS). The compounds identified from the total ion chromatograms were searched for biological activities against Dr. Duke's ethnobotanical and phytochemical database⁴ and the published literature. Subsequent fractionation of the crude MeOH fruit extracts was done in solvents with increasing polarity: hexane, chloroform, ethyl acetate and 1-butanol. All fractions were tested against a panel of reference ATCC strains of Gram-positive and Gram-negative bacteria using the broth microdilution method. The antioxidant activities were determined by the hydrogen peroxide scavenging assay against ascorbic acid as standard. The total phenolic content (TPC) and total flavonoid content (TFC) per 100mg of extract was measured using gallic acid and quercetin as standards respectively.

Results: There were distinct sets of eleven compounds identified in MPF and CGF with varying relative abundances. The fruits of both Cucurbitacea plants shared only the pentadecanoic acid, 1,4-methyl methyl ester, which was more abundant in MPF (6.002%) than

in CGF (1.043%). The following signature active compounds (not shared between both types of fruits, and with the highest relative abundance) were identified: for MPF – 9,12-octadecadienoic acid (Z,Z)-, methyl ester (24.064%); and for CGF – oleic acid (8.510%). The *C. grandis* fruit polar extracts (MeOH and 1-butanol) weakly inhibited bacterial growth (Minimum Inhibitory Concentrations (MICs) in the range 25 – 50 mg/mL), whereas none of the *M. pendula* fruit extracts was antibacterial (MICs > 50 mg/mL). Both crude MeOH fruit extracts contained more phenolics than flavonoids (TPC = ~ 2xTFC). However, since MPF had higher TPC and TFC than CGF, its antioxidant activity was higher (47% vs 33% respectively), and it was comparable to that of the antioxidant standard, ascorbic acid (50%).

Conclusions: The GC-MS analysis of MeOH fruit extracts of *M. pendula* and *C. grandis* from Trinidad confirmed the presence of various compounds, many of which were reported to have multiple biological activities. This lends support for the traditional use of crude plant extracts to reduce inflammation, to treat infections and manage various skin conditions. The experimental validation of the presence of antimicrobial and antioxidant constituents in *M. pendula* and *C. grandis* contributes to the field of pharmacognosy in Trinidad. It is anticipated that this study will promote the wider usage of these plants for their traditional medicinal purposes.

Acknowledgments: This study was supported by The UWI CRP.5.OCT18.67 grant and The UWI Postgraduate Scholarship (both awarded to FM).

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TOMATOES FROM THE GREENHOUSE VS. OPEN FIELD: WHICH ARE SAFER?

Rohanie Maharaj^{1*}, Farrah Mathura¹, Inteaz Alli²

¹UWI, St. Augustine, TRINIDAD AND TOBAGO ²McGill University, Québec, CANADA

Background: Tomato fruits are a nutritious and an economically important crop in the Caribbean, but chemical contaminants (pesticides) threaten food safety. Tomato grown under greenhouse conditions are generally considered to be safer and more controlled in their growing conditions compared to the open field. Both sources provide the fresh crop to the market where consumers cannot distinguish their source nor safety practices used. A lack of laboratory testing can also reduce the ability to export the crop to CARICOM markets. It is important to inform and educate the local population on food safety chemical and microbiological contaminants, so as to safeguard against any outbreak of deadly food borne diseases or illness from consumption of such produce.

Aims: To compare the tomato fruits harvested from an open field and greenhouse based on chemical contaminants in the form of pesticide residues, heavy metals (lead and cadmium) and microbiological contamination (faecal coliforms, *Staphylococcus aureus* and *Salmonella spp.*) in Trinidad.

Methods: Tomato fruits were harvested from an open field and two greenhouses in East Trinidad over a 2-year interval. Fruits were sorted, cleaned, and sanitized before maceration for subsequent testing. The filtrate was screened for the presence of 45 pesticides via Gas Chromatography-Mass Spectrometry (GC-MS) and any pesticides detected were quantified using internal standards. The filtrate was digested and screened for lead and cadmium using Gas Chromatography-Flame Ionization Detection (GC-FID). For microbiological testing, dilutions were plated on different agars using BAM methods¹ to enumerate any bacterial colonies (faecal coliforms, *S. aureus* and *Salmonella spp.*).

Results: Six pesticides were detected in both open field and in greenhouse grown tomato over the two-year period namely: ethion for open field tomatoes

(Year 1), lambda cyhalothrin for open field and greenhouse tomatoes and cypermethrin, bifenthrin, iprodione, and permethrin in greenhouse tomato (Year 2). However, they were below the EU and Codex Maximum Residue Limits (MRLs)² except for a batch of UWI Field Station Greenhouse grown tomato in Year 2, which exceeded the Codex MRL for lambda cyhalothrin. However, more pesticides were found in the Year 2 samples which is a cause for concern due to possible additive effects.

Both greenhouse grown and open field tomato did not demonstrate a hazardous quantity of the heavy metals, cadmium and lead, with the exception of a batch of open field tomato which contained 0.12mg/kg lead (exceeded Codex MRL). Both sets of tomato tested negative for faecal coliforms, *S. aureus* and *Salmonella spp.* There was no significant advantage of greenhouse grown tomato over open field grown tomato.

Conclusions: The qualities of tomato fruits from both open field and greenhouse were acceptable for consumers and exports. However, Trinidad and Tobago can benefit from annual monitoring of these parameters to guide good agricultural practices and in meeting consumers' demand for safe food.

Acknowledgments: The authors wish to thank the McGill University for support of this study through a grant and CARIRI for conducting the analytical tests.

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A COMPARISON OF THE QUALITY OF COMMERCIALLY AVAILABLE POTABLE WATER TO PUBLIC WATER SUPPLIES

Jewel Ward¹, Rohanie Maharaj^{1*}

¹UWI, St. Augustine, TRINIDAD AND TOBAGO.

Background: Providing safe water supplies is a necessity for human survival. Potable water or drinking water, is water that has been processed for use in food preparation and is safe to drink. Water services can be provided by the state or private companies. In Trinidad and Tobago, the state provides potable water by means of a network of piping systems throughout the country. The state-owned organization is called The Water and Sewage Authority (WASA) and was established as an Act of Parliament in 1965 to be responsible for water and sewage management of the country. There are several private water companies that provide convenient bottled water such as Blue Waters Products Ltd, Oasis One Brand Ltd, Blue Mountain Water, SM Jaleel & Co. Ltd, and The Coca-Cola Company among others. Routine monitoring of physical, chemical, and biological quality parameters is required to ensure all service providers produce water within established guidelines.

Aims: To evaluate the physicochemical and microbiological water quality of commercial bottled water and potable WASA water samples in Trinidad. Quality measurements include measuring the pH, turbidity, conductivity, chemical oxygen demand (COD), chlorine levels, heavy metals concentration, and the presence of coliforms, *E. coli*, *K. aerogenes*, *S. aureus*, yeasts, and molds.

Methods: Fifteen (15) water samples; six (6) sourced from the public water supply and nine (9) from the commercial water supplies were collected. The public water supply samples were collected from several areas in Trinidad including: Laventille (1), Belmont (2), Chaguanas (1), Diego Martin (1) and the UWI St. Augustine (1). The pH of each sample was measured with a pH meter, a turbidity meter measured turbidity while a conductivity meter measured conductivity levels. A digestion reactor was used to measure the chemical oxygen demand and a chlorine test kit was used to measure the free and total chlorine levels. Flame atomic absorption spectroscopy was used to detect the heavy metal contamination (Cr, Cu, Mg, Fe, Na, Ni, Zn, Pb). Biological testing was done using membrane filtration to enumerate bacteria, yeasts, and molds. Further testing

was done to identify, total coliforms, *E. coli*, *K. aerogenes*, and *S. aureus*.

Results: It was found that almost all the samples from both supplies (private and public) were within the recommended limits for the physical and chemical parameters analyzed except for the sample labelled Resident 2. This sample had a chlorine level of 0.1 mg/mL which was below the recommended 0.2 mg/mL. However, the commercial water supply (private source) was of a higher quality regarding the biological parameters tested as microorganisms such as *K. aerogenes* and *S. aureus* were present in samples from the public water supply. Bacteria, yeast, and molds were present in a higher frequency in the public water supply than the commercial water supply ($p < 0.001$). Based on these results, the residual chlorine levels from the public supply were inadequate to prevent the proliferation of microbiological contamination. Further many of the piping systems are outdated there could have possibly been a buildup of biofilm which was responsible for the higher levels of bacterial contamination.

Conclusions: The public water supply exhibited a higher level of microbial contamination ($p < 0.001$) compared to the commercial water supply as bacteria, yeast, and molds were present in a higher frequency in the public water supply. Microorganisms such as *K. aerogenes* and *S. aureus* were present in samples from the public water supply. It is recommended more frequent monitoring and corrective actions implemented for public potable water supply that does not meet established guidelines.

Acknowledgments: Special thanks to the Laboratory Technicians and staff of the Food Science and Technology unit in the Chemical Engineering department at the UWI St. Augustine Campus for assisting with this study.

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PRELIMINARY EVALUATION OF HYGIENIC PRACTICES OF STREET FOOD VENDORS IN BARBADOS

Ashlee Best¹, Rohanie Maharaj^{1*}

¹UWI, St. Augustine, TRINIDAD AND TOBAGO

Background: Foodborne diseases are often associated with poor personal and food hygiene of street food vendors [1]. In response, studies were done on the hygienic practices of street food vendors and the microbiological quality of street vended foods. Street vended foods or “street foods” are ready-to-eat (RTE) meals prepared and served along the streets or in public places from stalls or kiosks. Street food is recognized as a potential carrier of food pathogens which results in foodborne diseases. This growing concern of hygienic practices among street food vendors is mainly due to the issue of lack of food and personal hygiene; and/or the sanitary conditions of vending sites [2].

Aims: To examine the hygienic practices of street food vendors in Barbados regarding the prevention of food contamination using surveys and microbiological monitoring of popular pudding, souse and natural fruit juice consisting of mango/watermelon/pineapple mix over a six-week period.

Methods: A microbiological analysis of RTE street food was performed. A total of 18 street food samples (6 samples each of pudding, souse, and natural juices) were purchased from street food vendors and analysed for coliforms, *Escherichia coli*, *Staphylococcus aureus* and *Salmonella* over a six-week period.

Food samples were collected aseptically and stored for same day analysis. Fifty grams of each sample was weighed. Twenty-five (25) grams were homogenized with 225ml of buffer peptone water (BPW) for *Salmonella* testing and twenty-five (25) grams were homogenized with 22ml of diluent for *E. coli*, coliform and *S. aureus* testing using a stomacher. A serial dilution was created from each sample. Appropriate dilutions (10^{-1} , 10^{-2} , 10^{-3}) were inoculated onto media for bacterial growth. For coliform and *E. coli* testing, 1ml of dilutions from each sample were plated in duplicate onto *Escherichia coli* (EC) Petri film plates. For *S. aureus* testing, 0.1ml inoculum was plated (in duplicate) onto Baird Parker plates and spread. Lastly, for *Salmonella* testing, 1ml and 0.1ml of the enriched

BPW was transferred to Tetrathionate (TTH) and Rappaport-Vassiliadis (RV) broths respectively for each sample and incubated for 24hr. The inoculated TTH and RV broths were then streaked onto both Xylose Lysine Deoxycholate (XLD) and MacConkey agar.

Results: The results of the study indicated poor sanitary levels in personal hygiene, food hygiene and particularly a lack of food safety training which were key indicators among street food vendors in general. In relations to the street food vendors of Barbados, coliforms and *E. coli* were identified in the pudding and souse samples at unacceptable levels of contamination. Prevalence of coliforms was 72% and the prevalence of *E. coli* was 56% respectively of the analysed samples. The prevalence of *S. aureus* and *Salmonella* spp. among the street food samples were 0%.

Conclusions: The food safety knowledge and attitude of food handlers are essential factors in the prevention of food contamination. Improvements are required on the hygienic practices of street food vendors, especially in developing countries such as Barbados. Interventions, monitoring, and the implementation of the Hazard Analysis Critical Control Points (HACCP) approach should be regulated to maintain good hygienic practices and subsequently good microbiological quality of street food.

Acknowledgments: We thank the Food Science and Technology unit of the UWI, ST. Augustine Campus and the Microbiology department of the Government Analytical Services, Barbados.

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Temperature and Chemical induced conformational changes in purified PEPC

Bhaskarrao Chinthapalli^{*1,2}, Agepati S. Raghavendra² and D. S. Vijaya Chitra³

¹Department of Life Sciences, Faculty of Science and Technology, University of the West Indies, Mona, Kingston 7, St. Andrew, Jamaica.

²Department of Plant Sciences, School of Life Sciences, University of Hyderabad, Gachibowli, Hyderabad, India.

³Department of Biology, College of Natural Sciences, Arba Minch University, P.O. Box 21, Arba Minch, Ethiopia.

Email: bhaskar.chinthapalli@uwimona.edu.jm *Corresponding Author: Chinthapalli Bhaskar Rao

<https://orcid.org/0000-0002-0765-0060>

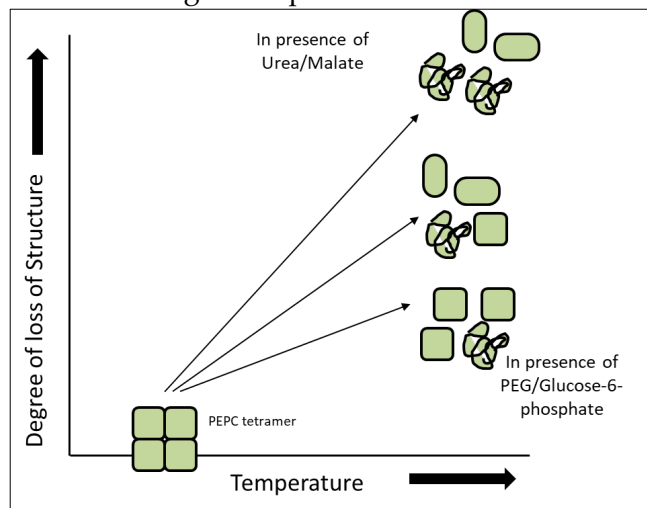
Highlight (novelty of paper in 30 words):

The presence of allosteric effector and polyethylene glycol demonstrates tetrameric stability for purified PEPC from *Amaranthus hypochondriacus* exposed to higher ambient temperatures, in contrast to urea and inhibitor, which promote denaturation.

