2020 Education for Sustainable Development (ESD) Okayama Award Winner



UNIVERSITI MALAYA

UM RESEARCH BULLETIN

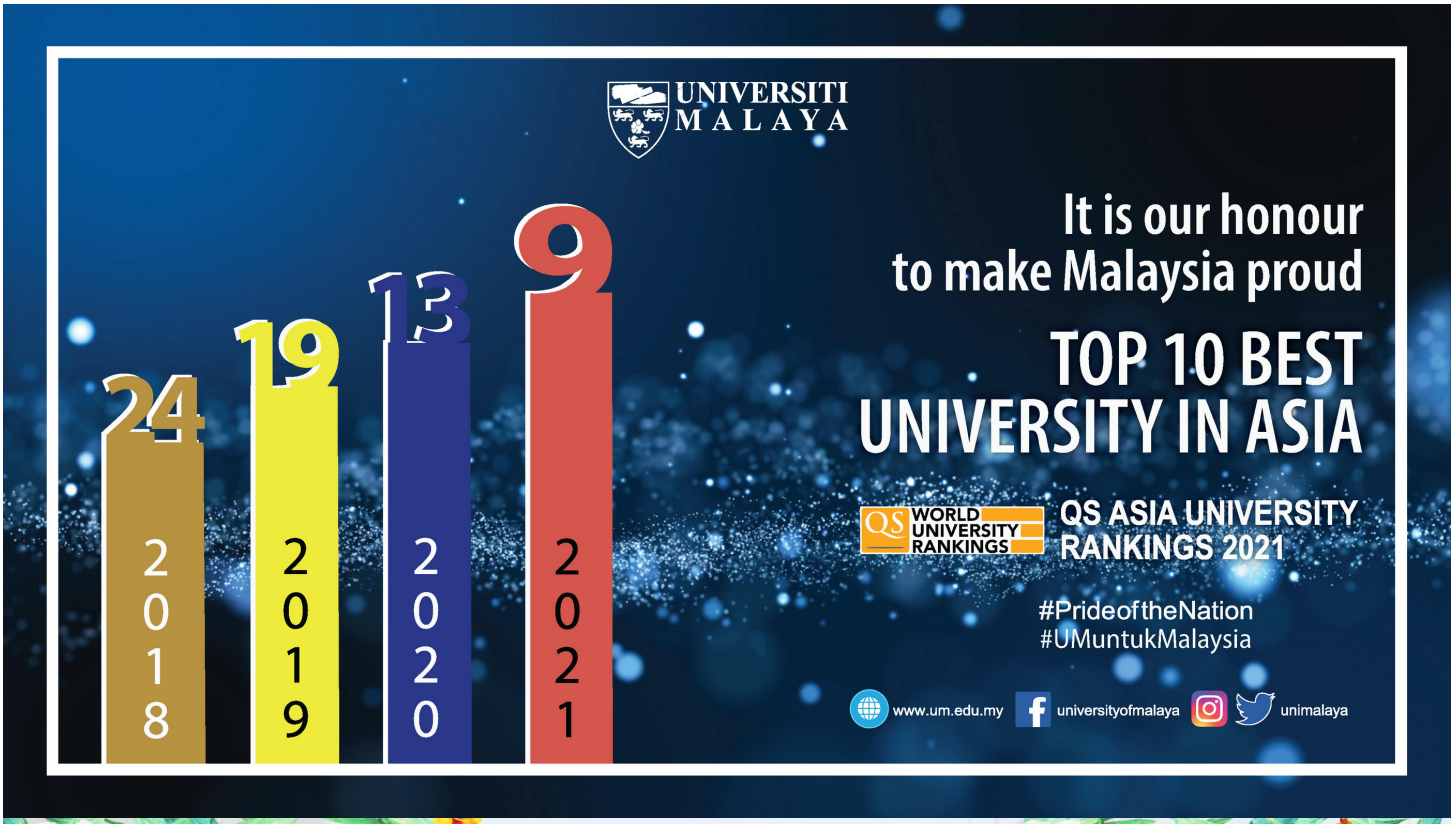
Vol.20 No.2
2020

2020

UM LEAP FURTHER AHEAD:

Top 10 Best University in QS Asia University Rankings 2021

Top 35 World's Most Sustainable University in UI GreenMetric World University Ranking 2020





PREFACE

The recent Quacquarelli Symonds Asian University Rankings (QS-AUR) 2021, UM was ranked at the 9th position amongst the Asian universities in QS-AUR 2021. This puts UM within the top 2% of the 634 Asian universities ranked by QS. UM breaking into the top 10 Asian universities for the first time since the inauguration of the QS-AUR in 2009 is a big milestone for UM. Thank you to everyone involved, directly and indirectly, that has enabled UM to reach this stage. UM is very proud to be with other prominent Asian universities such as the National University of Singapore, Nanyang Technological University (NTU) and Tsinghua University, within the top 10 position of the QS-AUR 2021 ranking.

UM is also proud of the recognitions received by members of our universities for their achievements. Prof. Dr. Ng Kwan Hoong from the Faculty of Medicine was recently awarded the prestigious Merdeka Award under the Outstanding Scholastic Achievement category for his contributions to breast cancer research and medical physics. Prof. Dr. April Camilla Roslani was honoured with the prestigious the American College of Surgeons fellowship, one of only 9 awards given out globally this year. Prof. Dr. April is the only woman and Malaysian amongst those awarded with the fellowship this year. Prof. Dr. Adeeba Kamaruzzaman takes on the responsibility as the President of the International Aids Society, the first Asian to be elected as the president of the society. This year, four of our researchers are elected fellows of the Akademi Sains Malaysia (Malaysian Academy of Sciences, ASM). They are Prof. Dr. Misni bin Miran FASc. (Chemistry), Prof. Dr. Hany binti Mohd Ariffin FASc. (Medicine), Prof. Dr. Faisal Rafiq Mahamd Adikan (Engineering) FASc. and Datuk Emeritus Prof. Dr. Norma binti Mansor FASc. (Social Science). Three other researchers, Prof. Dr. Loo Chu Kiong (Faculty of Computer Science & Information Technology), Assoc. Prof. Ir. Dr. Ching Yern Chee (Faculty of Engineering) and Dr. Goh Boon Tong (Faculty of Science) received the Malaysian Top Research Scientists (TRSM) Award from ASM. Kudos to all of these excellent researchers. Congratulations also to the many others who received awards and recognition, both nationally and internationally.

The year 2020 has been difficult for many of us with the CoVID 19 pandemic forcing most of us to review our normal day-to-day activities. It has taken a toll on our research activities as well. However, with all darkness, there is always a silver lining. Many researchers have learned to adapt and venture into territories that they have not considered before, creating novel innovations that are beneficial for the community. One example of such innovation is the CoVid-19 Symptom Monitoring System or CoSMoS, developed by our researchers from the Faculty of Computer Science and Information Technology together with the research from our Faculty of Medicine to help our clinicians to monitor their patients at home. There are many more innovation and exciting challenges out there that our researchers can assist with, despite the difficulties of restricted movement.

We pray for a better 2021, and that everything will return to some semblance of normalcy. Meanwhile, UM will continue to deliver excellence and hopefully, make the nation proud.

Thank you and Happy New Year everybody.

Professor Dr.Noorsaadah Abd Rahman
Deputy Vice-Chancellor (Research & Innovation)

UM Research Bulletin Vol. 20 No. 2 Issue of 2020 showcases one of the many UM award-winning projects, the longest running and pioneer UM Living Labs project on ‘Empowering Communities for Food Waste Recycling and Sustainable Urban Farming’ led by Professor Dr. Sumiani Yusoff bagged the international coveted Education for Sustainable Development (ESD) Okayama Award 2020. In response to the problem of food/solid waste management, UM Zero Waste Campaign kick-started in year 2019 has now grown into a living lab with a multi-prong solutions to address the issues of solid waste management on campus.

The University's efforts to make the campus as one of the most sustainable universities in the world has also been recognized in her recent achievement of the 34th World’s Most Sustainable University in Universitas Indonesia GreenMetric (UIGM) World University Rankings 2020. Congratulations and thank you to the whole UM community for our latest best achievement in the 2020 UI GreenMetric Rankings and 2021 QS Asia University Rankings. We managed to hold our identity as the country's leading university in research, teaching, learning and the empowerment of the community, in line with the nation's aspiration to create a higher education system that ranks among the world’s leading higher education systems and enables Malaysia to compete globally. Of course, we will never be able to do so without your contributions.

