



# Newsletter

# e-Science Putra

AGRICULTURE ■ INNOVATION ■ LIFE

Issue 2: January – April 2020

Faculty of Science is pleased to present the second issue of thrice-yearly e-Science Putra Newsletter. This e-newsletter intended to disseminate and highlight the latest research findings, activities and contribution to the community by the Faculty members. We hope that you enjoy reading this newsletter.

## HIGHLIGHTS

- Wild Malaysian Orchids
- TB Nanosense Test Kit
- Weibull Burr Type X Distribution
- Willemite based glass-ceramics
- *Orthosiphon stamineus'* Efficacies in Diabetic and Nephrotoxic Rat Models
- Southern River terrapin (*Batagur affinis*)

## Wild Orchids in Malaysian Logging Sites: Rescue or Leave to Die?

A mega diversity country and biodiversity hotspots such as Malaysia is also a country intensifying in deforestation activities. Virgin jungles have been exorcized indiscriminately since the late fifties and escalating after Malaya independence and later formation of Malaysia. All states leaders in the new federation saw forests and timbers as the new economic resources for the country's development. Hence, the saga of deforestation begins even without proper inventory or management, and mainly it was clear felling for planned transformation of land use into mega plantation. First it was for rubber and later the oil palm. Logging is now even rampant in the permanent nature reserve and the surrounding areas of National Parks. The land clearance within Peninsular Malaysia is evidenced by both licensed and illegal activities. Malaysia lost 472,278 km sq. forests in 12 years from 2000-2012 at the rate of 39,356 km sq. yearly, the highest in the world at 14.4% of the total land mass or 1.2% yearly. Forest destruction has always been the major factor degrading biodiversity species richness in the tropical rainforest especially

biota lacking ability to adapt to environmental changes, causing their existence threatened to extinction. The uncontrolled forest exploitation by timber industry, either legally or illegally, excessive logging, and the natural disaster has posed a greater threat to wild orchid species diversity and others canopy dwelling biota. Hence, from November 2016 to May 2018, we have been rescuing orchids from active logging concessionaries surrounding Kuala Koh with Terengganu and Kelantan boarder with permission from the Forest Department of Peninsular Malaysia, and Terengganu State.

This report is mainly based on our field observation and data collected from the state.



*Rescuing trips to the logging sites*

We discovered that the canopy disruptions caused by timber extractions have negatively modified the temperature, humidity, and light conditions, making them unfavourable niche for both the epiphytic and terrestrial shade-adapted orchid species survival where extremely harsh full exposure to sun irradiation and heat, water stress, and nutrient-poor soil because the top soil and nutrient were eroded away during felling and timber extraction. An ideal specimen for identification and classification is an entire plant, including the reproductive structures. Thus, all living the plants found in the logging sites were collected and nurtured in an *ex-situ* conservatory for later identification. Majority of the specimens collected were exhibiting signs of dying or illnesses, wilting or withered, yellowing, and spots of rot on the leaves due to the scourging sun exposure, instigating recommended rescue should be done within a week of felling.



*The new orchid species to science from Malaysia in paintings*

Monitoring was done by photographing growth, recording of phenology occurrence, and morphological variability of each species collected after being rescued and acclimatised to *ex-situ* conditions. Within the 18 months of rescuing mission, we recorded a total of 273 orchid species belonging to 77 genera and 73 species are new records to Terengganu. Three species are endemic to Malaysia, this includes *Bulbophyllum concavilabium*, *Bulbophyllum striatellum* and *Thrixspermum pulchrum*; 15 species are endemic to Peninsular Malaysia including the newly discovered species; *Bromheadia petuangensis*, *Dendrobium ainiae*, *Dendrobium ruseae* and *Dendrobium mizanii*. In addition, two species are new record to Malaysia; *Crepidium oculatum* and *Liparis vestita*; and one species as new record to Peninsular Malaysia, *Dendrobium agamense*.



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*New orchid species and records to Malaysia*

Through this study the total number of orchid species recorded in Terengganu increased to 370 species in 93 genera. Anticipating in the farfetched high orchid diversity rescued from active logging sites, the discovery of new records and species, we believed that rescuing orchids from logging sites is the most effective and rapid way to document our orchid flora, simultaneously conserving gene pool for future breeding and floriculture industry, and planting materials of *ex-situ* conservation and forest restoration in the future. Therefore, should we rescue or leave them to die is obviously we should, but we need active participations from all stake holders, the government, private agencies and timber-based companies, philanthropies to generously support wild orchid conservation monetarily. Remember, saving any species means you are saving the biodiversity of life network sustaining healthy environment that provides continuous fresh water and air for mankind!