Abstract (stand-alone text 200 words)

As a key enzyme for C₄ metabolism, the phosphoenolpyruvate carboxylase (PEPC) enzyme is of interest to numerous plant scientists working to improve photosynthesis worldwide. By estimating intrinsic/extrinsic fluorescence and CD spectroscopy, the current work reports the impact of temperature on the secondary and tertiary structure of the PEPC of *Amaranthus hypochondriacus*. The study demonstrates how temperature variations cause conformational changes. When PEPC was subjected to low temperatures, these alterations were seen to be reversible, but when exposed to temperatures above ambient, they became partially irreversible due to the loss of secondary and tertiary structure, as indicated by an increase in random coils. The inclusion of urea and malate was found to exacerbate these conformational alterations (inhibitor for PEPC). On the other hand, PEG and glucose-6-phosphate were

discovered to offer some degree of stability to protein structure even at high temperatures. These findings suggest that structural alterations are a factor in how allosteric effectors and inhibitors affect PEPC function. Investigations involving the integration of CCM into C₃ plants have PEPC as a target since it is a crucial component of the carbon concentrating mechanism of higher plants. As a result, studies pertaining to its structure and function advance our understanding of the protein.



Keywords: PEPC, conformation, temperature, malate, glucose-6phosphate, intrinsic fluorescence, extrinsic fluorescence, CD spectroscopy, aggregation

Simulation driven investigation of the effect of SnS, ZnO and MnO layers on a GaAs/AlGaAs heterojunction Solar Cell

Kevin Gurbani Beepat*, Dr. Davinder Pal Sharma.

The Department of Physics, University of the West Indies, St. Augustine Campus, Trinidad, WI.

Background: Simulation and modelling of solar cells before actual fabrication can aid in saving expenses and time by providing an efficient route to enhancing next generation solar cell development. The present paper shows the importance of using modelling in developing 4th generation solar cells. In this paper the modelling software COMSOL Multiphysics 6.0 is used to simulate solar cells containing novel materials such as Tin (SnS), Zinc (ZnO) and Molybdenum (MnO) compounds. The IV characteristics as well as the power conversion efficiencies of a GaAs/AlGaAs heterojunction are investigated with and without the addition of the novel materials. The study indicates that the addition of such materials alter the charge carrying capability of the solar cells and opens room for further investigation and innovation.

In order for solar cells to continue having the impact it is having it must first overcome some limitations that can prevent it from making the impact that it hoped to do. These drawbacks include crystalline-Si cells' high energy input, GaAs cells' limited material production, and CdTe, CIGS, dye-sensitized, crystalline-Si, and thin-film Si cells' material scarcity. A major limitation of solar cells is its high installation cost compounded with its long payback period (which can be as much as 10 years). Added to this is the relatively low efficiencies for domestically available panels ranging from 10%-20%. It should be noted that there are more efficient solar cells commercially available but these come at a higher price.

Aim: To investigate the effect Tin (SnS), Zinc (ZnO) and Molybdenum (MnO) has on a GaAs/Al_{0.25}Ga_{0.75}As het-

erohjunction using simulations.

Methods: These models are built sequentially with increasing complexity as it is developed. It is first developed two dimensionally using the Semiconductor and Wave Optics Modules of COMSOL. This entails the GaAs/Al_{0.25}Ga_{0.75}As heterojunction being built. Once this is done the semiconductor physics such as the analytical doping and geometric doping models are added. The wave optics physics such as the power of the incident wave is also added. The results are verified the SnS, ZnO and MnO compounds are added to the model and its results are observed and investigated.

The placement of the layers are also investigated to ascertain the optimal position within the heterojunction structure it is most suitable.

Results: The position of the layers also affect the power conversion efficiencies. When exposing the structure to electromagnetic radiation, the penetration is what would be typically expected as shown in Fig. 1 (left). The resulting I-V graph is shown in Fig. 1 (right). The energy level diagrams, doping profile and electric field profile for the model us also produced.

Conclusion: Via further investigation, the improvement of the cell's thermal and optical stability can be accomplished.

Acknowledgments: The authors thank the University of the West Indies which provides the COMSOL license and space to work on solar cell modelling.

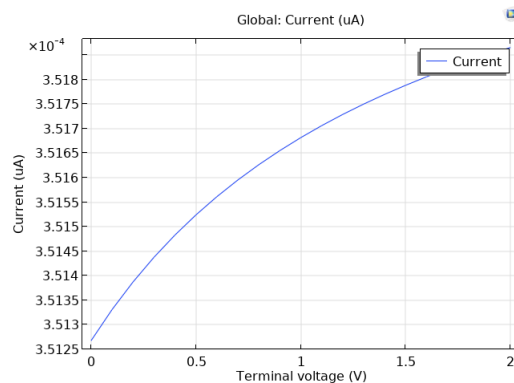


Figure 1: (left) Electromagnetic radiation (10W/m) penetration of solar cell (GaAs left side/AlGaAs right side). (right) I-V graph of solar cell shown in left.

CLIMATE STRESS INERTIA: A POLICY MESSAGING RESPONSE TO FARMER POWERLESSNESS AND PASSIVITY COGNITIONS IN DROUGHT EXTREMES IN A JAMAICAN CASE STUDY

Sarah Buckland¹

¹ University of the West Indies, Mona Campus, JAMAICA

Background: The threat and realities of increased climate extremes have led to efforts by climate policymakers and activists to produce messaging with alarmist undertones in public education and policy documents. While such- urgent messaging is crafted with the aim to encourage adaptive action, little is understood about the effectiveness of such communication approaches on the schemas, perceptions, and actions of frontline climate-exposed persons, such as farmers.

Aims: To conduct a preliminary assessment of selected Jamaican agro-climate policy documents using keyword matching techniques associated by farmers with increased passivity in case study communities.

Methods: A sequential-exploratory mixed-method approach to perform a preliminary appraisal of selected Caribbean agro-climate policy documents using keyword matching techniques associated by farmers with increased passivity (Figure 1).

Results: Multinomial model results from the Clarendon case study indicate farmer inaction being linked with increased actual and perceived climate stress (higher temperatures, winds and long drought duration). Key

word matching on the eleven (11) selected policy documents reveal that there is significant overlap in the word choice associated with farmer passivity and messaging. Despite increasing incidence of solution-oriented terms such as “adapt” and “mitigate” in more recent documents, there remains a high relative frequency of stress-related terms, including: “change”, “damage”, “loss” and “threat” being emphasized in the documents examined.

Conclusions: Since case study farmer experience apparent cognitive overload when processing extreme climate stress, alarmist language may produce counterproductive results than intended. With further research, policy messaging may focus on the empowerment of climate frontline workers, commencing with more emphasis on a solution-oriented approach to climate messaging, rather than a risk oriented one. Further research may be required to assess the comparative impacts of empowerment messaging on increased climate action at the farm level.

Acknowledgments: The author is grateful for financial support from the Office of Graduate Research and Publications Grant, which offset the costs of fieldwork.

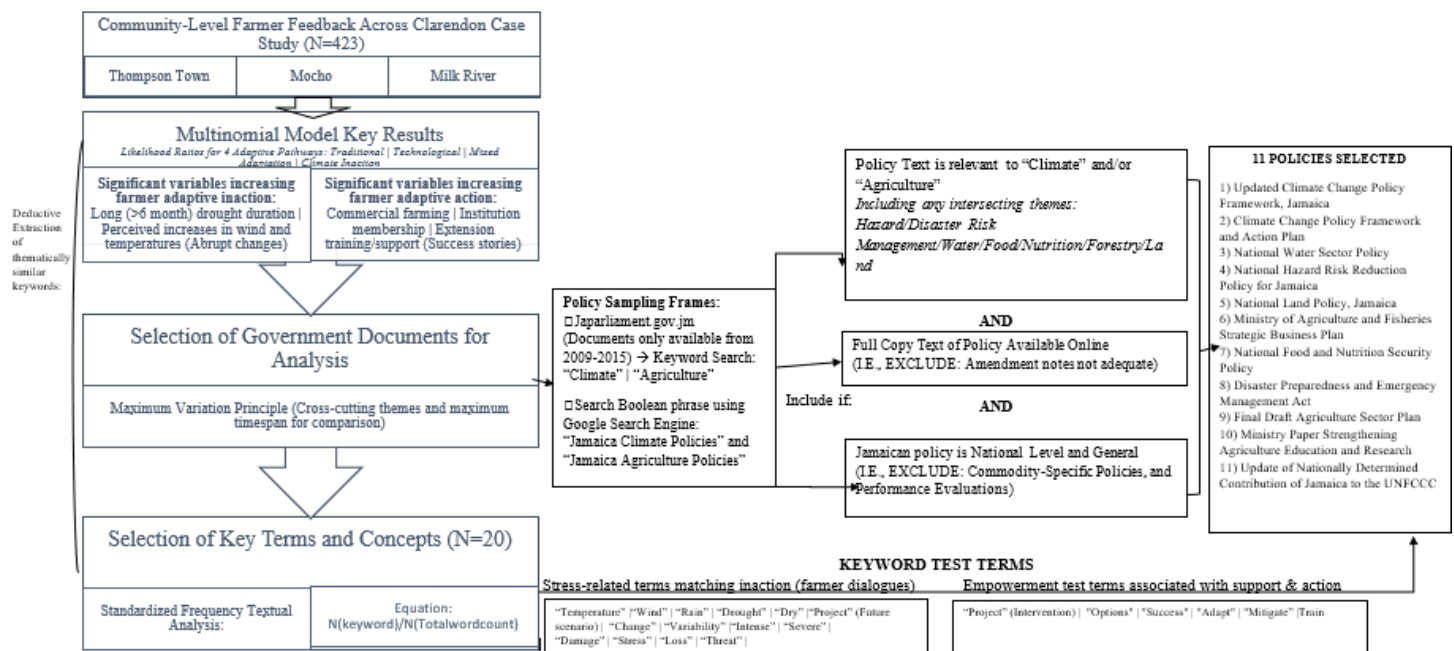


Figure 1: Overview of Research Methodology

Source: Researcher

A baseline assessment of Lionfish (*Pterois* sp.) population dynamics, distribution, and diet within the Montego Bay Marine Park, Jamaica during January - December 2018

Christopher May*

The Montego Bay Marine Park Trust, Montego Bay, JAMAICA

Lionfish (*Pterois* sp.) are an Indo-Pacific species of venomous marine fish that have successfully invaded the waters of the Atlantic. Their environmental and trophic generalist natures allow them to occupy and thrive in a multitude of habitats and niches; allowing them to prey on a myriad of organisms. Invasive Lionfish pose deleterious effects to an environment's overall health and functioning, by the (over)consumption of keystone species, such as herbivorous Parrotfish. The effects can extend into the local tourism and fishing industries via loss of resources (i.e., fishes), attractions (i.e., reefs), and ultimately revenue.

During the calendar year of 2018, 117 recorded Lionfish sighting sessions were detailed and logged. 902 Lionfish were captured and dissected to formally project the general locations, size classes, maturity stages, and overall diet of Lionfish within the Montego Bay Marine Park. Lionfish were found to occupy low-, med-, and high-profile reefs, low-profile artificial reefs, sand patches, rock/ rubble, and seagrass patches. In total, 13 families of teleosts, 3 families of crustaceans, and 1 family of molluscs were identified in the diet of the dissected Lionfish. Certain sites were revisited throughout the year, to determine the effectiveness of consistent and interval culling efforts made on Lionfish populations within the respective sites.



Figure B.1: Satellite image of the Montego Bay Marine Park with estimated borders of the respective sections with regards to this survey.

Next Generation Sequencing of Geminiviruses in Jamaica

Chantal Marriott^{1*}, Icolyn Amarakoon², Judith Brown³, Marcia Roye¹

¹ The Biotechnology Centre, The University of the West Indies Mona, JAMAICA ² Department of Basic Medical Sciences, The University of the West Indies, Mona, JAMAICA,

³ School of Plant Sciences, University of Arizona, Tucson AZ, USA.

Background: Geminiviruses are the largest group of economically important phytopathogens. They represent a significant threat to the security of Jamaican crops, as a large-scale infection could have a severely damaging effect on the country's agricultural sector, which is an important contributor to Jamaica's GDP. Through genetic processes such as mutations, recombination and reassortment, plant viruses will continue to evolve and cause the emergence of novel species, new viral strains, and new plant diseases reducing agricultural productivity. This could lead to the importation of food items to meet growing demand, and an increase in the price of goods, along with loss of income for farmers. There is therefore a need for advanced technology to aid in the effective and efficient identification of these viruses.

Aims: The aim of this research is to characterise the geminiviral species infecting crops, weeds, and ornamental plants using next generation sequencing (NGS) and to determine if NGS is an effective tool for widescale and successful characterization of the geminiviral virome in Jamaica.

Methods: Total genomic DNA was isolated from 112 plant samples, displaying symptoms of a viral infection, using the Dellaporta extraction method. The viral DNA was enriched for using polymerase chain reaction (PCR) and rolling circle amplification (RCA). The RCA products were sequenced using Illumina High Throughput Sequencing. Sequences were assembled using SeqMan Ngen 12.0.0. Contigs for which begomoviral hits were obtained, with an E-value of zero, were aligned using MUSCLE and analyzed using NCBI BLAST and MegAlign. NCBI ORF Finder was used to map open reading frames, and MEGA 11 used to complete the phylogenetic analysis.

Results: From the Illumina analysis, thirteen (13) unique viral species were identified with 2 deltasatellites. Papaya

(*Carica papaya*) and gungo peas (*Cajanus cajan*), were identified as new hosts of the weed-associated begomoviruses, *Malvastrum yellow mosaic Jamaica virus* and *Rhyncosia golden mosaic Yucatan virus*, and a crop geminivirus, *Tobacco leaf curl Dominican Republic virus* (TbLCDOV; from papaya). Several weeds were found to be new hosts or previously characterized geminiviruses. e. g. *Euphorbia mosaic virus* in *Jatropha* sp. and *Sida* sp. Novel deltasatellites were reported for the first time in Jamaica from papaya, *Jatropha*, and *Bougainvillea* sp. These were named *Malvastrum yellow mosaic Jamaica deltasatellite* and *Macroptilium yellow mosaic deltasatellite*. Three tentatively novel begomoviruses were also identified from wild plants *M. americanum*, *Jatropha* sp., and *Boerhavia* sp.

Conclusions: A total of 43 sequences (9 full length DNA-A, 7 partial DNA A, 7 full length DNA B and 17 partial DNA B) were successfully characterized using the Illumina high throughput method. The method is effective in providing a wealth of information and giving an overview of the virome population. No prior information about the nature of the virus is required which makes NGS an important tool for virus discovery. The technique requires processing of significant amounts of data and use of resources that require training.

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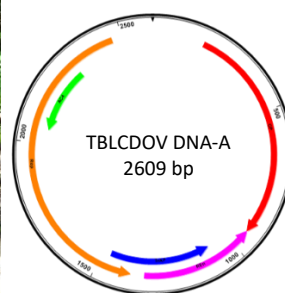


Figure 1: Healthy and infected papaya plant (left), found to be infected with two distinct geminiviruses, MaYMJV and TbLCDOV. (Right) Genome Map of DNA A component of TbLCDOV found in bastardia and papaya.