Here's wishing you a pleasant closure to 2020 and a prosperous year ahead for 2021. Keep well and stay safe!

Professor Dr. Shaliza Ibrahim CEng FIChemE
Associate Vice-Chancellor (Research and Innovation)

EDITORIAL MESSAGE

Dear readers,

It is our pleasure to present the latest publication of UMR Bulletin (Volume 20, No. 2). Our goals are to create a platform for information exchange on all aspects related to research, covering the science and non-science research projects, as well as to encourage the dissemination of the knowledge to a broader audience. To achieve these, we strive to keep you updated on the current and continuous breakthroughs/contributions made by UM researchers, by giving you inside stories on their development and directions, plus introducing and highlighting our researchers and experts in each article.

Thus, we welcome you to submit original research write-ups with related images/photos of studies run by UM researchers. We hope that UMR Bulletin develops into a respected publication that is able to link external partners with our experts for any kinds of service or collaboration, that will ultimately enable us to transform our research into public consumption.

Our success entirely depends on your response. Thank you for providing us with your continuous feedback and support.

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MALAYSIA'S MEDICINAL GEM – THE TIGER MILK MUSHROOM



The tiger milk mushroom has long been extolled for its medicinal properties and has been used for the treatment of asthma, cough, fever, cancer, liver-related illnesses, and joint pains and as a tonic. The history of usage for tiger milk mushroom dated back to almost 400 years ago. With the advent of cultivation success of one of the most utilized species of tiger milk mushroom (*Lignosus rhinocerus*) in 2009 (termed TM02®, filed in 2011 under the **New Plant Variety Protection (NPVP) of Malaysia**, recognizing the cultivated variety as a distinct in comparison to that of the wild type), scientific investigation was subsequently done to validate its traditional use and to investigate its safety for consumption and biochemical and biopharmacological properties. As of September 2010, the Tiger Milk mushroom has since been listed under the **traditional medicine active ingredient list in the Malaysian National Pharmaceutical Control Bureau**. Prior to moving forward into the investigation of the bioactivity of *Lignosus rhinocerus*, Dr. Fung Shin Yee and her team won the **ITEX Gold medal** for the work on pre-commercialization of *Lignosus rhinocerus* and was also awarded the **Prix Du Salon International Des Inventions De Geneva, Salon International Des Inventions De Geneva** in 2011 for the pre-commercialization work on *Lignosus rhinocerus*.

Since the inception of scientific research into the cultivation of *Lignosus rhinocerus* to the bioactivity of the mushroom extracts, our research group has revealed various relevant, solid data that supports the translation of our scientific data (anti-inflammatory, anti-proliferative, antioxidative, anti-glycation and immunomodulatory) to practical use and have been patented. We have identified the extract and fraction from TM02® that plays a role in **anti-inflammatory, anti-proliferative, antioxidative, antiglycation and immunomodulation**. In view of the various discoveries made, TM02® was awarded the **Malaysia Health & Wellness Brand Award** in

2017. The medicinal use for Tiger Milk Mushroom for respiratory ailments is also currently undergoing the UM accelerator programme (UM Deep Tech, UMDT) to be marketed as xLr, the extract of Tiger Milk Mushroom.

Further investigations on the various metabolic pathways on which the bioactive fraction and/ or the bioactive molecules from *Lignosus rhinocerus* exerts its bioactivity is underway; which will form a basis to drugs discovery; reduce the extract molecules to nanoparticles using up-to-date nano-technologies and/or liposomes to ease absorption orally or topically. We are also in the midst of discovering novel molecules from the genomes of *Lignosus rhinocerus* and two other closely related species of *Lignosus*, namely the *Lignosus tigris* and *Lignosus cameronensis* which are also native to Malaysia. From our preliminary studies, we have discovered that these two species are new, distinct species (morphologically, these species looked almost similar but upon detailed inspection were found to have differences in their pore and basidiospore sizes). We also look forward to exploring the health maintenance of all citizens of the world using this medicinal gem from Malaysia. Our preliminary shows that *Lignosus rhinocerus* has the capacity to immunomodulate our immune system, rendering an increasingly healthy body. This is especially important as the environment (including air) around us is increasingly deteriorating leading to various symptoms and diseases.



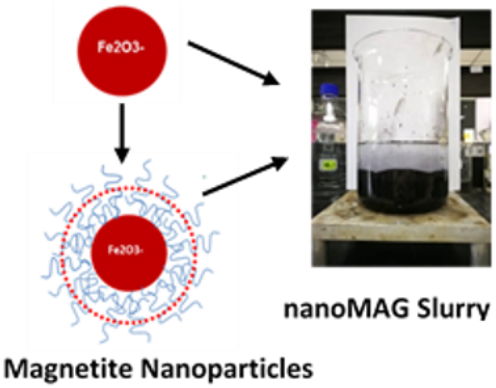
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MODIFICATION OF EXISTING NITRILE LATEX WITH IRON OXIDE NANOMATERIAL



NBR gloves are used extensively in food and pharmaceutical industries to avoid contamination of the products being handled. However, poor elasticity of NBR may cause small pieces of the glove torn away during manufacturing and get mixed with the products. A small piece of glove contamination can result in a recall of an entire production run and potential lawsuits. For those that keep track of food recalls, “glove contamination” is an all-too-familiar phrase. Ensuring effective measures to prevent contamination of food products is a major concern for food manufacturers. Not only do contamination accidents require production line stoppages and incur huge costs, but they also involve a vast amount of time and money to regain consumer trust and rebuild a shattered brand image. Since ordinary gloves cannot be detected by metal detectors, finding a solution to glove contamination issues has been a challenge for a long time. One solution of the above problem is the use of magnetic detectable gloves that can be made from various magnetic mineral materials such as iron oxide, or metals such as steel, lead, silver and chromium. Most of these gloves are made by incorporating a proportion of a magnetic material which is present throughout the whole product. The size and concentration of magnetic material are intended to allow a homogeneous amount of the material throughout the glove, thereby attempting to ensure that all parts of the glove are potentially detectable by a detector. Thus, there remains a need to provide improved magnetic gloves that provide more sensitivity in detection, while remaining wearable by an end-user.







Nanotechnology and Catalysis Research Centre (NANOCAT) has partnered with Hartalega Sdn Bhd to develop and commercialise nanomagnetite metal detectable nitrile gloves. Torn pieces of this product can be detected by metal detectable equipment down to sizes of 3mm x 3mm. The core of the project is based on the development of technology to make the gloves detectable in the electro-magnetic field by doping the NBR latex glove with super-magnetic iron oxide nanoparticles (nanoMAG). To fulfil the production of the need of industrial counterpart (Hartalega Sdn Bhd), a UM research team under the supervision of Prof. Rafie Mohd Johan and Dr. Leo Bey Fen has designed a semi-automated pilot plant located at the UM Research Incubator Building.



Internal View (left) and External View (right)

This pilot plant with a capacity of 300 L can be estimated to produce 100 kg of nanoMAG per batch capacity per day. These nanoMAG additives will then be further processed by Hartalega to produce approximately 200,000 pairs of gloves per day as requested by its Japanese customers, Midori Anzen (Japan). The potential for such a glove is significant not only for Japan but on a global scale. Hartalega being an export-based manufacturer would want to innovate and deliver the next wave of innovative nanoMAG gloves for the food processing and handling market. Currently, NANOCAT is exploring the applications of nanoMAG with various industrial partners.

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RAPID DIAGNOSTIC TOOLS FOR COVID-19



Following the announcement of COVID-19 pandemic, several real-time reverse transcription-polymerase chain reactions (qRT-PCR) methods have been developed for detection of the virus. But the currently available tests do not provide the kind of rapid result that is needed to isolate people before they can pass on the virus. Testing has become central to the discussion about how to best tackle the current coronavirus pandemic. Frequent and broad testing is highly recommended to identify infected patients and stop its spread by isolating them.

In response to this, University of Malaya have lifted their capabilities to develop solutions to the COVID-19 pandemic in collaboration with the Hospital Sungai Buloh focusing on the development of rapid diagnostic tools for the virus. These efforts are based on research projects and competencies established over the years by Prof. Dr. Lau Yee Ling and her Postdoc, Dr. Lai Meng Yee (Picture). They have been working in close contact with the team under Dr. Kalai from Clinical Research Centre, Dr. Afifah from Pathology at Hospital Sungai Buloh and Dato Dr. Goh from Institute of Clinical Research (ICR), to develop a novel rapid test that would greatly simplify the virus detection process.

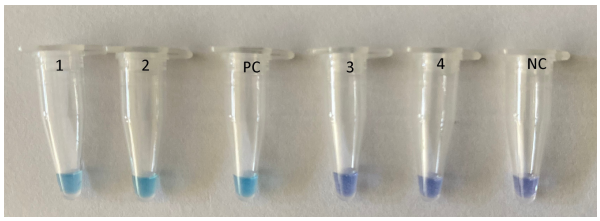


Fig 1: Assessmend of RT-LAMP results based on hydroxynaphthol blue visualization of color change.

A positive reaction indicated by sky blue colour is seen in tubes 1-2 and the positive control (PC), while a violet colour indicates a negative reaction in tubes 4-5 and the non-template negative control (NC).

A rapid, sensitive, and specific real-time reverse transcription LAMP (RT-LAMP) assay was successfully developed for SARS-CoV2 detection. This assay detected the virus in 30 mins by using a simple incubator (Figure 1). Forty-seven qRT-PCR positive and 42 qRT-PCR negative RNA samples extracted from nasopharyngeal swabs were tested. The RT-LAMP showed comparable performance with real-time qRT-PCR. Real-time qRT-PCR typically takes at least three hours, whereas the new test only needs 30 min. Combining simplicity and cost-effectiveness, this assay is, therefore, suitable for use in resource limiting settings. This method is very sensitive and can diagnose infected patients even in the early phase of the disease. Their work has been successfully published in an international journal and a patent has been filed (Filing No.: PI 2020002230).

“Our goal is to produce a cheap, near-instant test kit that anyone can use. Further optimization involving direct nasopharyngeal swabs without RNA extraction will be conducted if the project is funded.” Prof Lau.

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SOCIAL MEDIA, GOT ETHICS? A COMMUNITY SERVICE SUPPORT



In promoting social media ethics awareness, a community service support project was conducted at Pustaka Raja Tun Uda (RATU), Perbadanan Perpustakaan Awam Selangor (PPAS), Shah Alam, Selangor from 6 - 9 December 2019.

The information service project was conducted to fulfil the graduation requirement for Master of Library and Information Science (MLIS) program offered by the Faculty of Computer Science and Information Technology (FCSIT), University of Malaya. The project has set up a dedicated booth in the RATU library to provide information service to promote awareness on social media safety and privacy for parents and children. There were various activities conducted during the 4 days event such as tagging online safety, pick the 'social media ethics egg', online games, and tips for parents/guardians. The community project has attracted the participation of 53 parents and 74 children (10-17 years old). This research project has constructively contributed to the development of postgraduate external programmes/ activities. It has given an opportunity for the student to engage closely with the community and enhance student's learning process and experience.

"I think it's great for kids' knowledge and for me as a parent, it's really good."
Linda (Pseudo name is used)

"Such studies are very important now because most parents are now starting to allow their children as young as 7 to interact with social media… This study in my view reflects the current situation."
Rosenita (Pseudo name is used)

"this community project initiative was very good and that it may extend to some form of education that can be incorporated into the subject of schooling."
(Unit Perkhidmatan Perpustakaan RATU, PPAS)

"It's a valuable experience throughout my journey in doing MLIS programme here."
(MLIS student)

Video on the community service support project could be viewed at https://www.youtube.com/watch?v=1Y96ZrELYvY&t=197s



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SMART SELF-CLEANING GLASS: PRODUCE ENHANCEMENT CLEANING FOR GLASS

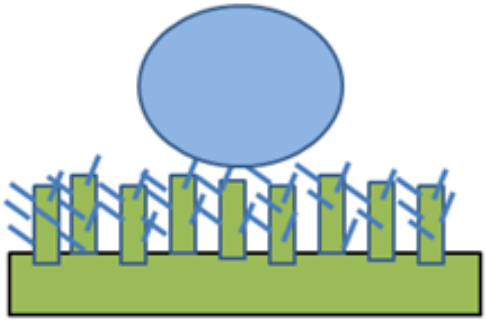


Fig 1: The lotus leaf structurecleaning coating

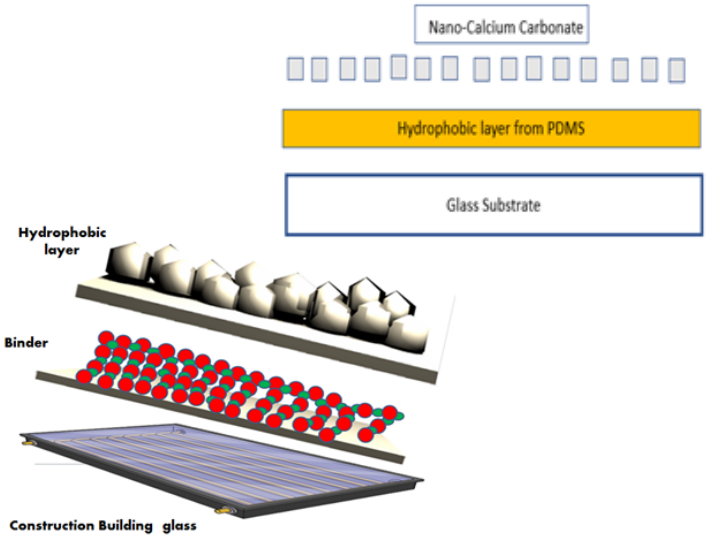


Fig 2: The structure of smart self-cleaning coating

Majority of building glass, automotive glass and solar photovoltaic (PV) panel are impacted by dust and dirt particles which causes deep water-mark on glass surfaces. This deep watermark is stubborn and requires polishing using chemicals such as buffers and is time-consuming. The polishing method can remove 50-70% of watermark only. The dust accumulation causes more power loss in the PV panel each year and hampers the electric generation in the solar farm. Fog on the automotive car-windscreen would disturb the driving vision and always require ineffective air-conditioner control. Under a harsh environment, the heavy fog would cause a fatal accident to drivers. Aside from that, the continuous moisture from fog especially at cold places stimulates the growth of mould and fungi on the building glass. As a result, the building glass becomes dirty and dusty, promoting irrevocable damages to the structures and facade.

The smart self-cleaning glass is a waterproofing formulation developed which are produced by using advanced nano-calcium carbonate and polydimethylsiloxane (PDMS) polymer. The advanced materials providing long-lasting effective water-repellent on any glass and plastic surface such as tempered window glass, acrylic, polycarbonate and etc. The water-repellent properties are inspired with lotus leaf effect where the water droplets are suspended on its surface. This is because the lotus leaf consists of micro-and nano-papillae which forms a large barrier against water.

As shown in Figure 2, this technology is designed with small nanostructures which prevent the penetration of dirt and dust into the capillaries and create a durable anti-dust surface. The anti-dust surface forms spherical water droplets which rolling-off or sliding the dust particles away from the coated surface. This self-cleaning hydrophobic coating offering easy cleaning maintenances and keeps the glass panels stay clean for a longer period. The polymer compounds reduce the surface tension within nano-capillaries, keeping away the dirt and organic particles from the glass substrate. Several micron-

sized particles will not be attached on the glass surface and blown away by strong wind easily.

Small nanoparticles also can protect the glass surface against fog and moisture. As the surface was highly hydrophobic, the coating prevents the moisture penetration into substrates and sustain the durability of coating against heat, cold weather and UV light as well. The durability of polydimethylsiloxane (PDMS) is contributed by its strong siloxane bond. The chemicals bond is not degraded under heat or UV-light, resulting in long-lasting protection against rain and humidity. Incorporating the nanoparticles as the second layer, the coated surface guaranteeing extra-ordinary durability through van Der Waals reaction. As shown in Figure 3.0, the polydimethylsiloxane (PDMS) forms a strong hardness characteristic imposing great resistance against scratch and mechanical abrasion. The hardness characteristic of a coating system can prevent permanent scratch mark on the exterior glass panel and automotive glass. Unlike the conventional hydrophobic water-repellent coating, the smart self-cleaning coating can sustain the mechanical scratch hardness up to 5N leave no trace of the coating failure point. The scratch-resistance coating is useful to protect the car-windscreen against road debris, stone chips and wiper from the real environment.