Assessing the Impact of the COVID-19 Pandemic in Jamaica: Physical Activity Participation, Weight Gain, and the Mental Health Perception

Van Der Rowe

Kingston, JAMAICA University of Technology, Jamaica.

Background: The discussions worldwide always conclude that engagement in physical activity (PA) and practicing healthy lifestyles are essential for improving health status. However, the onset of the COVID-19 pandemic created an environment that reduced the level of PA globally, which created fears of increased chronic lifestyle diseases and deaths [2]. Many studies published during the height of the pandemic showed very low levels of PA participation. One such study was done by [2] that showed a decrease from 80.9% to 62.5% compared to pre-pandemic conformity with the WHO guidelines on PA. Likewise, Jamaica's PA levels pre-pandemic were extremely poor with 82% of Jamaicans participating below WHO's recommendations for PA. The PA prevalence within the country declined by 5% to 67% with non-communicable disease (NCDs) death recorded at 79% [1]. However, the COVID-19 pandemic brought many of the initiatives by the Ministry of Health and Wellness (MOHW) to curb physical inactivity in Jamaica to a standstill. As a result, this research sought to assess the impact of the COVID-19 pandemic on PA participation, weight gain, and the mental health perception of participants in Jamaica. The study can act as a catalyst in helping Jamaica and the international monitoring agency in supplying valuable data, which can help to plan strategic interventions based on the current situation.

Aims: To assess the impact of the COVID-19 pandemic on physical activity participation, weight gain, and the mental health perception in Jamaica.

Methods: The study took the form of a quantitative approach utilizing a cross-sectional survey design. The study surveyed participants living in Jamaica during the COVID-19 pandemic. Based on the confines placed on movement and social gathering during the data collection process, the study used a combined sampling technique that utilized snowballing and convenience sampling. The study surveyed 836 participants ages 12–71 years, from all 14 parishes in Jamaica. The

questionnaire sought responses on the frequency of participation in PA before and during the COVID-19 pandemic. Also, participants were asked about the types of PA they participated in, the duration, their weight increase, changes in eating habits, and the perceived mental impacts of the COVID-19 pandemic. These areas were used to run the Pearson Chi-Square test, Pearson Correlation test, and an ANOVA test to generate charts, summaries, and p-values.

Results: The results indicated that the level of PA participation during the COVID-19 pandemic was 73.3%. However, 87.2% of the respondents engaged in less than 150 minutes of PA per week, while 96.1% of the respondents participated in low intensity and short durations of PA below the recommended PA guidelines set out by the WHO as the very minimum needed to provide health benefits to people. Additionally, the government restrictions impacted eating habits and weight gain for the majority of the respondents. Participants also indicated that stress and depression were the most perceived mental impact of the COVID-19 pandemic.

Conclusions: The PA levels of the participants declined significantly during the height of the pandemic. Home isolation and lack of PA caused greater food consumption and may have increased the risk of many of the participants developing non-communicable diseases.

Acknowledgments: I want to thank the Ministry of Health and Wellness and their Health Promotion and Education Unit for their help with data collection.

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HOST PREFERENCE, IMPACT OF HOST TRANSFER AND INSECTICIDE SUSCEPTIBILITY AMONG *APHIS GOSSYPYII* GROUP (ORDER: HEMIPTERA) IN JAMAICA

Desireina Delancy*, Tannice Hall, Eric Garraway and Dwight Robinson

Department of Life Sciences, Faculty of Science and Technology, The University of the West Indies, Mona Campus, Kingston, JAMAICA

Background: *Aphis gossypii* (cotton aphid), as a pest, directly damages its host plant by extracting sap (sucking) and indirectly damages it by transmission of viruses, ultimately affecting the yield of the host (Blackman and Eastop 2000)[1]. Due to its polyphagous nature, this species affects a wide range of host plants, some of which may serve as a reservoir for colonisation of important crops.

In Jamaica there have been outbreaks of viral plant pathogens that were transmitted by *Aphis gossypii*. Three such examples are, *Citrus tristeza virus* (Fisher, Tennant, and McLaughlin 2010)[2], the *Watermelon mosaic virus* and *Papaya ringspot virus* (Tennant, Ahmad, and Gonsalves 2005)[3]. *Aphis gossypii* also heavily colonized economically significant host plants including pepper, eggplant, watermelon, cucumber, and hibiscus.

To facilitate integrated pest management, it is imperative to understand the biology of the aphid and its host preference. Preliminary work in Jamaica has indicated differences in biology and host preference within the species. However, specific details of fecundity, colony growth, host preference, distribution and insecticide resistance of *Aphis gossypii* were unknown.

Aims: To investigate the following in relation to *Aphis gossypii*:

1. Influence of the host plant on colonization, life span, fecundity, population size and morphology.
2. Impact of host transfer on fecundity and population size as a measure of host preference and host transfer success.
3. Susceptibility to four commonly used insecticides.

Methods: Fecundity and colony size were documented daily from aphids acclimatized on *Capsicum chinense* Jacquin 1776 (pepper), *Cucumis sativus* Linnaeus 1630 (cucumber), *Gossypium hirsutum* Linnaeus 1751 (cotton) and *Abelmoschus esculentus* (L.) Moench 1794 (okra) for three generations. The same measures were used after third instar *Aphis gossypii* were transferred among the hosts as a measure of suitability and success. Field plots and a glasshouse were used as the research sites. Mortality, and fecundity of survivors, were determined after aphids were exposed to varying concentrations of

Actara[®], Diazinon[™], Karate Zeon[®] and Pegasus[®]. R Studio[™] (3.5.3) was used to perform: Shapiro-Wilk's, Levene's, ANOVA and Kruskal Wallis tests.

Results: Host preference results indicated that, over a 24-day period, *Aphis gossypii* reached its largest colony size on cotton (\bar{x} 381.80), with January – February being the most fecund period. Host transfer experiments were all significantly different with the most significant occurring between transfers from pepper to cucumber ($p < 0.05$). Colony sizes were found to increase significantly every 5 days. Insecticides ranked on lethality are Karate Zeon[®] > Actara[®] > Pegasus[®] > Diazinon[™]. The highest LC₅₀ values were obtained for aphids on cotton and pepper was with Pegasus[®] and for those on cucumber with Diazinon[™]. Survivors of insecticide treatments had colony sizes on average that were 98 % less than untreated aphids.

Conclusions: Cotton was preferred both in the field and in the glasshouse. It is on cotton the aphids settled first, had the highest fecundity and the lowest mortality. cotton can serve as reservoir for (re)populating other cotton or different host species based on migration due to overcrowding, heavy showers, high wind, or ant-attendance. Host transfer success among all three host is highly probable within an intercropping system. Survivors of insecticide treatments can successfully repopulate host plants; this has implications for regimes implemented to monitor and evaluate plots.

Acknowledgments: We would like to thank the UWI Mona Research and Publication Grant and the New Initiative Grant.

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USING LARVAL MORPHOLOGY TO DISTINGUISH SARCOPHAGIDAE FLIES OF FORENSIC IMPORTANCE IN JAMAICA

Rochelle Daley*, Eric Garraway

University of the West Indies, Kingston, JAMAICA

Background: Forensic entomology can be defined as the use of information about insects and some insect relatives to aid in legal investigations [1]. This field of Forensic Science has had limited use in the Caribbean. Forensic entomology is mainly utilized in estimating Postmortem Interval (PMI) which can be used as evidence in court or criminal investigations. Identification of the relevant insects is the first crucial step needed to effectively use forensic entomological data. Among the insects of forensic importance, Dipterans are the most utilized and studied. Sarcophagidae is one of the three main families associated with forensic entomology with over 3000 species [2]. This family however is known for being difficult to identify using adult morphology due to high similarity [3]. Being able to determine the species of Sarcophagidae through larval morphology has the potential to be cost-effective, time-efficient and prevent misidentification when an expert taxonomist is not readily available. This research also adds to the growing body of data about forensic entomology in hopes it may one day be utilized in the Jamaican legal system.

Aims: To identify species of Sarcophagidae of Forensic Importance in Jamaica using larval morphology.

Methods: Baited Van Someren Rydon traps [4] were set up in areas within selected parishes of Jamaica. Adult flies and larvae collected were transported to the laboratory. The abdomens of gravid female adult flies were squeezed for larvae. Larvae found were reared on bovine liver under laboratory conditions. This served to create colonies for morphological work. Larvae were killed using boiling water and cleared using 10%KOH. Using light microscopy illustrations and descriptions of

various larval features were made. The ability and effectiveness of these features in identification were assessed and compared.

Results: Consist of illustrations and descriptions of the larval structures that can effectively distinguish species found during research. The following morphological features are highlighted: the anterior spiracles, anal segments, cephalopharyngeal skeletons and posterior spiracles. There is also a list of Sarcophagidae species found in Jamaica of forensic importance.

Conclusions: Larval features were shown to distinguish species collected, within the scope of the research. Some features are not suitable for the identification of Sarcophagidae.

Acknowledgements: We thank the Department of Life Science and the Office of Graduate Studies and Research at the University of the West Indies, Mona.

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NUTRITIONAL ANALYSIS OF JAMAICA'S HIBISCUS *SABDARIFFA* (SORREL CALYXES, SEEDS AND LEAVES)

Paul Gyles*, Delano Chambers, Alston Miller

Department of Biology, Chemistry and Environmental Science, Northern Caribbean University, Mandeville, Manchester, JAMAICA.

Background: *Hibiscus sabdariffa*, also known as rosella or Jamaican sorrel among many other names is a native of India and Malaysia [1]. Much work has been reported on its effectiveness against life threatening diseases in other parts of the world treating many cardiovascular disorders, helminthic disease and cancer [2].

Aims: To determine the nutritional contents of sorrel calyxes, seeds and leaves and their implications in humans.

Methods: *Hibiscus sabdariffa* has been reported to have nutraceutical properties. Work done locally in different varieties was reported on main consumable portion, the calyxes. Extracts from sorrel's calyxes, seeds, and leaves were analyzed for presence of carbohydrate, protein and lipid. The samples were analyzed for iron, sodium, potassium, calcium, magnesium, and copper.

Results: Carbohydrate was higher in leaves and calyxes while protein and lipid were higher in seeds. Seeds had higher concentrations of copper along with lowest concentration of sodium and calcium; leaves had higher concentrations of magnesium, and iron; whilst calyxes had a higher concentration of potassium.

Conclusions: While calyxes are main consumable portions locally, data suggested that leaves and seeds were sources of good nutrition. The presence of relatively high protein, carbohydrate, and lipid contents are indicative of possible anti-oxidative and anti-inflammatory properties. The heavy metals present could enhance human health. This study shows the Jamaican traditional red variety of *Hibiscus sabdariffa* calyxes, seeds, and leaves to have potential health benefits that can help in the prevention of diseases and contribute to good nutrition.

Acknowledgments: Thanks to the Science area at Northern Caribbean University for providing the facilities and equipment to conduct this research.

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THE MICROBIAL ANALYSIS OF SURVIVAL STRATEGIES FOR OPPORTUNISTIC ORAL PATHOGENS IN THE ORAL CAVITY

Gad Onywere¹, Paul Gyles¹ and Patience Bazuaye-Alonge¹

¹Department of Biology, Chemistry and Environmental Science
Northern Caribbean University, JAMAICA (W.I.).

Background: The diversity of microorganisms in the oral cavity plays a significant role in maintenance of good oral health [1]. Bacteria forms an important group of microorganisms found in both healthy and diseased mouths. Commensal bacteria are regarded as beneficial by defending against the colonization of invading pathogens. The opportunistic pathogens are infectious pathogens that are normally commensal in the body but can cause diseases when the host's resistance is altered [2].

Aim: This study aimed at analyzing microbial survival strategies of the opportunistic pathogens in the oral cavity.

Methods: Six opportunistic bacterial pathogens were isolated from the oral cavity and sub-cultured in Blood and MacConkey agar. The isolates were: *Streptococcus mutans*, *Staphylococcus aureus*, Methicillin Resistant *Staphylococcus aureus* (MRSA), *Klebsiella pneumoniae*, *Enterococcus spp.* and *Pseudomonas aeruginosa*. The biofilm formation and planktonic growth kinetics of these pathogens was screened to determine the attachment. Extracellular polymeric substance (EPS) of the microbes was then extracted using an organic solvent for microbial total chemical content analysis.

Results: *Streptococcus mutans* and *Enterococcus spp.* had the highest biofilm formation (0.06Au) while *Pseudomonas aeruginosa* had the lowest biofilm formation (0.004Au). *Klebsiella pneumoniae* had the

fastest planktonic growth rate (0.0014 cells/minute) and generation time (49.5 minutes); *Pseudomonas aeruginosa* had the slowest growth rate (0.010 cells/minute) and generation time (69.3 minutes). The EPS content for *Streptococcus mutans* was the highest followed by MRSA, *Staphylococcus aureus* and *Enterococcus spp.*

Conclusions: Planktonic growth kinetics influences biofilm formation size and microbial population growth. Biofilm formation act as a defensive mechanism of the pathogens during various stress conditions. The EPS is the major component in establishing functional and structural integrity of the pathogens. Therefore, understanding the survival strategies of these microbes is significant in future prevention and treatment of oral infections.

Acknowledgments: We thank the Department of Graduate Studies and Research, Department of Biology, Chemistry and Environment Science at the Northern Caribbean University for providing the facilities and resources utilized in the study.

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NEARING A TIPPING POINT: HEAT-STRESS AND SMALL SCALE POULTRY FARMING IN JAMAICA

Dudley Williams, Theodore Wynter, Jayaka Campbell, Tannecia Stephenson, Marhoun Ferhat
University of the West Indies, Mona Campus, Jamaica.

Background: Heat stress is the leading cause of high mortality and low production in small livestock farming in Jamaica [1]. Additionally, the persistent warming of the Caribbean due to climate change worsens the problem in the sector. This paper presents a field investigation into the heat stress problem at the Vere Technical High School in Clarendon Jamaica.

Aims: Determine the extent of heat stress in small scale poultry farms in Jamaica and explore mitigation options.

Methods: A typical open ventilated poultry house, made of galvanized zinc roof, timber framing and meshed sides was chosen as the test site. Measuring instruments were installed inside to record temperature and humidity, along with an external weather station. Baseline data was collected in 2019. A radiant barrier was installed in the ceiling of one section of the poultry house in 2020, to reduce heat ingress from the zinc roof. The Temperature Humidity Index (THI) was used to assess the thermal comfort of the broiler chickens using Eqn.1 and the following THI classifications: no stress < 26, heat-stressed 26-29 and severely stressed > 30 [2]. The project also explored nighttime radiative cooling by modifying a solar water heater to reduce the temperature of 30 gallons of water during the night with a 3W circulating pump. This experiment was conducted at the Department of Physics of the University of the West Indies, Mona Campus. Eqn.1 $THI = 0.85 * t_{drybulb} + 0.15 * T_{wetbulb}$.