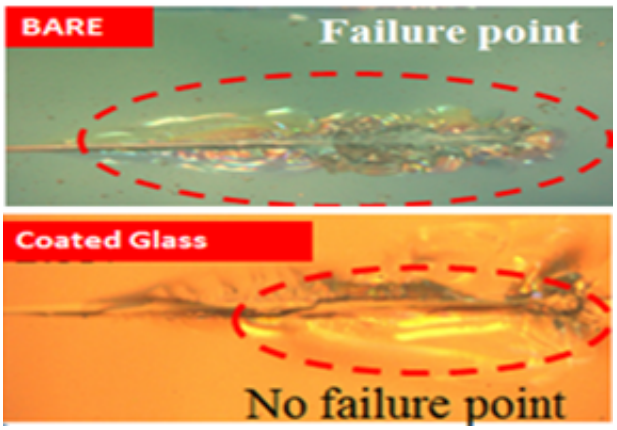
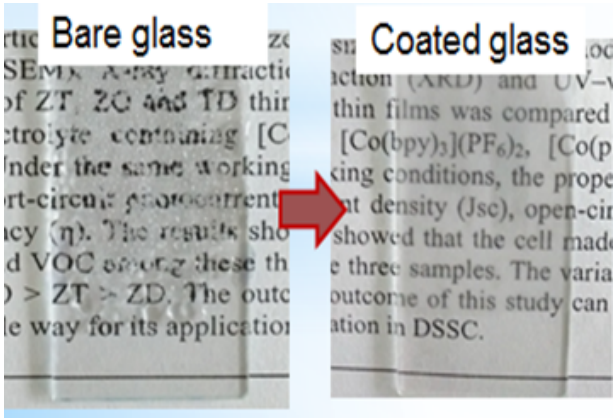


Fig 3: The scratch-resistance of coated glass surface

In conclusion, the smart self-cleaning coating is developed to provide great protection on the glass substrate under prolonged real environment. At the same time, the coating systems can conserve the value of the property and sustains the green energy efficiency of the photovoltaic panel (PV).



The anti-fog coated glass surface



MTE 2020 Gold and Best Research Award
for SMART SELF CLEANING Building Glass

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EMPOWERING COMMUNITIES FOR FOOD WASTE RECYCLING & SUSTAINABLE URBAN FARMING – UM ZERO WASTE CAMPAIGN



Universiti Malaya Zero Waste Campaign (UM ZWC) – the longest-running and pioneer UM Living Labs project in Universiti Malaya was incepted in 2009. In response to the problem of solid waste management in campus, UM ZWC kickstarted with a goal of diverting and reducing waste generated from going to the landfills. What initially began as a student-initiated campaign earned sponsorship from CIMB Foundation and curated to a campus-wide project with the ultimate goal of zero waste campus status. Today, the ZWC Centre located off the Damansara Gate Universiti Malaya with the container-reuse concept, established an in-house composting technology which has now grown into a living lab with a multiprong solution to address the issues of solid waste management on campus.

UM ZWC is established with four main objectives: 1) to develop policy and innovation system to divert solid waste from disposal in landfill for resources and energy recovery; 2) to streamline recycling activities and strategize efforts to increase recycling rate; 3) to create awareness and inculcate the best practice of waste separation at source among the campus community; and 4) to form a strategic partnership with various stakeholders in order to develop the integrated waste management system.

UM ZWC since 2009 has been actively promoting food waste recycling to be converted to organic compost via anaerobic digestion of Takakura Composting technique which now becomes a sustainable source of income generation for the University by uplifting values on food waste which are in abundance composition of our daily waste generation; about 40 to 60 per cent of waste composition in average. Since its inception in 2009, UMZWC has generated more than RM41,000 income from the sales of organic compost, training and organic vegetable sales

while offsetting a total of carbon emission of 5,341,576 kg CO_2-eq. The carbon emission offset from this initiative is equivalent to carbon sequestered by 88,234 tree seedlings grown for 10 years or greenhouse gases emission avoided by 1,817,000 kg of waste recycled instead of landfilled (source: https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator). The key solution in addressing this issue is through waste separation at source (SAS) with the introduction of UM Policy on the Banning of Single-Use Plastics and Food Waste Separation at Source for all food premises in UM in early 2019.

The initiative then expanded to sustainable urban farming with the adoption of a Circular Economy approach in 2019 by empowering communities for food waste recycling. UM ZWC Urban Garden off Damansara Gate UM is a living proof that by minimizing and closing the loop of waste from ending up in landfills, serves a better purpose of optimization of converting waste to resources, which eventually be used for the benefits of growing and maintaining the Urban Garden.





UM ZWC via strategic participation of UMCares – The Community & Sustainability Centre, in particular, the Malaysian Research University Network (MRUN Zero Waste Movement in Urban Poor Community Urban Farming) has reached out to the Lembah Pantai Community with support of YB Fahmi Fadzil, Member of Parliament of Lembah Pantai. Several communities in Lembah Pantai have been engaged with the aims to promote knowledge and practical technical know-how on food waste recycling and sustainable urban farming; P20 Pantai Dalam and Bayview Court 1D Apartment of Taman Seri Sentosa communities. Sustainable Urban Farming of Taman Seri Sentosa famously known as Kebun-Kebun Sentosa is now a third Urban Garden in Lembah Pantai. This initiative put forth the community empowerment as the epicentre of the project within a systemic support system of Unversiti Malaya's experts from various backgrounds in joint collaboration of Kuala Lumpur City Hall (DBKL) and Solid Waste and Public Cleansing Management Corporation (SWCorp) Kuala Lumpur.

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A RESEARCH PARADIGM IN CROP GENETICS: EN-ROUTE TO A SUSTAINABLE FUTURE

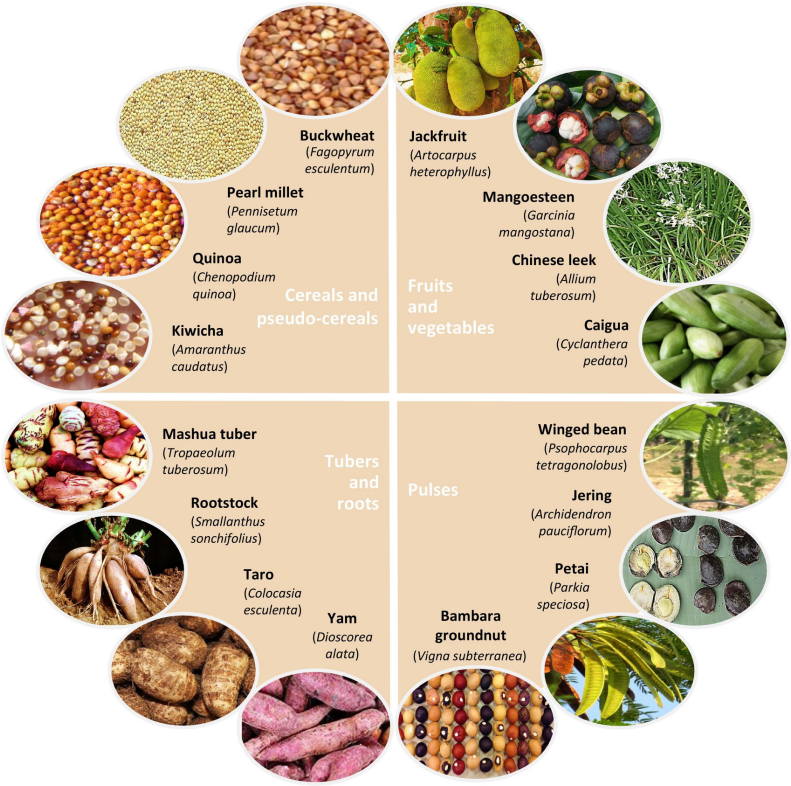


Fig 2: Examples of potential underutilized species

The United Nations has developed a blueprint to build a sustainable future for all, or known collectively as the sustainable development goals (SDGs) as a universal call for action to protect our Mother Earth, eradicate poverty and hunger, and ensure the well-being of mankind.

Agriculture, the largest user of natural resources such as land and water in the world, plays a key role in helping to achieve the SDGs.

Today, the contents of a typical food basket worldwide are limited to a small number of crops, with the 'big three' kinds of cereal (rice, wheat, and maize) accounting for more than 60% of the world's calories. The global yields of these cereals had skyrocketed to at least double average yields through a step-change in agricultural practices, better known as the Green Revolution which was launched in the 1960s. However, the revolution has spurred some negative consequences, especially in inducing ubiquitous monoculture systems that can increase the vulnerability of global agricultural systems to climate variability. A new paradigm of green agriculture, where fewer resources and more smart farming techniques are used to grow crops, is required in the 21st century to feed the ever-growing population in the midst of climate change. For example, in the case of rice, several plausible strategies to achieve its sustainable production have been identified recently by our research team (Figure 1). Rice is a dependable staple for more than half of the world's population, including our local population. Through the lens of science, rice is an excellent model species for crop genetics research mainly due to its relatively small genome size (~430 Mb). Nonetheless, recent findings indicate that genetically improving



Sustainable rice production at Greenhouse, LSU AgCenter, Louisiana State University



Fig 1: Plausible strategies to achieve sustainable rice production

rice and other major crops alone would not be sufficient to feed the rapidly growing population mainly because these crops generally are unsuited to hostile weather patterns and low-input environments.

During the last decade, one of the primary strategies for sustainable agriculture is by unlocking the genetic potential of underutilized (or orphan and neglected) crops, from nutrient-packed ancient cereals, such as quinoa and millets, to the poor man's pulses such as winged bean and bambara groundnut (Figure 2). These crops can help to shape a more diversified global agricultural and food system, holding great promise for future livelihoods. One of the promising ways to instil resilience in major crops with narrow genetic backgrounds is by introgressing alleles from the germplasm of suitable underutilized species that harbour novel genes responsive to various biotic and abiotic stresses. Genetic and genomic resources of many potential underutilized species are currently being exploited by our research team to improve certain major crops, notably rice, through the identification and transfer of desirable alleles or traits. The broader adoption of hardy and versatile underutilized species can also benefit the environment. For example, by growing underutilized crops that are naturally resistant to certain pests or diseases, certain harmful chemical pesticides can be avoided.

Scepticism surrounding crop diversification by various parties, including some researchers, is understandable given that millions of lives were preserved by only a handful of crops during the inception of the Green Revolution. Developing and using underutilized crops may not save the world overnight, but their ability to survive the changing planet clearly indicates that they are worthy to be explored. Nevertheless, a concerted global effort is crucial to unleashing the full potential of these crops, especially when the possibilities are endless with recent advances in agricultural biotechnology.

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INFORMATION HIDING – PROTECTING YOUR DIGITAL FILES IN A MODERN WAY

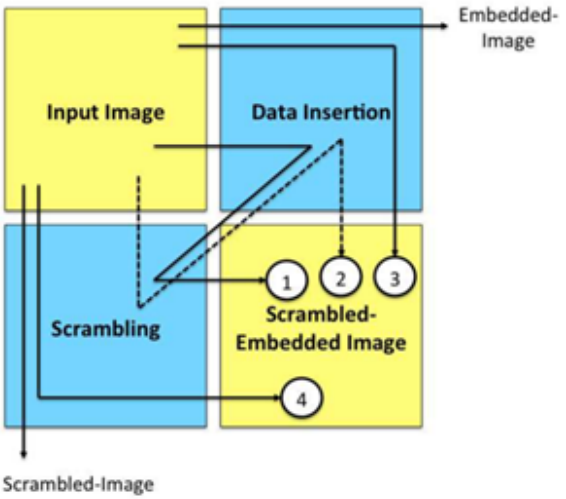


Fig 1: Information Hiding Unification Framework

Let's start by asking ourselves the following question: "Do you share your picture or document online?" If the answer is positive, ask yourself the next question: Did you *protect* these digital files?

Most of us will share the same answer - *no*. We often assume that we *will be fine* if we set the *privacy setting to private*. But, does this assumption hold true all the time? Realistically said, once you shared your phone online, it will exist online *almost forever*, even after you deleted it later.

If we do not protect our digital files (e.g., document, pictures, email, etc.) when we are sharing, transmitting and storing it online, the consequences can be disastrous. Infringer might take or steal your digital files and misuse them to ultimately gain financial benefits via identity theft, copyright infringement, etc.

Information hiding is one of the prominent solutions when it comes to digital files protection. It is divided into two major disciplines, including encryption and data insertion. Encryption conceals the perceptual view of the digital files by making it unintelligible while data insertion embeds additional information (e.g., watermark, metadata) into it. In recent years, techniques from both disciplines were often integrated to complement each other in creating a well-rounded protection scheme. Apart from inserting identification/authentication data in protecting the copyright of the digital files, encryption is added to transform the file in ensuring secure transmission/storage via the Internet or cloud.

In the year 2011, Ong et al. proposed a general unified framework to discuss all possible categories in integrating both disciplines (refer to Fig. 1), including i) ETS (Embed-Then-Scramble), ii) STE (Scramble-Then-Embed), iii) E2S (Embed-To-Scramble) and iv) S2E (Scramble-To-Embed). The first two categories are the commonly proposed one, by realizing this unification using two distinct techniques in a single method. The latter two categories aim at extending a single technique to enable both functions in multiple scales. By using the predefined parameter in I2E or E2I methods, the user can flexibly adjust from enabling single functionality to the maximum extends of dual functionalities (i.e., maximum data insertion with maximum encryption).

Besides, our research group also focusing on proposing novel methods in data insertion. One of the obstacles of the uncommon usage of these techniques is usability. In a normal scenario, whenever a user wants to add watermark into their images, the user needs to download a tool and learn to use it. What if we can integrate watermark into photo effects or



Fig 2: Data embedding using various photo effects.

image enhancement techniques. This research idea assumes that most of the user will enhance their images before they upload or transmit them online. Hence, our group came out with several novel ideas based on this assumption. We refer the interested reader to Fig. 2 for data embedding using photo effects (i.e., Halftone, Vintage and Sketch Effects) and Fig. 3 for data embedding using an image enhancement technique.

On another direction, we push the boundary of information hiding by proposing coverless data insertion. Conventional data hiding suffers from multiple passive and active attacks due to the use of cover (i.e., the carrier or the original media). Thus, to prove this hypothesis, we propose a novel coverless data hiding technique using pattern synthesized image. It generates a pattern image (see Fig. 4) using only the secret data provided by the user.

There are many more problems to be solved in Information Hiding area in the user and technical research perspectives. Apart from the aforementioned works, our research group also conduct researches in image, signal, video processing and their relevant applications. Kindly contact us for any questions or interest for collaboration.

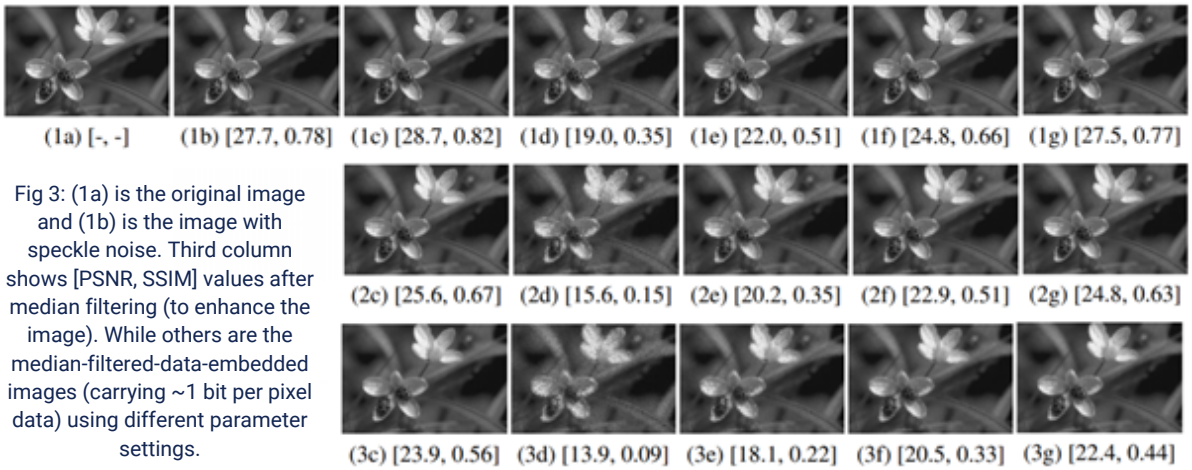


Fig 3: (1a) is the original image and (1b) is the image with speckle noise. Third column shows [PSNR, SSIM] values after median filtering (to enhance the image). While others are the median-filtered-data-embedded images (carrying ~1 bit per pixel data) using different parameter settings.