Results: Severe heat stress is experienced between 9 am and 6 pm daily, with no thermal relief until 12 am to 7 am the following day. It was noticed that chickens would experience stress constantly for several consecutive days in June, Figure. 1. The results showed that the radiant barrier reduced the air temperature by 2°C on average compared to 2019 values. The radiative cooling experiment was able to produce water of 19°C nightly with the lowest record of 16°C.

Conclusions: Improving the thermal performance of the building may not be sufficient to reduce the number of hours spent in severe THI conditions. Methods that can reduce the temperature of the air without being energy-intensive are needed to address the heat stress problems of small farmers. Based on preliminary results, radiative cooling could be a solution.

Acknowledgments: We thank the Environmental Foundation of Jamaica for funding this work.

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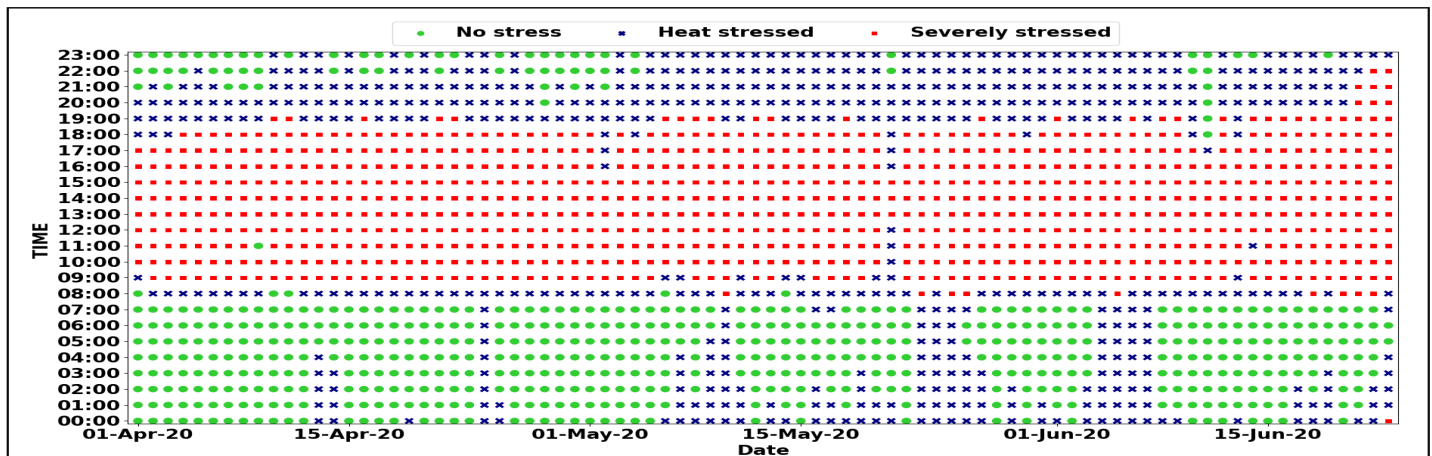


Figure 1: Heat stress levels for the period April 1- June 24, 2020.

TO BE OR NOT TO BE: INDUCERS, INHIBITORS AND IMPLICATIONS FOR TRANSPORT DECARBONISATION IN A SMALL ISLAND

Danielle Evanson

University of the West Indies, Cave Hill, St. Michael, BARBADOS

Background: Though a small island developing state, Barbados' transport sector mirrors the transport culture that is prevalent in developed countries dominated by private car ownership, low use of shared modes and behaviours which reinforce this reliance. The Barbados National Energy Policy (BNEP) 2019-2030 articulates the ambition to become a 100% renewable energy economy by 2030 and the Nationally Determined Contribution commits to a "more efficient, reliable, affordable and resilient" transport system with 100% alternative fuel or electric vehicles in the passenger fleet. However, there is still no overarching strategy for the transportation sector. To date, the only BNEP measures realised have been introducing electric buses to public transport, and a 2-year holiday on excise and value added taxes on electric vehicles (EVs) and road usage taxation for EVs.

Aims: To investigate why the transport sector has not seen any substantive traction in its transformation, despite high-level commitments and ambitious goals, by exploring whether experts consider the sustainable decarbonisation of the Barbados transport sector to be a viable undertaking, the reasons supporting their perspectives and the potential policy implications.

Methods: A Delphi expert study was used to obtain perspectives from professionals in diverse spheres of road transport and related sectors in Barbados. Key points of investigation included whether they considered the transition to be feasible by the 2030 timeline, the factors contributing to or inhibiting the decarbonisation transition of the sector, and the critical actions perceived as needing to be taken.

An inductive thematic analysis was undertaken of the qualitative survey data for the initial coding and descriptive statistics performed. The avoid-shift-improve (ASI) framework was used as the deductive themes for analysing the inducing and inhibiting factors described, supplemented by cross-cutting themes where factors were non-specific and could support multiple ASI aspects, such as governance and finance (ASI+). They were also categorised by types of carbon lock-in being addressed. The factors were then compared to the BNEP measures for coherence and gaps between the factors and policies.

Results: There is a 50:50 divide among experts about whether the vision of a sustainable transport sector is feasible within the target timeframe, also with an equal divide among males and females. Financial incentives and investment, regulation and its enforcement, stakeholder and political buy-in were the factors most considered to enable the transition, and inappropriate regulation and legislation, inadequate financing, affordability and availability of electric vehicles in the local market were seen as the greatest inhibitors. There is clear preference of respondents toward themes of improving technology and efficiency, finance and governance as enabling factors, with emphasis on the institutional and infrastructural and technological lock-in components. Behavioural norms and preferences are recognised more as inhibiting factors, though with no inclinations toward employing avoid or shift strategies.

Of the 24 policy measures, as pertain to the ASI+ themes, one relates to shifting to public transport and three to overall governance (monitoring, planning). All others (83.3%) directly apply to the improve segment of the ASI framework, thus reinforcing the dominant car-centric culture. There is no reference in the BNEP to cycling, walking, sharing services, accessibility, equity or mobility. This approach conflicts with the literature which frequently finds that avoiding (or reducing) travel demand and shifting to more efficient modes such as public transport are more effective at reducing emissions.

Conclusions: There is considerable divergence among practitioners about whether the promised 2030 transition is possible. This uncertainty is buttressed by limited progress to date on implementing planned measures within a guiding policy which perpetuates the individualistic travel patterns and behaviours associated with the business as usual (BAU) pattern of dominant car use. Given the narrow perspectives, without adjustment, it is likely that sector actors will work toward reinforcing the BAU car-dependence paradigm. This would therefore be unlikely to disrupt the inertia of carbon lock-in associated with current practice and trends, thus making the intended goal an improbable prospect.

HABITAT PREFERENCE SHIFTS WITH PREDATORY THREAT IN AUSTRALIAN SEAGRASS FISH SPECIES

^{1, 2} Nikki A. Bramwell, ^{1, 3} Edward Hammill and ¹ David Booth

¹The School of Life Sciences, University of Technology Sydney, Sydney, PO Box 123, Broadway, NSW 2007, Australia.

²School of Natural and Applied Sciences, University of Technology, Jamaica

³College of Natural Resources, Utah State University, United States

Background: An organism's preferred habitat may be abandoned in the face of predation to seek shelter, oftentimes in more structurally complex areas. In the south-eastern Australian coastal seascape, seagrass beds, sandy substratum and/or rocky algal reef border each other forming a matrix of varying habitat configurations with varying protection potential.

Aims: Our study sought to investigate the change in habitat selection in four Australian seagrass fish species, *Stigmatopora argus*, *Acanthaluteres spilomelanurus*, *Pelates sexlineatus* and *Atherinosoma microstomata* with the inclusion of predatory threat using tank experiments.

Methods: A total of 159 fish were collected from within seagrass beds in two estuaries along the New South Wales coastline, Careel Bay, Pittwater (33°36'47.88"S 151°19'15.79"E) from within a *Posidonia australis* bed and the majority – one hundred and twenty-four (124), were collected from Kurnell in Botany Bay (34° 0'20.31"S 151°12'50.60"E). The Kurnell collection site supported a mixed seagrass bed of *Posidonia australis* and *Zostera marina*. The species collected include: *Atherinosoma microstomata* (n=68), *Pelates sexlineatus* (n=46), *Stigmatopora argus* (n=28), *Acanthaluteres spilomelanurus* (n=11), the remainder were not included in the final data analysis.

The **experimental tank** contained three habitats – seagrass, sand and rock arranged in an unbroken circular path creating three distinct edge combinations and resulting in six sections of varying levels of complexity and heterogeneity. A transparent inner wall separated the habitat matrix from the central test chamber, which contained a demarcated "zone of decision". Each test fish (n=123) was placed in the tank centre for 2 – 3 minutes in an isolation tube to acclimatize before being released to make its selection. This was repeated for each test fish first

without predatory threat then with. Each test fish's selection in the absence and presence of predatory threat was videoed using the GoPro attached to the tank.

Habitat preferences were evaluated using two metrics (a) percent time spent in each habitat section to be supported by (b) most common first habitat section selected by tested fish species immediately upon release. A combination of statistical tests including PERMANOVA analysis and paired t-tests was performed to analyze the collected data.

Results: A general increase in selection of heterogeneous habitats with greater complexity over homogeneous and less complex ones was observed with predatory threat. The most structurally complex option, seagrass-rock, which was in "no predator" trials one of the least selected habitats (for example, selected by only 18.18% of *A. spilomelanurus* individuals), was increasingly chosen with predatory threat (50% of *A. spilomelanurus* individuals). For this same species, selection of the homogeneous seagrass-only habitat dropped markedly with predatory threat (54.5% to 0% i.e., percent of individuals making this section their first choice) and significantly less overall time was spent in this habitat by *A. spilomelanurus* with predatory threat ($p = 0.016$ paired t-test).

Conclusions: This observed preference of more complex habitats along with an apparent shift from homogeneous to heterogeneous habitats, especially those conferring higher structural complexity in the face of predatory threat, must be carefully considered in edge studies as well as in conservation biology. Also, to be considered is the species-specific habitat shift response to predatory threat. Both considerations will ensure that the full range of potentially beneficial habitats is included in portions of the seascape slated for protection to guarantee the venture's success.

IDENTIFICATION AND EXPRESSION ANALYSIS OF SWEET POTATO AUXIN SIGNALING GENES INVOLVED IN ROOT TUBER INITIATION

Sarah R. Mathura^{1*}, Fedora Sutton², Judy Rouse-Miller¹ and Valerie Bowrin¹

¹UWI, St. Augustine, TRINIDAD AND TOBAGO, ²ScienceVisions Inc, Brookings, SD USA

Background: Sweet potato (*Ipomoea batatas* (L.) Lam.) is an economically important crop due to its edible storage root tubers. It is essential to understand the mechanism of tuberization in this crop to accelerate the development of higher-yielding varieties. Auxin is a plant phytohormone required for the initiation of sweet potato tuberization but the exact mechanism by which auxin induces tuberization in crops is unclear. Members of the auxin response factor (ARF), auxin/ indole-3-acetic acid (Aux/IAA), Gretchen-Hagen 3 (GH3) and Small Auxin-Up RNA (SAUR) gene families are involved in auxin signal transduction. The ARF, IAA, GH3 and SAUR gene family members in *I. batatas* have not been characterized and the roles of these genes during the initiation of tuberization are yet to be elucidated.

Aims: To identify the members of the ARF, IAA, GH3 and SAUR gene families in *I. batatas* and analyze their expression during the initiation of tuberization.

Methods: Sweet potato (cultivar O49) plants were grown and harvested 49 days after planting. RNA was isolated from storage root, fibrous root, pencil root, stem, and leaf tissues, with three biological replicates per tissue. Total RNA was extracted from the tissue according to previously described protocols.^{1,2} Bioinformatics analyses were conducted to determine which genes to investigate. Briefly, the ARF, Aux/IAA, GH3 and SAUR Hidden Markov Models (HMMs) were downloaded from Pfam³ and was searched against the sweet potato proteome⁴ using HMMER. The resulting sequences were examined with the Conserved Domains Database⁵ and only complete sequences were retained and characterized. RNAseq datasets from the published literature for sweet potato storage roots and fibrous roots were downloaded and analyzed for the expression of the auxin signalling genes. Genes showing statistically significant (adjusted p-value < 0.05) upregulation/downregulation in tuberizing storage roots compared to non-tuberizing fibrous roots were selected to analyze

their expression with qRT-PCR.

Results: The analysis revealed that there are 29 ARF, 39 Aux/IAA, 13 GH3 and 200 SAUR gene family members in the sweet potato genome. The *in silico* expression analysis indicated that several genes (such as ARF8, ARF12, IAA16, IAA17, SAUR2, SAUR12, SAUR47, SAUR49, SAUR61, SAUR64) were expressed significantly higher in storage roots when compared to fibrous roots from 30 days after planting and beyond, with expression being between twofold to fourfold higher in storage roots. The opposite trend was observed for some GH3 and SAUR genes (GH3.2, GH3.3, SAUR9). Therefore, eight of these genes were selected for qRT-PCR analysis. The *in silico* gene expression was similar to the qPCR results.

Conclusions: Several auxin signaling genes were significantly upregulated in sweet potato storage roots compared to fibrous roots, which implicate their possible roles in the regulation of tuberization. Work is being conducted to determine how early these genes are expressed and their role in initiation of tuberization.

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CO-HABITATION OF ESBLs AND PLASMID-MEDIATED AMPCS IN UROPATHOGENS AT A TERTIARY CARE HOSPITAL IN THE CARIBBEAN

Steven Stone^{1*}, Felecia Dawson¹, Stacy Stephenson-Clarke¹, Maxine Gossell-Williams¹, Jenene Cameron², Camille-Ann Thoms-Rodriguez^{1,2}

¹University of the West Indies, Mona, JAMAICA. ²University Hospital of the West Indies, JAMAICA.

Background: As the world battles a global crisis of antimicrobial resistance (AMR), it is increasingly important to ensure that resistance phenotypes are properly identified within communities to prevent misuse of antibiotics. Common mechanisms employed by these pathogens include extended spectrum beta-lactamases (ESBLs) and AmpC beta-lactamases. Unfortunately, these systems are known to co-habit a microorganism leading to false negative results during phenotypic testing for the detection of ESBLs. This study looked at the co-habitation of these two beta-lactamases among uropathogens at the University Hospital of the West Indies (UHWI), Jamaica. Such data will inform modification of the approach to detection as required.