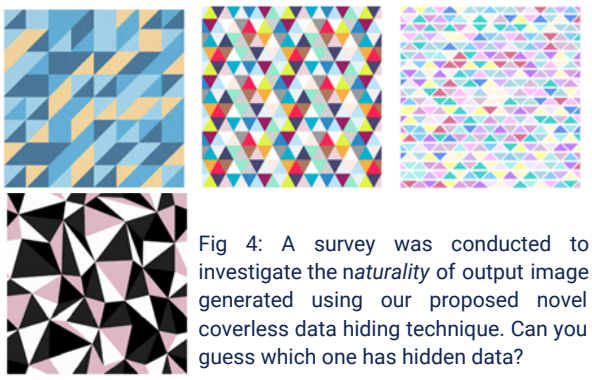


Fig 4: A survey was conducted to investigate the n*aturality* of output image generated using our proposed novel coverless data hiding technique. Can you guess which one has hidden data?

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NATURAL WASTE SHELLS FROM AQUACULTURE: A VALUABLE CALCIUM-RICH BIOMATERIAL FOR BIOFUELS SECTOR



Fig 1: Clam shell wastes from marine aquaculture activities. Source: CCTV news

Did you know facts about the calcium carbonate ($CaCO_3$) makes up 4% of the composition in the earth's crust. It is a common chemical compound found in the rocks as mineral calcite and aragonite, that occurring naturally as chalk, limestone, or marble. Apart from this, $CaCO_3$ is the main component (at least of 95%) for mollusc shells from aquaculture and seafood industries, such as oyster, mussel, clam, scallops, cockle, mud crab shells etc. (Fig. 1). Malaysia is one of the lead producers of bivalve mollusc with about 4% of the total bivalve mollusc production among Asian country. Normally, the mollusc shells are collected, and the flesh is sold for human consumption as an ingredient of food dishes in the restaurant. The shell has no practical use and is usually thrown out as waste material. Most of the waste shells are disposed in landfills or dumped at sea without any processing, as it was traditionally useless. While a small amount of the waste shells will be applied as a moneymaking by-product like handicraft or souvenir.

Thus, a research study in transforming natural waste shells as a valuable calcium-rich biomaterial for the aspects of circular economy and sustainable development is in progress. One of the potential applications proposed by Dr. Lee from Nanotechnology and Catalysis Centre (NANOCAT) is the re-engineering chemical structure of $CaCO_3$ in waste shells to calcium oxide (CaO) or calcium hydroxide ($Ca(OH)_2$), which act as green-type of solid base catalysts for biofuel sector. Utilization of natural waste shells as a renewable precursor for catalysts synthesis could reduce the disposal of aquaculture residues with a concern of earth-friendly as well as cost-effectiveness catalyst for biofuel production.

Dr. Lee's team has successfully developed various calcium-based catalysts from natural waste shells for biofuels (biodiesel and renewable diesel) production. The natural waste shells-derived CaO catalyst renders superior characteristic as conventional CaO in

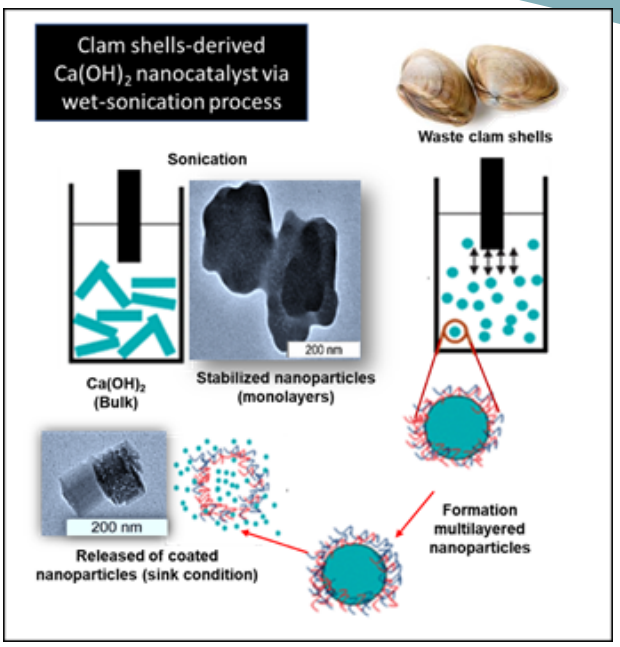


Fig 2: Clam shells-derived Ca(OH)2 nanocatalyst

basicity that offers a wide range of catalyst reactions such as transesterification and cracking-decarboxylation process. The team able to develop modified $Ca(OH)_2$ nanoparticles from clamshells with enhanced physico-chemical properties such as nanoparticle sizes, high surface area and strong basic strength distribution of active sites (Fig. 2). Clam shells-derived $Ca(OH)_2$ in nanostructured showed excellent transesterification reactivity under mild conditions and short reaction time with ~ 98% of palm-based biodiesel (fatty acid methyl ester) (Fig. 3).

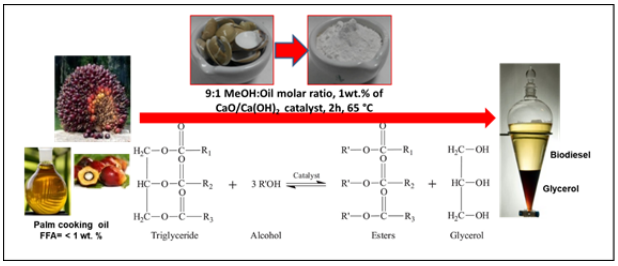


Fig 3: Transesterification of plant oil into biodiesel by using clam shells-based catalyst

The modified $Ca(OH)_2$ nanocatalyst catalysed transesterification process helps generate high quality of biodiesel that competitive with petroleum diesel. Other than biodiesel, renewable diesel (hydrocarbon fractions) was successfully prepared via deoxygenation process in the presence of $Ca(OH)_2$ nanocatalyst, as well as transition metals, modified CaO that derived from natural waste shells. The deoxygenation process is one of the important reaction pathways to produce petroleum-mimicked biofuel with desirable n-C_{17} hydrocarbon fractions via removal of oxygen moieties from plant oil in the form of CO_2 and CO. The $Ca(OH)_2$ catalysed reaction indicated higher content of liquid hydrocarbon (n-C_6-n-C_{24}) with high H/C and low O/C ratio that shown comparable fuel performance with petroleum-based diesel (Fig. 4).

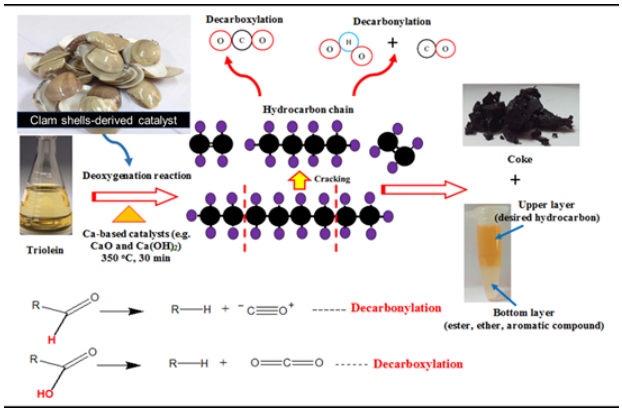


Fig 4: Deoxygenation of plant oil into renewable diesel by using clam shells-based catalyst

In summary, utilization of calcium-rich natural waste shells in biofuels production could effectively induce practice of waste recycling, proper waste management in aquaculture and seafood industries, reducing contaminants in biofuel products, low-cost with the eco-friendly biomaterial, and the sustainable catalytic process by using a green catalyst. The team hopes to continue to develop new-types of calcium-based catalysts from potential natural waste shells that can improve the catalytic reactivity of biofuel process, while mean time is applicable for various type of oil feedstock (from edible to non-edible ranged of biomass), as well as the concern of economic friendly biomaterials.

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THE RELATIONSHIP BETWEEN PERCEPTION OF PARK QUALITY AND PHYSICAL ACTIVITY, ADIPOSITY, AND HEALTH





Park is an area of natural, semi-natural, or man-made green space that serve as the human recreational and social focus, or the protection of wildlife or natural habitats. Parks like Taman Rimba Bukit Kerinchi are a green space set aside for recreation to residents and visitors. The design, operation and maintenance are usually done by the Landscape and Recreation Development Department of Kuala Lumpur City Hall by involving park conservancy, non-government organization, group of friends, or private sector company. An urban park may consist of lush grass, rocks, soils and trees, but may also contain other artefacts or man-made structures such as fountains, monuments, playgrounds, walkaway, wooden and/or gravel steps, bridge, camping site, benches, shelters, toilets and others. Parks are increasingly recognized as an imperative component of the built environment to improve physical activity. By providing low-cost and accessible opportunities, parks are used by a vast majority of people to enhance physical activity at the population level across various age, culture, ethnic, religion, gender, marital status, income level and abilities.