Aims: To investigate the co-habitation of ESBLs and plasmid-mediated AmpCs in uropathogens not already known to carry chromosomal genes (pAmpCs) at UHWI.

Methods: Consecutive de-duplicated urine samples collected from patients at the University Hospital of the West Indies, Jamaica (between January and March 2020) were subjected to systematic statistical analyses. From this, 64 non-duplicate bacterial isolates were further tested using conventional biochemical techniques and examined for antimicrobial susceptibility using the Kirby Bauer Disc Diffusion Method according to Clinical Laboratory Standards Institute (CLSI) guidelines. Isolates whose antibiogram was suggestive of possible ESBL or pAmpC production underwent phenotypic and genotypic testing including the double disc synergy test (DDST), cefoxitin resistance, disk approximation test, multiplex PCR and, for select isolates, whole genome sequencing as appropriate.

Results: Overall ESBL and pAmpC prevalence were 28.13% (n=18) and 6.25% (n=4) respectively. This is also the first report of the AmpC genes *bla*_{DHA}, *bla*_{CMY} and *bla*_{CIT}, found in Jamaica. All isolates (100%, n=4) positive

for pAmpC production were confirmed to also produce ESBL enzymes. The overall prevalence of AmpC and ESBL co-habitation was 6.25%. These isolates, belonging to the species *K. pneumoniae* and *E. coli*, were susceptible to meropenem, nitrofurantoin, amikacin, and gentamicin.

Conclusions: Although relatively low, the appearance of newly reported genes as well as observation of co-inhabitancy between these two resistance genes suggests that negative DDST results for the detection of ESBLs in organisms that may carry AmpCs (both plasmid and chromosomal) should be followed up with further testing for the detection of ESBLs. Without it, masking of the ESBL enzyme can occur. Meropenem remains a suitable option for treatment of these organisms and is the drug of choice for serious infections.

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Options for controlling for phosphorus during low temperature Bayer processing of Jamaican bauxites

Nijole J. Young^{1*}, Anthony M. Greenaway¹, and Michael D. Coley¹

¹ Department of Chemistry, The University of the West Indies, Mona, Kingston 7, Jamaica.

*Corresponding author. Email address: nijole.young02@uwimona.edu.jm

Background: Several of the goethitic bauxites slated for future mining in Jamaica have unusually high phosphorus concentrations.^[1] During the Bayer process, phosphorus impurities in bauxite may dissolve, accumulate in the liquors, and eventually contaminate the alumina product while also adversely affecting the general plant operations.^[2] Local processing plants limit phosphorus concentrations in the sodium aluminate liquors to <200 mgP₂O₅/L while worldwide alumina standards limit phosphorus in alumina to be smeltered to <10 mgP₂O₅.^[3,4] Since phosphorus minerals are among the major contaminants affecting the operations of the local Bayer processing plants, strategies to mitigate the effects of processing goethitic bauxites with unusually high phosphorus concentrations are needed if Jamaica is to remain as one of the key players in the global bauxite-alumina market.

Aims: This study therefore sought to investigate the effectiveness of four Ca containing chemical additives for controlling for phosphorus during the processing of a goethitic bauxite with a high caustic soluble phosphorus concentration.

Methods: Each additive was characterised using light microscopy, powder x-ray diffraction, sieve, and instrumental neutron activation analyses to determine their morphology, mineralogy, particle size and elemental concentrations respectively. The stoichiometric equivalent of Ca required from the additives to precipitate the caustic soluble phosphorus in the liquors was calculated and added to equal masses of a test bauxite that had up to 6.5% P₂O₅. The bauxite and each additive were then digested together in 102 g NaOH/L caustic solutions under low temperature (145 °C) Bayer processing conditions.

Results: Our results suggest that 5.00 moles of Ca from each additive was effective in reducing the phosphorus concentrations in the liquors to <200 mg P₂O₅/L. The calculated phosphorus removal efficiencies showed that NYAGMC4 was the most effective chemical additive for removing caustic soluble phosphorus from the liquors.

It was better at controlling for phosphorus in Bayer liquors than NYAGMC1, which is traditionally used by the processing plants.

Conclusions: The research has thus contributed to a better understanding of the complex behaviour of phosphorus in Jamaican bauxites during low temperature Bayer processing and proposes the use of an alternative additive to improve the efficacy of controlling for this impurity.

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Key words: bauxite; goethite; caustic soluble phosphorus; phosphorus control; calcium; powder x-ray diffraction; crandallite; apatite

EVALUATION OF THE INTER-ANNUAL VARIABILITY OF SITE-CORRECTED DAILY GLOBAL HORIZONTAL SOLAR IRRADIATION IN TRINIDAD AND TOBAGO

Nalini Dookie¹, Xsitaaz Chadee¹, Ricardo Clarke¹

¹Department of Physics, Faculty of Science and Technology, University of the West Indies, TRINIDAD AND TOBAGO

Background: Presently, the Government of Trinidad and Tobago (T&T) has plans to install their first grid-scale photovoltaic systems. With large financial investments, investors and project developers need a clear understanding of the short-term and long-term risks and uncertainties associated with their investment. The variability and the accuracy of the solar resource directly impact the system performance estimations and thus the associated cost of the generated electricity. Previous studies evaluated photovoltaic system performance in T&T using modeled solar data. Their biases were not evaluated nor site-corrected using high-quality ground-measured data for T&T [1,2,3]. Modeled datasets that have not been site-compared and corrected have unquantified uncertainty and can introduce a large risk in the photovoltaic project and as such, when analyzing large-scale projects, it is recommended that at least one year of high-quality ground measurements be collected and used to determine the accuracy of the modeled datasets and further correct them if needed [4].

Aims: The objective of this study is to decrease the uncertainty associated with long-term modeled daily global horizontal irradiation for T&T by evaluating and correcting its site-specific bias and then further evaluating its long-term inter-annual variability.

Methods: Ten years of daily on-site global irradiation data (2001 – 2010) was obtained from the Trinidad & Tobago Meteorological Service. Data for 2003 contained no missing values and was therefore used to evaluate the representativeness of two long-term modeled datasets, NREL's PSM V3 and NASA's SRB v3.0. The evaluation was done through the analysis of scatterplots, the mean bias error (MBE), root mean square error (RMSE), and the mean absolute error (MAE). The bias associated with the modeled datasets was corrected using a measure-correlate-predict (MCP) approach. The inter-annual variability of the corrected datasets was evaluated through the coefficient of variability (COV).

Results: Before the correction, both the NREL PSM V3 and NASA SRB v3.0 datasets overestimated the ground measured solar resources at the site by 25.0% and 36.6% respectively. The NREL PSM V3 dataset was found to be more representative of the ground

measured solar resource at the site compared to NASA's SRB v3.0 dataset. It was found to have fewer random errors as its scatterplot showed less scatter, smaller bias due to its smaller MBE of 25.0 % compared to 36.6 %, fewer outliers due to its smaller MAE of 25.3 % compared to 37.5 %, and smaller variance due to its lower RSME of 26.7 % compared to 40.6 %. On applying the MCP correction, to both datasets and comparing them to the existing ground measured daily dataset, a significant reduction in bias, outliers, and variance is observed. After correction, the MBE, MAE, and RSME for the corrected NREL's PSM V3 dataset for 2001 to 2010 reduced to -1.0 %, 10.0 %, and 3.6 % respectively. For the corrected NASA's SRB v3.0 dataset for 2001 to 2007, the MBE, MAE, and RSME reduced to 0.3 %, -3.4 %, and 6.9 % respectively. The interannual variability of the corrected datasets indicated low interannual variability in the solar resource as a COV of 2.4 % and 2.1 % were found for NREL's PSM V3 and NASA's SRB v3.0 datasets, respectively. Since the inter-annual variability is low, short periods of measurements could potentially be used to explain the long-term characteristics of the solar resource.

Conclusions: The modeled data showed significant site-specific biases and would therefore introduce large risks in performance estimations when used in predicting photovoltaic system performances. After correction, a significant reduction in bias, outliers, and variance was observed. In addition, since the inter-annual variability is low, short periods of measurements may be useful in characterizing the long-term solar resource in Trinidad and Tobago.

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PHYSICAL, THERMAL, OPTICAL, SHIELDING AND ELASTIC MODULI PARAMETERS OF $\text{Bi}_2\text{O}_3\text{-B}_2\text{O}_3\text{-TeO}_2$ GLASS SYSTEM DOPED WITH Fe_2O_3

André McGlashan^{1*}, Venkateswara Penugonda¹, Peter Nelson²

¹UWI Department of Physics, Mona Campus, JAMAICA ²UWI Department of Chemistry, Mona Campus, JAMAICA

Background: Concrete is currently the most used material for radiation shielding. However, concrete has its disadvantages as a radiation shielder such as bulk, opacity to visible light and a lack of homogeneity, which makes it use impractical in certain scenarios ^[1]. Glasses doped with heavy metal oxides (HMOs) have been investigated as an alternative. Previous research has shown that these glasses are suitable alternatives. Research has shown that doping glass with metal ions can affect various properties of the glass such as physical, optical, thermal and shielding parameters. The ions serve as network modifiers, disrupting the network of the glass via non-bridging oxygen (NBOs). The result of (NBOs) is changes to the parameters of the glass. $\text{Bi}_2\text{O}_3\text{-B}_2\text{O}_3\text{-TeO}_2$ glass systems have garnered interest due to their desirable parameters such as low melting point, high transparency, good radiation shielding and non-toxicity ^[2]. Transitional metals, such as Fe, when used as dopants, have been shown to cause interesting and often desirable changes in the doped glasses ^[3]. To the best of my knowledge, no prior research has examined a glass system with the specific composition used in this research.

Aims: To determine the doping effect of Fe_2O_3 on $\text{Bi}_2\text{O}_3\text{-B}_2\text{O}_3\text{-TeO}_2$ glass system for various properties in hopes of finding good radiation shielding material that has other desirable properties such as low weight and non-toxicity.

Methods: The mixture of the compounds was melted in a platinum crucible in a PID electric furnace. The masses of prepared glasses were measured in Ohaus digital balance with a precision of 10^{-4} g. The prepared glass densities ($\pm 0.0001 \text{ g/cm}^3$) measured by Archimedes principle, by using of O-xylene liquid. Thermal behaviour of glasses was studied in the temperature range 35-1000 °C with heating rate of 10 °C/min was studied by DTA analysis (Netzsch STA 449 F1 Jupiter). Nitrogen atmosphere (5.0 purity) and corundum crucibles /empty corundum crucible was used as reference. The Raman spectrum was measured between 100 and 4100 cm^{-1} at a resolution of 0.5 cm^{-1} with a QE65 pro spectrometer. Optical absorption was measured at a resolution of 0.5 nm using a Cary 5000 UV/Vis/NIR spectrometer between

200 and 3300 nm using the polished samples. X-ray diffraction was carried out using a PANalytical XPERT-PRO with Cu K α , (45 kV accelerating voltage, $\lambda = 1.5406 \text{ \AA}$), through the angle 2θ between 10° and 80°, with a step size of 0.05° s⁻¹ was used. Mass attenuation coefficients of samples were derived using data from NIST XCOM program. Other parameters were derived using the experimental parameters and data and formulae taken from the literature.

Results: Doping with Fe_2O_3 : decreased radiation shielding compared to undoped sample (however radiation shielding was still greater than concrete), decreased density, increased elastic moduli parameters, decreased cross-link density, increased glass transition temperature, softening point, Debye temperature, thermal stability against crystallization, melting point and glass forming ability, decreased optical band gap, increased refractive index, increased reflection loss, decreased UV-VIS transmittance and Urbach energy, increased dielectric constant, increased molar refraction, polarizability, metallization criterion and optical basicity. XRD confirmed amorphous nature of the samples; Raman spectra show disruption of structural units with doping. Fe_2O_3 acts as a network modifier. EPR analysis shows that iron mostly exists in its Fe^{3+} state in the doped glass.

Conclusions: Doping with Fe_2O_3 affected various parameters of the glass. Fe_2O_3 reduced radiation shielding compared to undoped sample but radiation shielding was still greater than concrete.

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THE IMPACT OF LAND MANAGEMENT ON SOIL HEALTH IN JAMAICA: A CASE STUDY OF THE MILLBANK FARMING REGION

Tiffany Wallace¹, Adrian Spence^{1*}, Donovan Campbell², Alex A. Moulton³, David Barker², Tashana Malcolm², Lance Scott², Jhannel Tomlinson²

¹International Centre for Environmental and Nuclear Sciences, University of the West Indies, Mona, Kingston 7, Jamaica, ²Department of Geography and Geology, University of the West Indies, Mona, Kingston 7, Jamaica, ³Department of Sociology, University of Tennessee, Knoxville, TN, USA

Background: The land sector represents an important carbon pool and offers significant mitigation opportunities while delivering food, fiber, fuel, and other renewable resources as well as biodiversity conservation, provided the sector is sustainably managed. One of the co-benefits of sustainable land management is that it restores and maintains healthy soils, a prerequisite for the land sector to deliver much needed ecosystem services in the face of multiple and simultaneous environmental perils. Despite this consensus, the impact of land management on ecosystem services at the local scale remains poorly quantified.

Aims: In this case study, we examine numerous abiotic factors as proxies to decipher the impact of land management on long-term soil health and the potential implications for the delivery of ecosystem services in rural farming communities of the Upper Rio Grande Valley.

Methods: Surface soils (0–30 cm) representing different land-use types were collected along a transect (5.9 km, and an area encompassing 340 ha) dominated by *Colocasia esculenta* (dasheen) cultivation (in the northwest) and a forest reserve (in the southeast), in the adjoining rural communities of the Upper Rio Grande Valley (18.04°N, 76.40°W). The following parameters were determined from the <2 mm soil fraction: soil pH, determined in a water suspension (soil: solution; 1: 2.5); phosphate and nitrate concentrations in 1 M KCl (soil: solution; 1: 5) by colorimetry; soil organic carbon (SOC) by dry combustion via loss on ignition (LOI) at 550°C for 4h [1]; and soil carbon stocks (megagram per hectare) estimated by the below equation [2]:

$$\text{SOC}_{\text{STOCK}} (\text{Mg C ha}^{-1}) = \text{SOC} (\%) \times \text{bulk density} (\text{g cm}^{-3}) \times \text{depth of soil (cm)}.$$

Additionally, we applied infrared spectroscopy and instrumental neutron activation analysis to provide details on the molecular structure and elemental composition of the samples, respectively. Further, we leveraged the gamma emitting fallout radionuclides ²¹⁰Pb, ¹³⁷Cs, ⁷Be and ²²⁶Ra as a proxy to determine soil redistribution rates and nutrient cycling [3]. Soil CO₂ efflux (μmol CO₂ m⁻² s⁻¹) was determined *in situ* using a

non-dispersive infrared gas analyzer and provides auxiliary information on soil health.