Studies found that certain park characteristics, such as access, safety, features, condition, and attractiveness, may affect park-related physical activity. Other studies reported that park proximity, size, neighbourhood environment, park and facility condition, number of features, and certain park facilities (e.g., trees, trails, playgrounds, and sidewalks) are related to the park use and physical activity. Besides the park characteristics, the individuals' perceptions of these characteristics are equally important to understand park visitation, park-related and overall physical activity. Some studies showed that the perceived measures of park characteristics were even more important than the objective measures in predicting physical activity and health. Most research on the perceptions of park characteristics and physical activity has focused on the perceptions of access and availability. Some studies have also examined the relationship between the perceptions of park quality elements (i.e., features, condition, aesthetics, and safety) and physical activity or health outcomes.

Most studies on park characteristics and health behaviours or outcomes have examined proximity, accessibility, or park availability or have focused on park use rather than physical activity. Only a few have examined park quality perceptions such as condition or aesthetics, and even less research has examined them collectively. Consequently, additional research is required to understand park characteristics' perception better, particularly about park quality, and how it relates to physical activity and health. Park quality may not only be related to park-based physical activity but also overall physical activity. However, the compensation hypothesis proposes that more physical activity in one setting could reduce others' physical activity. It is crucial to examine relationships with not only the setting-specific physical activity which is a component of overall physical activity but also relationships with the overall physical activity and, consequently, people's health.

The BE ACTIVE (Built Environment & Active Living) project is a multidisciplinary mixed-method study that involves the faculty of the built environment, medicine, sports science and education. One of the study's objectives is to determine the association between residents' perceptions of park quality in their neighbourhood, and their overall and park-based physical activity, adiposity level and health. As park-based physical activity is an important component of overall physical activity, perception of the park quality may impact park-based and overall physical activity. Furthermore, some research has established associations between park access or features and body mass index, yet no studies to date have examined perceptions of park quality, adiposity level (weight, body mass index, body fat percentage and lean muscle mass) and health.

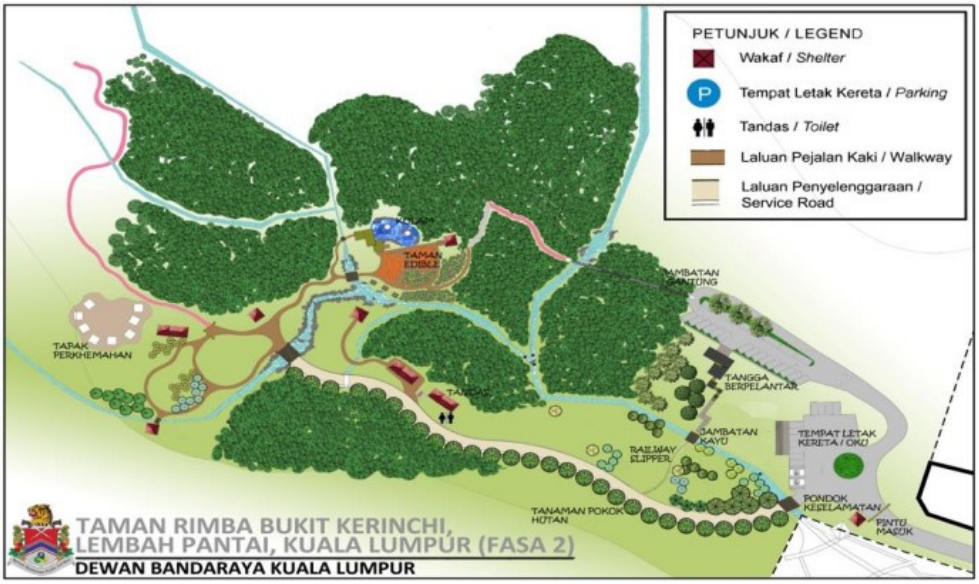


BE ACTIVE
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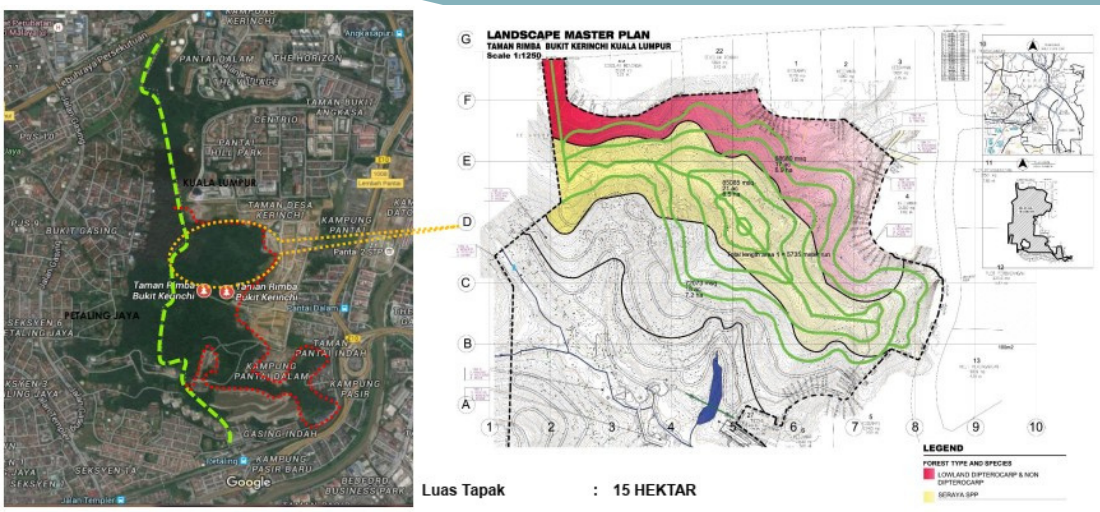
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URBAN PARK PRESCRIPTION: IN DEALING WITH THE MENTAL HEALTH REOCCURRING THROUGH NON-COMMUNICABLE DISEASES



In November 2019, our research team has started the research odyssey after successfully being a part of the applicants that granted by impact-oriented Interdisciplinary Research Grant. The project titled, "Encouraging health community in Malaysia through an interdisciplinary approach of the built environment in urban park planning and management" is led by Gs. Dr. Nur Aulia Rosni from the Faculty of Built Environment. One of the subprograms (out of four): “Urban park characteristics in integrating mental health comorbid with non-communicable diseases through salivary cortisol pattern and spatial analysis”, is headed by Assoc. Prof. Dr. Hazreena Hussein, an expert on the environment – behaviour and access to outdoor environments. One of her co-researchers, Assoc. Prof. Gs. Dr. Rosilawati Zainol looks into the spatial analysis. The grant requires the inclusion of multiple disciplines, hence the involvement of Prof. Dr. Jas Laile Suzana Jaafar from the Department of Educational Psychology and Counselling is crucial in giving inputs on mental health. While Prof. Catharine Ward Thompson from OPENspace Research Centre, University of Edinburgh is an extended collaboration for cortisol study.

The rise of mental health problems is alarming in the modern world and it has proven co-occur with the non-communicable disease these days. In the Malaysian context, there are eight prominent problems of the disease includes cardiovascular diseases, diabetes, cancer, mental illness, and injury-related conditions. Even though, there is an enormous amount of study related to the benefits of a green environment towards health yet in Malaysia still at the unsatisfied level. These perspectives have not adequately addressed are often overlooked as there are less of research has been done on the association of



urban parks with mental and physical health in Malaysia. The linkage between exposure to parks and health outcomes remains unclear. Therefore, the purpose of this research is to examine the characteristics of an urban park that can reduce mental health problems. This research focuses on depression, anxiety, and stress, mainly on the B40 population, using Taman Rimba Bukit Kerinchi as the case study. This 66.15 hectares of the recreational park has been gazetted as the green space, owned and maintained by DBKL.