Results: In general, there are significant differences between geochemical parameters of managed and unmanaged lands. For instance, the OM content (19.22%) and soil carbon stock (250.13 Mg C ha⁻¹) of unmanaged land are significantly ($p \leq 0.0001$) higher than that of managed land (10.96%; 180.07 Mg C ha⁻¹, respectively). Conversely the rate of soil respiration and carbon loss were lower for unmanaged land (40.66 Mg ha⁻¹ yr⁻¹; 11.09 Mg CO₂-C ha⁻¹ yr⁻¹, respectively), when compared with managed land (50.21 Mg ha⁻¹ yr⁻¹; 13.69 Mg CO₂-C ha⁻¹ yr⁻¹, respectively). Additionally, soil redistribution rates were lower for unmanaged land (0 to -6 t ha⁻¹ yr⁻¹), when compared with managed land (-7 to -75 t ha⁻¹ yr⁻¹).

Conclusions: Land management is a cause and consequence of global environmental change. Here, distinct differences are observed between the proxies of soil health for managed and unmanaged land in the Millbank farming region. The impacts of these findings on land surface properties and the provisioning of various ecosystem services - the soil's ability to regulate plant nutrient and climate change via carbon sequestration or emission - are being investigated.

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Facing Cancer Occurrences and Lethality: The Potential of Lesser Galangal (*Alpinia officinarum* Hance Jam1) as an Antiproliferative Agent

Samson N. Omoregie^{1*}, Kacey Reid² and Vincent Wright²

¹School of Natural and Applied Sciences, University of Technology, Kingston 6, JAMAICA.

²College of Natural and Applied Sciences, Allied Health and Nursing, Northern Caribbean University, Mandeville, JAMAICA.

Background: With over nineteen million incidences of cancer and nearly ten million cancer deaths occurring globally in 2020, the lethality of cancer is of continuous concern. Although breast cancer topped the incidences, presenting with over 2.26 million occurrences, lung cancer remains the highest killer of cancer sufferers in the world, with about 1.80 million deaths caused by it in 2020. The irony of the increase in cancer mortality is being witnessed, in spite of the increase in treatment modalities and technologies, which include the use of chemotherapy, surgery, radiotherapy, immunotherapy, hormone therapy and stem cell therapy. In the island of Jamaica and the entire Caribbean, prostate cancer topped the incidence of all cancers, accounting for 21.7% and 18.9% of all occurrences, respectively. Prostate cancer has consistently proved to be the most lethal of all cancer types in Jamaica, resulting in 18.4% of all cancer deaths in 2020, in congruence with the range of 17-21% reported between 2003 and 2015. In contrast, lung cancer was the leading cause of cancer deaths in the Caribbean region, causing 15.3% of all cancer deaths in 2020.

Aim: To examine the potential of Lesser Galangal (*Alpinia officinarum* Hance Jam1) as an antiproliferative agent against acute monocytic leukemia, breast, prostate, and colon cancers.

Method: Extracts of the leaves of Lesser Galangal (*Alpinia officinarum* Hance Jam1) were prepared in aqueous and organic solvents which included 50% methanol, 100% methanol or ethanol, dichloromethane, chloroform, and hexane. Extracts were applied against *in*

vitro grown cancer cell types.

Results: The Lesser Galangal (*Alpinia officinarum* Hance Jam1) leaf extracts were found to have significant antiproliferative activities against acute monocytic leukemia (AMoL) THP-1 cells, breast MCF-7 cells, prostate PC-3 cells, and colon HT-29 cells.

Conclusions: Preliminary studies suggest that the activity of *A. officinarum* Hance Jam1 against these cancer cells may be by apoptosis. Case studies of persons that opted to consume crude extract formulations from the plant show that their prostate-specific antigen (PSA) levels were reduced to normal ranges. Further studies are underway to determine the full anticancer potentials of Lesser Galangal (*Alpinia officinarum* Hance Jam1) against specified cancer types.

Acknowledgments: We thank the Northern Caribbean University and Texas A&M University, Corpus Christi, Texas, USA, for sponsoring a major and initial parts of this study, respectively.

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ANTIMICROBIAL POTENTIAL OF *ALLIUM SATIVUM* IN THE PRESENCE AND ABSENCE OF HEAT STRESS

Joneshia Bryan-Thomas*¹, Teena McClear¹ and Samson Omoregie²

¹College of Natural and Applied Sciences, Allied Health and Nursing, Northern Caribbean University, Mandeville, JAMAICA. ²School of Natural and Applied Sciences, University of Technology, Kingston 6, JAMAICA

Background: It is no surprise that the *Allium* genera is of much economic and folklore medicinal importance. *Allium* is one of the largest cultivated herbal plants essentially used in culinary practices to flavor foods. It is believed that these herbs and spices can be used to cure and alleviate ailments if used effectively. Garlic has been used for millennia as a flavoring for foods and meats and also has migrated to the shelves of many households as a nutraceutical agent for treatment of several ailments.

Allium species have been used as ingredients in many dishes and with ethnomedicinal purposes for many years. *Allium sativum*, is rich in two chemical groups that are thought to provide benefits to human health: flavonoids and alkenyl cysteine sulfoxides. Apart from its culinary uses (fresh, cooked or dehydrated), medicinal properties have been attributed to it since ancient times, prompting in recent years an accurate chemical analysis of its most characteristic active components. Compounds from onions have a range of health benefits such as anticarcinogenic, antiplatelet, antithrombotic, antiasthmatic, antidiabetic, fibrinolytic and hypocholesterolemia properties, and other various biological actions including antibiotic effects (Santas et al., 2008).

Aims: To investigate the potential of uncooked and cooked *Allium sativum* bulbs obtained from the Jamaican market to inhibit named microbes.

Methods: Aqueous extracts of crushed fresh samples of 15g/100ml (wet weight) and dried, pulverized samples of 12.5g/100ml, 25g/100ml, 50g/100ml and 100g/100ml (dry

weight) were obtained following incubation for 4 hrs. All samples were tested for inhibition of growth of microbes, which include *Streptococcus pneumoniae*, *Klebsiella oxytoca*, *Pseudomonas* sp., *Klebsiella pneumoniae*, *Escherichia coli*, *Proteus mirabilis*, *Salmonella* sp. and *Candida albicans*. Samples were tested following application of cooking heat for 5, 10, and 15 min. respectively in comparison to the uncooked samples.

Results: The fresh garlic extracts were observed to express inhibitions ranging from 12.0±1.7 mm for *K. oxytoca* to 30.0±0.0 mm for *C. albicans*, except for *S. pneumoniae* and *Pseudomonas* sp. which showed no zones of inhibition. Cooking resulted in severe decrease or complete loss of zones of inhibition of microbes by both fresh and dried samples, as evident in the regression analysis. The dried uncooked garlic extracts of 50g/100ml and 100g/100ml resulted in the largest microbial inhibition.

Conclusions: The antimicrobial activity of garlic against susceptible microbes was, at the mildest, lessened by cooking. The use of uncooked garlic may be the best route among the common culinary allium spices for obtaining the greatest potential against susceptible bacteria and fungi.

Acknowledgments: We thank the Northern Caribbean University for providing the environment for this study

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SIMULATION OF COVID-19 IN A CARRIBEAN ISLAND USING MULTI-AGENT SYSTEMS

Kelia GAETE¹, Michael SOLIMAN¹, Baptiste CHARRIER^{1*}, Sébastien REGIS²

Math. and Comp. Sc. Lab, French West Indies University, P-à-P, GUADELOUPE, ¹Master Student ²Assist. Prof.

Background: We present a study simulating the spread of the COVID-19 virus on the islands of Guadeloupe, with little respect for social distancing. Most of the simulations and studies carried out concerned very large countries in a continental context (see [1] for instance). Our work continues a first series of simulation on the spread of the virus taking into account mainly two factors: age and obesity [2,3]. The originality of our work is to add new factors which should make it possible to refine the results.

Aims: To Better estimate the spread of COVID-19 on an island Caribbean population with its own physiological and sociological characteristics in a context of absence or lack of respect for social distancing.

Methods: Our approach is based on a Multi-Agent System. The population is represented by 100 agents taking into account the demographic proportions by age group (young, adults, elderly) of the islands of Guadeloupe. Obesity-related characteristics are also taken into account (as in previous studies) to assess the severity of the form of COVID (mild, severe, critical). In addition to these two factors, we also tested scenarios taking into account other aggravating factors such as hypertension and diabetes (which are often characteristics more present in our populations than in other regions of the world). Each agent has a degree of belonging (of fuzzy type) to a severity class (mild, severe, critical) for each of the aforementioned factors. If an agent is infected, a combination of these membership degrees is performed via an aggregation operator. The agent is classified in the severity level for which it has the highest aggregate membership degree.

This approach also takes into account certain sociological elements. Indeed, we took into account, at least partially, the distribution of the working population to model potential infections in a professional context. We also took into account possible

exchanges (and infections) within the same household or between young and elderly relatives. Finally, two scenario elements were considered in our simulations. First, the arrival of a more contagious variant (like the “Deltacron” AY.4/BA.1 variant) was simulated. Second, taking into account the socio-economic factor (in our case, the poverty index) is used to estimate a number of deaths related to COVID-19 (especially for the elderly). The time unit chosen was half a day and each simulation lasted 30 days.

Results: The results of the simulations show that the elderly and adults who combine the aggravating factors are the most affected by the critical form. Moreover, the arrival of a variant would have the effect of increasing the peak of the pandemic and turning it into a plateau. (see figure 1). This extension of the plateau could have serious consequences for the hospitals of island countries whose number of beds is limited and the transfer of patients to other countries is difficult.

Conclusions: The simulations of the COVID 19 pandemic on a Caribbean archipelago with little or no respect for social distancing that we have proposed and which take into account various medical and social factors make it possible to have a better projection of the effects of respect for barrier gestures and can help to better target the people to be protected as a priority.

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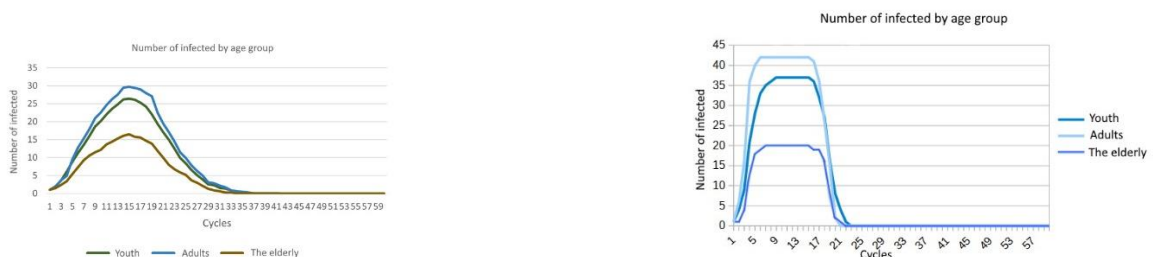


Figure 1: No of cases with COVID-19 (left). No of cases with variant (right).

Opine and Lactate Dehydrogenase of the Intertidal Sea Snails of Genus: *Nerita* and Their Response to Differing Environmental Conditions.

Spencer St. John, Shane Austin

The University of The West Indies, Cave Hill Campus, Barbados.

Background: Opine dehydrogenases are a group of pyruvate oxidoreductases which are utilized to produce energy during periods of time where organisms experience hypoxia [1]. The Opine dehydrogenases are functionally analogous to the well-known Lactate Dehydrogenase pathway. The Lactate Dehydrogenase pathway utilizes pyruvate and NADH to produce lactate and NAD⁺. The Opine dehydrogenases utilize similar substrates, as they also use pyruvate and NADH and yields NAD⁺ but they also incorporate an amino acid which will produce an amino acid derivative called an Opine [1]. Opine Dehydrogenases and Lactate Dehydrogenase are utilized by marine organisms and are heavily distributed within the intertidal zone [2]. The intertidal zone is characterized by the changing levels of the tides, this causes some inhabitant organisms to be exposed to air and unable to extract oxygen from the water, thus making anaerobic energy production essential. The chosen study species are those of Genus *Nerita*. Nerites are common in the intertidal zones of Barbados. There are three main species, *N. peloronta*, *N. versicolor* and *N. tessellata*. These three snails display marked zonation and occur at differing zones in the intertidal with some overlap [3].

Aims:

- (1) To demonstrate the presence of the Opine Dehydrogenases in the genus of intertidal sea snails of Genus *Nerita*.
- (2) To demonstrate a change in the activity of Lactate and Alanopine Dehydrogenase in response to changes in environmental conditions.

Methods: Samples of *N. peloronta*, *N. versicolor* and *N. tessellata* were collected from the intertidal zones of Atlantic Shores Barbados. Foot muscles from the samples were removed and homogenized in a 1:5 w/v ratio of Homogenization Buffer (100mM Imidazole). The homogenate was centrifuged (12,000rpm 20 min @4 C) and the supernatant was used as the Crude Extract which was used for the enzymatic assays. There were two enzymatic assays performed, Lactate Dehydrogenase and Alanopine Dehydrogenase. The Assay Buffer consisted of 2.5mM Pyruvate and 0.15mM NADH in 100mM Imidazole for Lactate Dehydrogenase.

The Assay buffer for Alanopine Dehydrogenase consisted of 100mM Alanine, 2.5mM and 0.15mM NADH in 100mM Imidazole. The absorbance was recorded at 340nm for five minutes to measure the change in NADH levels. The above procedure was repeated with specimens which were collected and placed into an aquarium for 5 days which was oxygenated using an air pump. The activity of Lactate Dehydrogenase and Alanopine Dehydrogenase was recorded on these specimens.

Results:

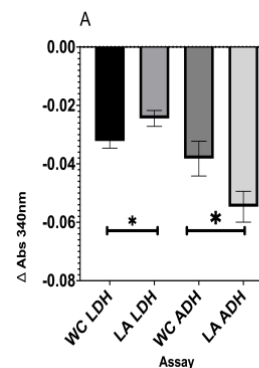


Figure A: Decrease in the Abs@340nm for 5 minutes, Wild Caught (WC) and Lab Acclimated (LA) *N. peloronta* which was assayed for LDH and ADH. Columns represent means \pm SEM.* -p<0.05. N=9, t tests. Normalised through total protein content in the homogenates.

Conclusions: The activity levels of the Lactate Dehydrogenase and Alanopine Dehydrogenase levels of the Nerite snails demonstrate preliminary evidence that the activity of these enzymes can be influenced by the environmental conditions.

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FOLIAR DISEASE DETECTION AND QUANTIFICATION USING IMAGE ANALYSIS TOOLS

Vijayanandh Rajamanickam¹, Jayaraj Jayaraman², Adesh Ramsubhag^{2*}

¹Lecturer, Department of Computing and Information Technology, The University of the West Indies, St. Augustine campus, TRINIDAD AND TOBAGO ²Professor, Department of Life Sciences, The University of the West Indies, St. Augustine campus, TRINIDAD AND TOBAGO.

Background: Global food production will need to increase every year as the world's population grows. However, plant diseases and pests and their damages cause major challenges to crop production threatening the global food needs and supply. Farmers will be able to apply appropriate disease management practises should they able to detect and measure the disease severity early on. Disease severity measurements is the key data required for researchers for assessing the disease damages and for evaluating the disease resistance traits in plant types. Nowadays high-resolution cameras is becoming the commonest inbuilt feature in smartphones and this can be effectively used for capturing images of diseased plant leaves. Smartphone cameras can help in the picturing of plant samples quickly and easily at a reasonable resolution.

Aims: To develop a much simpler and more effective method for measuring diseased area of the detached leaves from smartphone captured images, scanned images, and PlantVillage dataset.

Methods: The image is converted to grayscale [1] and Otsu's method [2] for segmenting the leaf area is applied, yielding the binary leaf image. In addition, the original image is converted to HSB color space [3, 4] for identifying the leaf area and diseased area using hue and brightness threshold values. Using threshold values, the diseased area is identified from the binary image and quantified.

Results: Fig. 1 illustrates the working flow of the proposed method with sample image. The preliminary study results show that, by employing the image

analysis tools and the protocol developed it is possible to estimate the diseased/infected areas of leaves with relative degree of precision from digital images captured from a camera or scanner. This method could work well for leaves collected from the field grown plants as well as from inoculated greenhouse plants. The pixel-based quantitative measurement of optimized images had high degree correlation with the established visual-based disease intensity/assessment scales.

Conclusions: Digitally captured plant images could be effectively used for foliar disease intensity measurements. The method will be evaluated for wide range of plant diseases for further optimization of the tool.

Acknowledgments: We thank the Campus Research and Publication Fund Committee, The University of the West Indies, St. Augustine campus for funding this study.

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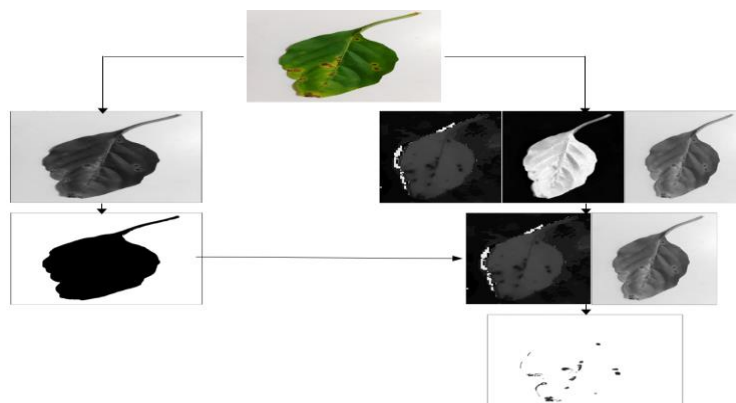


Figure 1: Working flow of the proposed method with sample image

Estuarine River System: A comparative study of benthic macroinvertebrate communities and physico-chemical properties of the upper and lower regions of Salt River, Clarendon, Jamaica.

Troy Franklin*, Dr. Eric Hyslop

The University of the West Indies, Mona, JAMAICA

Background: Salt River, Jamaica, is very atypical when compared to most rivers; consisting of water with abnormally high salinities (ranging from 1 to 31; mean 13.9) as opposed to most global rivers (mean <1). The entire river experiences relatively strong tidal forces, making it functionally an estuary; this makes it unlike most rivers which generally only exhibit these features in their lower (seaward) regions. Due to narrow tolerance ranges to abiotic factors, most benthic macroinvertebrates are expected to be restricted distributions. These restrictions imply varying diversity of species within Salt River, with community composition deviations, from the typical tropical river. Overall, there is a lack of studies on the distribution of Jamaican estuarine benthic invertebrates in relation to temperature, pH and salinity.

Aims: To assess if there are clear (biotic and abiotic) distinctions in the the lower (LR) and upper (UR) regions of Salt River and how these factors diverge from other Jamaican rivers.

Methods: Data are presented on the taxonomic composition of benthic macroinvertebrates observed within the LR and UR of Salt River. A total of twelve non-consecutive monthly samples at five sites were collected for biotic (taxonomy, richness and abundance) and physico-chemical data (temperature, pH and salinity) through the period of December 2014 to May 2016.

Specimen were collected once a month from each sample site using primarily kick net sampling over a 30-minute period at alternating high and low spring tides. *Uca* were estimated by counting all borrows within a 15m² area (one burrow = one crab).

These data were used to calculate macroinvertebrate community similarities (Jaccard and Whittaker

Percentage Similarity Indices), diversity (Simpson Diversity Indices) and determine functional feeding groups. Spearman Correlation Coefficient was used to determine correlations between abiotic and biotic factors. Multiple (relevant) parametric and non-parametric tests were used on varying sets of data to test for significance.

Results: The most notable physico-chemical significant difference was the UR having a higher overall salinity ($p < 0.001$). Total of 78 invertebrate families. Regional communities were relatively dissimilar, sharing approximately half their total richness (56% JCC and 51.5% WPS). Crustacea was the most relatively numerous group sampled: UR 46.90% (mostly Harpacticoida [47.99%]) and LR 81.22% (mostly Podocopida [46.66%]). Only Hexapoda had a significant correlation with salinity in the LR ($r_s = -0.608$, $p = 0.047$) compared to only Crustacea ($r_s = -0.588$, $p = 0.034$) and Conchifera ($r_s = -0.661$, $p = 0.014$) in the UR.

Conclusions: The LR and UR are significantly distinct (biotic and salinity) and very dissimilar from other Jamaican rivers, especially since the UR is saltier than the LR (most rivers globally have inverse conditions). Salt River has a significantly higher diversity of benthic invertebrates than any other Jamaica and potentially Caribbean River, inclusive of unique species.

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The Effect of Dangerous Prey on Anoline Hatchlings in Jamaica

John Hall,

University of Technology Jamaica, Kingston, JAMAICA

Background: Ants are among the most successful invertebrate groups in the tropics, and are the most common invertebrates in Jamaica with species adapted to every environment on the island [1]. One would therefore think that ants would form a large part of the diet of the mainly insectivorous *Anolis* sp. especially of juvenile hatchlings which because of their size tend to be limited in the types of insect prey they can attack. The presence of *Solenopsis geminata* in areas where Anoline hatchlings hunt may complicate predator /prey interactions since the stinger of the ant can cause significant damage to the hatchlings and potentially reduce their overall survival [2] In areas where *Solenopsis geminata* is located rejection of ants as prey may reduce overall caloric intake by hatchlings but increase survival chances by allowing the hatchling to avoid potential injury however in areas without *Solenopsis* hatchlings should consume larger quantities of ants and begin consumption earlier to maximize calorie intake.

Aims: The purpose of this study was to determine if the initial attack on ants by the anoles (*Anolis lineatopus* and *Anolis grahami*), would be affected by the presence of *Solenopsis* in the area where anole eggs were collected

Methods: Eggs of both anoles were collected from areas in St. Andrew with *P. fallax* but no *S. geminata* and from areas with both *P. fallax* and *S. geminata* present. The hatchlings were initially starved for 3 days after hatching to ensure hunger and were then offered ant prey, if it was not attacked after 5 minutes the ant was then removed after a 5 minute delay the anoles were offered *Tribolium confusum* (harmless prey) . If the *Tribolium* was attacked then ant was considered to have rejected the ant as prey. The

procedure was repeated daily until the anole attacked the ant prey. The total time the anoles were exposed to the ant before initial attack was then determined.

Results: Based on ANOVA analysis it was concluded hatchlings taken from areas with *S. geminata* required more feeding days before an initial attack on the ants, consequently needing more exposure before attack. The study suggests that the increased rejection by anoles from areas with *Solenopsis* must be innate.

Conclusions: *Solenopsis geminata* which prefers grasslands continues to spread into deforested areas, Anoline population in these areas will not have innate mechanisms of dealing with the ant and may be negatively impacted by its presence. Increasing deforestation in Jamaica can lead to increasing threats from *Solenopsis* on the local anole population. A reforestation program may reduce the prevalence of *Solenopsis* and mitigate its effects.

Acknowledgments: We thank ABC for the financial support. (This is an optional section and can be removed, if not applicable.)

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MARISA CORNUARIETIS (LINNAEUS, 1758) (GASTROPODA: AMPULLARIIDAE): A NEW ADDITION TO THE FRESHWATER MALACOFaUNA OF JAMAICA WITH HEALTH AND ECONOMIC IMPLICATIONS

Marco-Dean Brown^{1*}, John Lindo², Ralph Robinson¹

¹Department of Life Sciences, The university of the West Indies at Mona, Kingston, JAMAICA ²Department of Microbiology, The University of the West Indies at Mona, Kingston, JAMAICA.

Background: *Marisa cornuarietis* (giant ramshorn snail) is an aquatic snail of the family Ampullariidae, which are generally referred to as apple snails. *M. cornuarietis* is native to Colombia, Venezuela, Trinidad and Tobago and the Amazon Basin regions of Brazil, Bolivia, and Peru [1]. This species was deliberately introduced to some countries, among them several Caribbean islands, as a biological control agent of intermediate host species (primarily *Biomphalaria* spp.) of zoonotic schistosomes and for the control of aquatic macrophytes. Several ampullariids, including *M. cornuarietis*, are invasive alien species across several islands of the Caribbean, where they are associated with considerable ecological and economic outcomes. This species was collected as part of a wider study assessing the epidemiology and transmission of *Angiostrongylus cantonensis* in Jamaica; we appreciate that *M. cornuarietis* is poorly susceptible to infection with *A. cantonensis* [2].

Aims: 1. To confirm the presence of *M. cornuarietis* in Jamaica. 2. To discuss potential environmental, economic, and social implications of *M. cornuarietis* in Jamaican ecosystems.

Methods: During an aquatic snail assessment conducted in the Parish of St. Andrew, Jamaica, from May to June 2021, 153 specimens and a gelatinous mass containing eggs were collected. These samples were obtained using a kick net and by hand from vegetation in two freshwater ponds, and within trenches exiting those ponds. Juvenile specimens were fixed and preserved in 95% ethanol, while eight adult snails were dissected using a stereoscopic microscope. The Adult specimens were photographed and carefully identified using morphologically distinguishing features. Molecular diagnostic techniques were also used to

determine if the species is a carrier of the zoonotic parasite, *A. cantonensis*, to determine the risk of human infection with the parasite, if any, associated with the species locally.

Results: Two populations of *M. cornuarietis*, one of which is reproductively active, were observed in the parish of St. Andrew, Jamaica. Adult specimens ranged from 33 mm to 41 mm in width. Individuals collected in the study exhibited considerable polymorphism; some individual's shells were completely golden/yellowish (Figure 1A) without any banding patterns, while those of others were yellow to brown ground colour with three to six dark brown bands (Figure 1B) on the spines. The species exhibits significant sexual dimorphism: males had relatively thicker shells with a rounded aperture, while females had thinner shells with an oval-shaped aperture. The species was not found to be a carrier of *A. cantonensis* in Jamaica.

Conclusions: *M. cornuarietis* is a new addition to the malacofauna of Jamaica and the species introduces potential threats to local ecosystems, agricultural and health sectors.

Acknowledgments: We extend sincere gratitude to all the individuals and organizations that assisted in the completion of the project.

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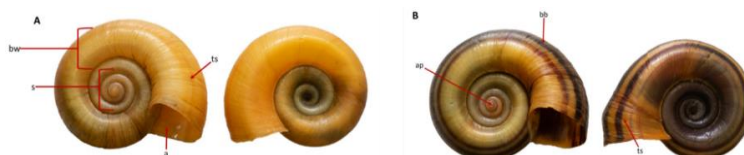


Figure 1: *Marisa cornuarietis* exhibits polymorphism; (A) shells completely golden/yellowish and (B) shells of yellowish-brown ground colour with three to six dark brown bands on the spine

Phytochemical Screening, Proximate Analysis, and Mineral Composition of Ultrasonic extract of Annatto (*Bixa Orellana* L.) Seed extract.

Modupeola Abayomi¹, Roy Porter¹

¹Department of Chemistry, University of the West Indies, Jamaica.

Background: Plants, animals, and micro-organisms signify a pool of natural products, particularly, the plant kingdom offers a wide variety of species as remedies for several diseases in many parts of the world ¹. Medicinal plants and extracts are regularly used to treat ailments because of the minimal side effect and cost-effectiveness. The plant *Bixa Orellana* L. popularly known as annatto belongs to the Bixaceae family. It is widely cultivated in tropical and subtropical regions. The pigment on the seeds is most frequently used worldwide, not only in food preparation, but in cosmetic, traditional medicine, textile, and paint industries².

Aims: To investigate the phytochemical constituents, proximate analysis, and mineral composition of ultrasonic extract of Annatto seed.

Methods: The analysis of the phytochemicals was carried out according to standard methods³. Proximate analysis was done according to Association of Official Analytical Chemists (AOAC) methods⁴ and the mineral composition was determined using Atomic Absorption Spectroscopy (AAS) and Flame Photometry Emission (FPE)⁵.

Results: The phytochemical analysis of ultrasonic extract of Annatto seed depicted the presence of tannins, terpenoids, steroids, glycosides, flavonoids, carbohydrates, and saponin. The proximate analysis revealed that moisture (0.74%±0.023), ash (0.053±0.0015), crude protein (4.37 %), crude fiber (11.54% ±0.25), crude fat (0.127 %±0.015), and carbohydrate (83.14 %). Mineral content showed the presence of zinc (0.027 mg/g), manganese (0.044 mg/g), magnesium (0.189 mg/g), iron (0.022 mg/g),

lead (0.018 mg/g), potassium (1.42 mg/g), and sodium (0.093 mg/g).

Conclusions: The ultrasonic extract of Annatto seed is a promising candidate as a nutraceutical due to the presence of important phytochemicals, proximate, and minerals which will provide medical and health benefits including prevention and treatment of disease.

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Over Three (3) Decades of Research on Jamaican Plant Extracts: The Case for Safer Agrichemicals and Linkage to Pharmaceuticals Including Potential Supplementary Treatments of Covid-19 Infections in Jamaica

¹ Marcia J. Blair-Thomas^{1*}, Wayne M. Forbes^{2*} and Arlene B. Wilson^{3*}

¹ Division of Biology, University of Technology, JAMAICA; ² Department of Biology, Slippery Rock University of Pennsylvania, U.S.A; ³ Western Regional Health Authority/Cornwall Regional Hospital, JAMAICA.