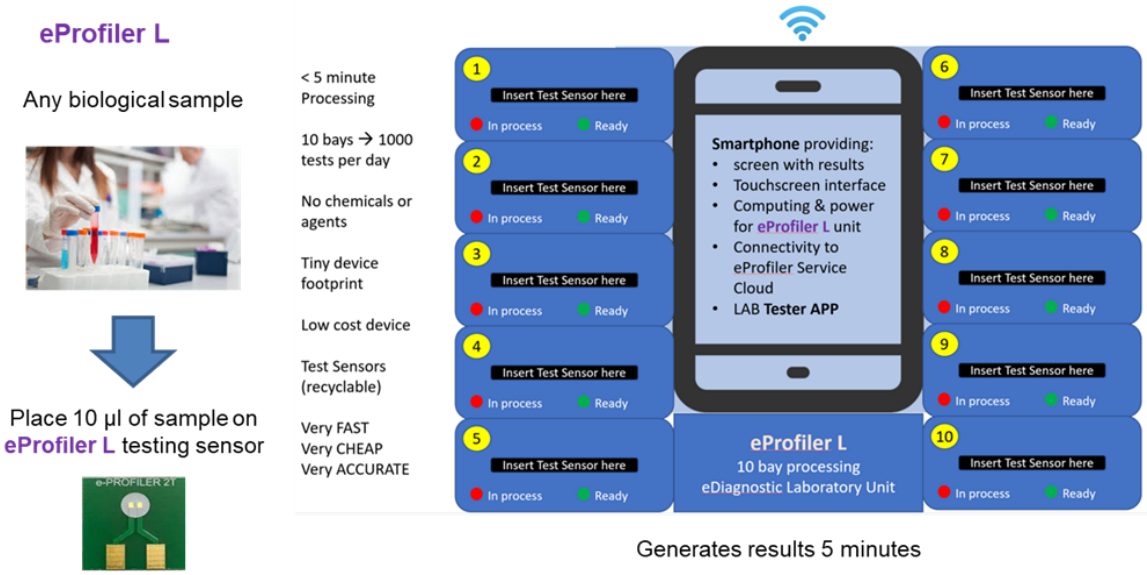
The method of saliva cortisol sampling via the diurnal pattern of salivary cortisol and the Perceived Stress Scale is used to indicate stress. While for mental wellbeing tests, the usage of the Warwick-Edinburgh Mental Wellbeing Scale is included. However, due to the pandemic COVID-19 that has affected all over the world, the research activity such as collecting data from the selected respondents are currently put on hold until further notice. The second alternative would be to conduct DASS which is a set of self-report scales purposely designed in measuring depression, anxiety, and stress. This research expected the outcome of the recommendations on the quality, quantity of the park, and spatial model in enhancing mental wellbeing in an urban park when it comes to battling the stress. On top of that, the findings will be useful to the policymaker in designing the park that will increase general health and reduce non-communicable diseases.

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E-PROFILER - NUCLEIC ACIDS AND PROTEINS IDENTIFIER



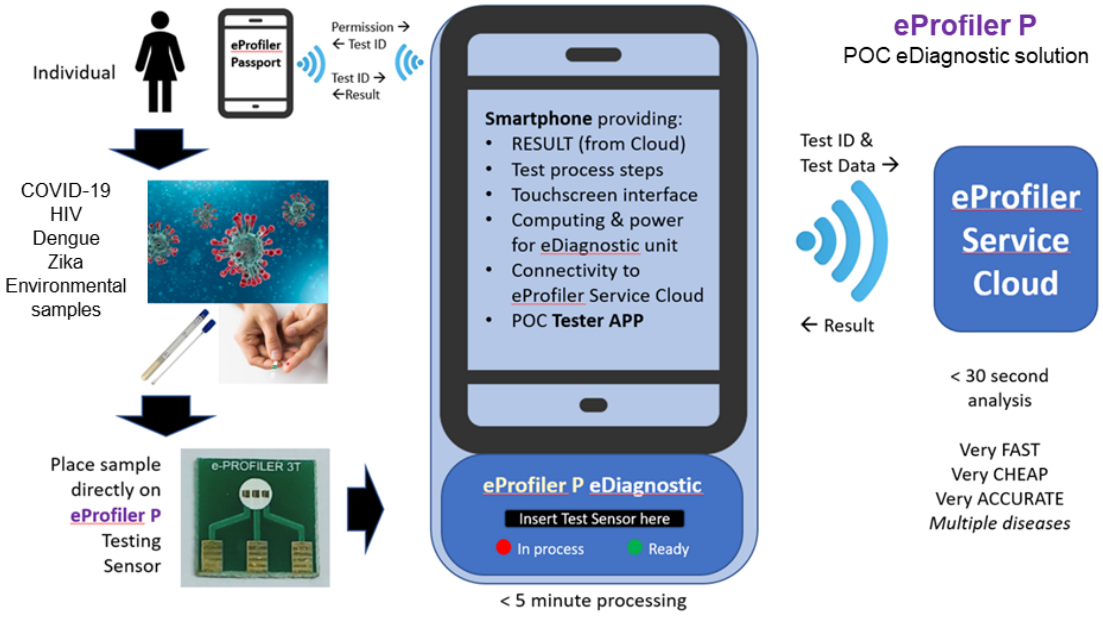
Development in modern molecular biology has always been towards making accurate and reliable techniques that enable us to perform rapid and precise identification of DNA/RNA sequences, proteins or cells especially for identifying microbial infections. Current molecular techniques involve mainly measurement of interactions between the biological materials and chemicals, an indirect measurement causing the possibility of false positives and false negatives. These indirect approaches are often costly, time-consuming and require preparations by trained personnel. Hence, a cost-effective, sensitive, rapid approach for the identification of pathogens is in dire need.

In addition, for the purpose of diagnosis and biomedicine, there is no single equipment or method that can function as a universal tool for detection and characterization of DNA, RNA and proteins. The available tools and devices are categorized under genomics (DNA/RNA) or proteomics (proteins) under which there are various methods/kits developed for detection of different types of biomolecules and/or microorganisms. Recently, through more than 10 years of research, we have discovered a universal language to decipher intrinsic cellular signals arising from nucleic acids and proteins within a living organism. This patented novel method involves acquiring electronic fingerprinting signals when the DNA/RNA/protein/cell is incorporated into a Schottky-like junction structure representing the first of its class of solid-state sensors for characterization and detection of biomolecules. This technology has in recent times been converted into a small portable platform that we call *eProfiler*, which can identify and differentiate various types of nucleic acids and proteins within a few minutes without the need for any additional preparation or laboratory equipment. On the verge of registering our UM spin-off company in the United Kingdom and Malaysia, we now have a fully functional tested prototype device. We have achieved this fully electronic biosensor, by embedding integrated smart algorithms into optimized circuit elements resulting in the development of miniaturized modular electronic sensors with the ability to operate with minimum complexity and reduced technical expertise. This technology we believe will therefore introduce a paradigm shift in biological and

molecular characterization of pathogens, overcoming problems presented by current laboratory techniques.

Aiming to pioneer a fully connected digital healthcare infrastructure in the near future, *eProfiler* devices are designed to function purely based on electronic sensing or electronic profiling which is by nature a direct measurement technique. These electronic devices can be easily interfaced to phone-based apps or a PC by means of a Graphical User Interface (GUI) to access the built-in database or Cloud data. Offering a fully digital and connected environment, *eProfiler* platforms allow researchers or clinicians to run similarity tests for molecular research or electronic diagnostics (eDiagnostics). This rapid, cost-effective and modular platform is expected to have a competitive edge against conventional methods especially due to its universal approach that is one platform for detection of all types of nucleic acids and protein or cells from any organism. More importantly, eProfiler Cloud services would help build a global network of researchers and healthcare systems (creating substantial new employment opportunities) to monitor infections globally and quickly identify any emerging pathogens, saving a tremendous amount of time and cost of tackling new health disasters.

We have received overwhelming attention from international institutes such as University of Edinburgh, UK resulting in a formal research collaboration agreement with UM, while awaiting collaborations to be formalized between other institutes such as Aalborg University Hospital in Denmark, as well as investors, biotech companies and government bodies from Europe, Middle East, Japan and India. We are currently conducting active collaborative research with local and international researches and experts from various fields to further expand our electronic database. One example involving a local biotech company is our on-going collaboration with Cytonex Sdn Bhd, the leader of stem cell therapy in Malaysia to establish the electronic profiles of Human Mesenchymal Stem Cells which would simplify the stem cell characterization process for a significant reduction in production cost.



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