Background: For more than three (3) decades, research conducted by Jamaican scientists on the pesticidal and medicinal activity of Jamaican plant extracts, has highlighted the untapped potential of Jamaican plants to contribute to the island's socio-economic development. This is especially important given the current economic crisis precipitated by the Covid-19 pandemic and geopolitical influences. Research by several Jamaican scientists has elucidated the pesticidal and medicinal characteristics of hundreds of Jamaican plants^{1,2}, and the mode of action of the bioactive components of related families of the plant species has also been documented. Specifically, the programme of work on insecticidal and acaricidal activities of the extracts of Jamaican plant species^{3,4,5} and the nematocidal potential of 25 Jamaican plants^{6,7,8}, have set the foundation for further research and development projects towards establishment of local cottage industries and commercialization of the most potent extractives. In tandem with research conducted by scientists worldwide, this concretizes conclusions regarding the critical role of plant secondary metabolites in the future development of safer agrichemicals with regards to human and environmental health and pharmaceutical developments to address medical/disease indications⁹.

For agricultural production and food security, it is of note that, given the highly hazardous nature of synthetic pesticides, increasing emergence of resistance to pesticides and resurgence of pest populations¹⁰, it has become more urgent to develop environmentally-safe and efficacious, viable alternatives. Linkages to the nutraceuticals and functional foods industry¹¹ have offered valuable lessons towards purported natural alternative medical treatments¹². In particular, with reference to potential for treatment of Covid-19 infections, a review of available literature supports the tremendous potential of plant-based compounds for treatment of coronaviruses and the significant number of personal accounts of successful treatments using plant-based concoctions in Jamaica, warrants further research investigation and validation. In fact, based on recent studies, there are currently 130 named compounds of natural products origin with known antiviral potential - 94 of these metabolites include alkaloids, flavonoids and terpenoids with demonstrated bioactivity against respiratory viruses such as influenza virus, SARS-CoV, MERS-CoV and SARS-CoV-2¹². It may not be far-fetched, therefore, that "tapping" of the vast potential of Jamaican plants with bioactive secondary compounds could be realized, effectively transforming lives and livelihood.

Aims: This paper seeks to review the seminal research work on pesticidal and antimicrobial potential of Jamaican plant extracts and the potential for development of cottage industries and commercialization of environmentally safe crop protection and animal husbandry products. Additionally, the paper explores the potential medicinal applications of Jamaican plant extracts as supplementary treatments of COVID-19 infections in Jamaica.

Methods: Secondary research was conducted on the findings of over three (3) decades of work conducted on the insecticidal, acaricidal and nematocidal potential of Jamaican plant extracts, based primarily on the post-graduate investigations by the authors and other subsequent investigations. An indicative survey was also done on purported supplementary use for Covid-19 infections using concoctions of Jamaican plants. The data were analyzed based on usage and demographics.

Results: The results indicated that crude and purified plant extractives exhibited potent acute and chronic toxicity, antifertility, antifeedant and semiochemical effects on several agricultural pests such as the sweet potato weevil (*Cylas formicarius elegantulus*), the cattle tick (*Boophilus microplus*), coffee pests (*Hypothenemus hampei* and *Leucoptera coffeella*) and the cabbage pest (*Plutella xylostella*). In addition, mode of action studies elucidated the specific physiological pathways of compromised fecundity of *B. microplus*. Formulations developed and tested in open-field cultivation of crops, revealed that the population of *P. xylostella* was kept significantly lower than the control ($P=0.003$). Extracts of Neem (*Azadirachta indica*) also decreased tick population on cattle more than that of control ($P=0.004$). Several crude plant extracts also demonstrated nematocidal activity against threadworm (*Strongyloides stercoralis*), with that of spirit weed (*Eryngium foetidum*) being the most effective. Eryngial, a bioactive patented compound was shown to have a 24h LD₅₀, which was significantly more

effective than that of ivermectin ($P < 0.05$) and also significantly inhibited the bacteria, *Staphylococcus aureus*, *Streptococcus pyogenes* and *Enterococcus faecalis* and the fungi, *Microsporum gypseum*, *Penicillium marneffeii*, *Cryptococcus neoformans* and *Candida albicans*.

A survey of personal accounts of purported treatment and prevention of Covid 19 infections in Jamaica using concoctions/decoctions of Jamaican plants revealed that culinary plants such as ginger, turmeric, garlic, fever grass, orange peel, lime, mango leaves, rosemary, peppermint, moringa, aloe vera, black pepper, onion and eucalyptus oil.

Conclusions: Jamaican plant extracts have immense potential in the agricultural sector, particularly as a tick wash for livestock and in coffee and vegetable production. There are also important applications for pharmaceuticals and treatment of parasites and microbes. Additionally, there is a vast potential for utilizing Jamaican plants for supplements for viral infections, particularly for COVID-19. If managed under an organized national bioprospecting programme, great economic gains could be achieved.

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THE LARVICIDAL ACTIVITY OF A MAGNOLIID SPECIES AGAINST *Aedes aegypti* MOSQUITO LARVAE

Kevon Stewart^{1,2*}, Ruby Lindo³, Sheena Francis^{1,4#}

¹The Natural Products Institute, The University of the West Indies, Mona, Kingston, JAMAICA ²The Biotechnology Centre, The University of the West Indies, Mona, Kingston, JAMAICA ³The Department of Basic Medical Sciences, The University of the West Indies, Mona, Kingston, JAMAICA ⁴Mosquito Control Research Unit, The University of the West Indies, Mona, Kingston, JAMAICA.

Corresponding author: sheena.francis02@uwimona.edu.jm

Background: The *Aedes aegypti* mosquito is the primary vector responsible for the transmission of numerous diseases including: dengue fever, yellow fever, chikungunya fever, and the Zika virus fever. Over 96 million people worldwide are affected by dengue fever alone with as much as 3.9 billion being at risk of infection [1]. The control and management of *Aedes spp.* populations plays an essential role in the reduction of disease transmission. Traditional larval control methods employ synthetic insecticides such as Temephos; however, their efficacy has been waning due to growing resistance. Temephos use is also problematic due to its high toxicity (on non-target organisms) and bioaccumulation potential [2]. Plants provide a rich source of potential larvicidal alternatives and are prime targets for screening for sufficiently effective but less deleterious compounds. This research strongly embodies the second 'R' in this conference's core acronym D.R.I.V.E.R since it represents research in the advancement of the life and health sciences. This work could also form the cornerstone for future work towards development and innovation leading to a Caribbean-born tool increasing our resilience in the fight against global vector-borne diseases. The vision is that entrepreneurial ventures arising from such work will bolster the need for increased STEM education regionwide.

Aims: To screen Magnoliid B for larvicidal activity against *Aedes aegypti* larvae.

Methods: The plant codenamed Magnoliid B was sourced in Jamaica; identified at a local herbarium; ground up using a blender; then subjected to sequential extraction using hexane, ethyl acetate and methanol as solvents. An enriched extract was also prepared after the initial extractions. In both cases, the liquid extracts were concentrated via rotary evaporation then refrigerated until needed.

Third and early fourth instar *Aedes aegypti* mosquito

larvae were sourced from a laboratory strain maintained at the University of the West Indies (UWI), Mona Campus.

For the screening procedure, 3rd and 4th instar larvae were randomly selected and arranged into sets of 15 in triplicate for each concentration. A Total of 5 concentrations (250, 62.5, 15.6, 3.9, and 1 ppm) were prepared for each extract in addition to a negative control. The larvae were immersed in equal volumes of the tested concentrations and observed over a 24-hour period after which larval mortality was recorded as a percentage. Each setup was repeated 3 times on different days and the mortality was averaged.

The standard error of the mean was determined using Microsoft Excel. The data collected was used to generate a graph in Sigma Plot 12.0 from which the LC₅₀ was recorded.

Results: The ethyl acetate sequential extract (SFKS-B2) and the enriched methanol extract (1011 SK) demonstrated the most potent larvicidal activity of the set with LC₅₀ 15.02 ppm and 7.30 ppm, respectively.

Conclusions: Biomolecules in extracts SFKS-B2 and 1011 SK demonstrated larvicidal activity. However, further work is required to determine active constituents and the mechanism of action.

Acknowledgments: We thank the Office of Graduate Studies and Research UWI, Mona for financial support to pursue this project.

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AN EVALUATION OF CHEMICAL PRESERVATION METHODS FOR EXTENSION OF THE SHELF-LIFE OF FRESH-CUT EAST INDIAN MANGO SLICES

Tafara T. Smith*, Andrea Goldson-Barnaby

The Department of Chemistry, The University of West Indies, Mona, JAMAICA

Background: Maintaining quality and shelf-life extension of minimally processed fresh-cut produce has long been an important objective of the post-harvest industry [1]. Development of new products to meet consumer demand for healthy and conveniently packaged food products have challenged food technologists and scientists to identify innovative methods of producing fresh, healthy and safe quality food in support of the industry. The advent and benefits of 'edible coating' in this industry has proven to be effective in not only preserving the biochemical qualities of fresh-cut products, but also its physical and microbial qualities; thus, ensuring an extended shelf-life and the safety of the final product [2].

Aims: The aim of this study was to evaluate the effectiveness of chemical preservation methods for the extension of shelf-life of fresh-cut mango slices (*Mangifera indica* cv. East Indian).

Methods: Five treatments were evaluated to include single and combination treatments of: (i) ascorbic acid (1%), (ii) calcium chloride (1%), (iii) chitosan solution (0.8 g/100 ml, 1% acetic acid) and two sets of combination treatments of (iv) ascorbic acid (1%) + calcium chloride (1%), (v) ascorbic acid (1%) + calcium chloride (1%) + chitosan (1 g/100 ml, 1% acetic acid). Mango slices were dipped in each treatment solution, drained, and then placed in polyethylene plastic double sealed bags on food trays. The trays were refrigerated at 3 °C for up to 15 days. Quantitative analysis for biochemical quality (pH, total soluble solid and total acidity) physical quality (colour and firmness) and shelf-life (microbial counts) of the mango slices were taken at 5 day intervals.

Results: Treatments involving the use of chitosan solution were observed to be the most effective in preserving both the biochemical, physical, and microbial characteristics of the fresh-cut mango slices for the duration of the study.

Conclusions: These results indicate that there was a significant difference in the biochemical and physical qualities and the shelf-life of mango slices treated with chitosan in both mature and fully mature mango slices. Chitosan was found to be the most effective treatment in preserving the quality of fresh-cut mango slices.

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Mr. Winston Chambers. Laboratory Technician, Department of Chemistry, The University of the West Indies, Jamaica

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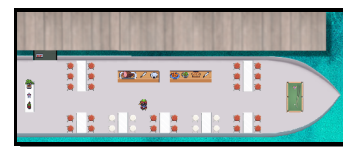
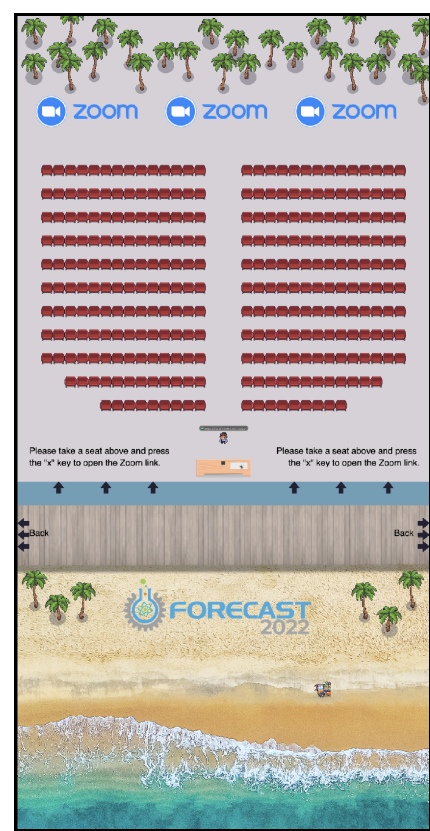
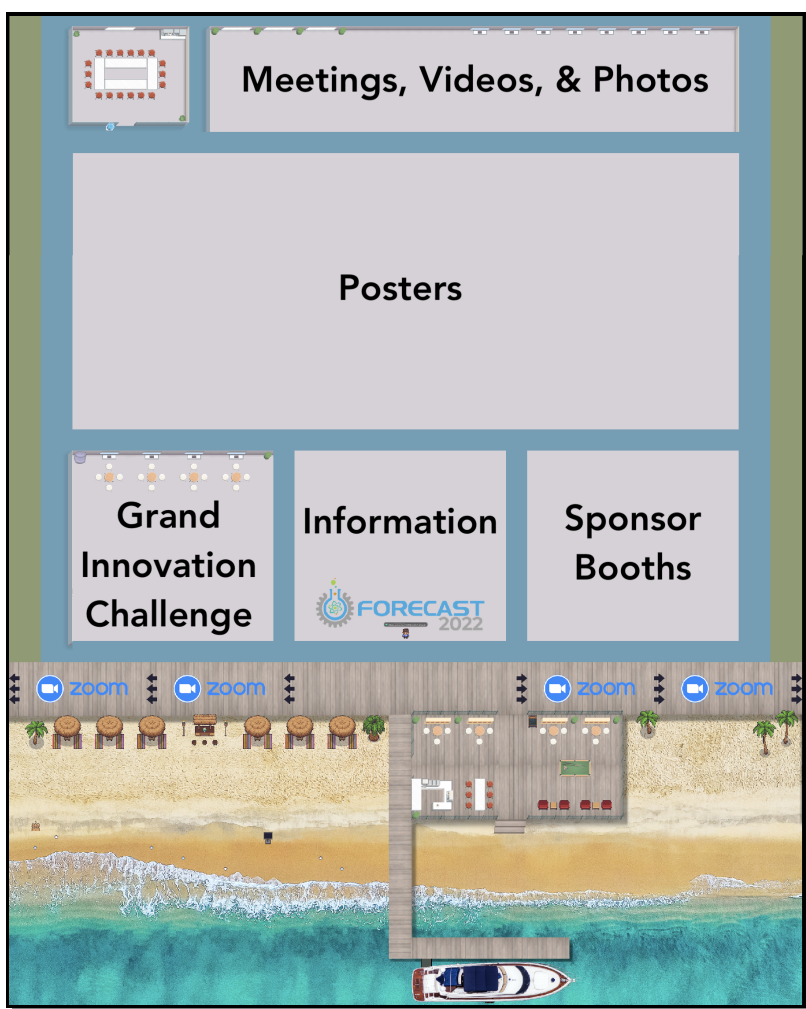
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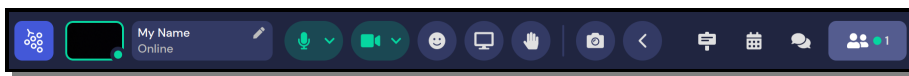
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














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