## TB Nanosense Test Kit for Rapid TB diagnosis

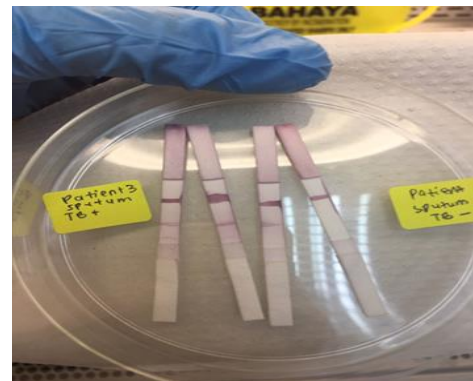
Tuberculosis (TB) is an ancient disease that has affected mankind thousand years ago. It is a chronic disease caused by the bacillus *Mycobacterium tuberculosis* and it is an airborne disease. 90% of TB cases are related to lungs which is known as pulmonary TB and it can also affect other parts of the body, such as brain, intestines, kidneys, or the spine known as ex-pulmonary TB. In the cases of pulmonary TB, it may cause symptoms, such as chronic cough, pain in the chest, haemoptysis, weakness or fatigue, weight loss, fever, and night-sweats. Active TB can be very harmful to your health, but it can be cured with a course of medicine. If you have latent TB, the TB bacteria in your body are 'asleep'. You are not ill and you cannot pass TB on to others. However, the bacteria might 'wake up' in the future, making you ill with active TB.



*Gold medal award in ITEX 2019 for the invention*

bacteria are examined in sputum samples under a microscope but sputum smear microscopy is unable to identify half of the positive TB infections and in addition, culture method require several weeks to grow the bacteria. The lateral flow immunoassay (LFIA) have been known as affordable, sensitive, specific and user-friendly technique. LFIA is based on recognition of one or more analyte, mainly proteins, by using antibodies. The antibodies are fixed onto a nitrocellulose membrane and they interact with the analyte either in sandwich or competitive formats using a proper label. Our Biosensor and Chemical sensor group in Chemistry Department, Faculty of Science has developed a TB Nanosense Test Kit based on LFIA technique and has been validated with clinical samples (sputum). Encouraging results have been obtained however more clinical samples are required to validate the kit.

TB is a serious global infectious pathogen causing pulmonary tuberculosis (TB) and remains as the second leading cause of death from an infectious disease worldwide, after human immunodeficiency virus (HIV). Therefore, early detection of TB is important in order to isolate the patients and control the disease. The current standard method used for diagnosing of TB is sputum smear microscopy and culture methods, in which



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## Weibull Burr Type X Distribution for Analysing Skewed Data

Statistical distributions are constantly and extensively used to describe and predict real world phenomena in broad spectrum of areas such as engineering, medicine, biology, demography, environment, economics and many others. However, there is a need for an extended form of these distributions such as in survival analysis whereby the hazard function might be of various forms. Due to this over the past decades many studies have been put forward to develop such distributions that are more flexible and useful. Attempts have also been made in defining new families of probability distributions by extending well-known families of distributions such as the

generation of the broad family of univariate distributions from the Weibull distribution.

We have proposed the generalization of Burr Type X distribution with two parameters by Weibull-G family of distribution. The asymptotic properties were established. The finite sample performance of the parameters estimate was assessed via simulation studies under different sets of conditions. The results indicated the estimators performed appropriately. The maximum likelihood estimation method was used to estimate the parameters.

The cumulative density function (cdf) of the Weibull Burr Type X (WBX) is as follows:

$$\Phi(y, \nu, \omega, \eta, \vartheta) = 1 - e \left( -\nu \frac{[1 - e^{-(\eta y)^2}]^{\vartheta \omega}}{[1 - [1 - e^{-(\eta y)^2}]^{\vartheta}]^{\omega}} \right)$$

The probability density function is

$$\phi(y, \nu, \omega, \eta, \vartheta) = 2\nu\omega\eta^2\vartheta y e^{-(\eta y)^2} \frac{[1 - e^{-(\eta y)^2}]^{\vartheta \omega - 1}}{[1 - [1 - e^{-(\eta y)^2}]^{\vartheta}]^{\omega + 1}} \times \exp \left( -\nu \frac{[1 - e^{-(\eta y)^2}]^{\vartheta \omega}}{[1 - [1 - e^{-(\eta y)^2}]^{\vartheta}]^{\omega}} \right)$$

where  $\nu > 0, \omega > 0, \eta > 0$  and  $\vartheta > 0$ , with  $\nu$  and  $\omega$  the two additional parameters.

Table 1: Descriptive statistics of turbochargers failure data set

N	Mean	SD	Median	Skew	Kurtosis	SE
40	6.25	1.96	6.5	-0.64	-0.49	0.31

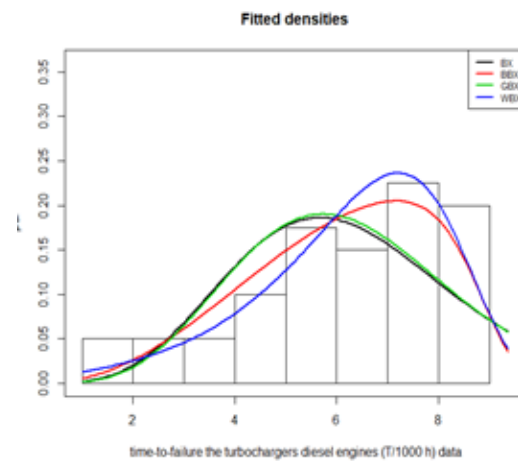


Figure 1: Histogram and plots of fitted densities time-to-failure of turbochargers diesel engine data

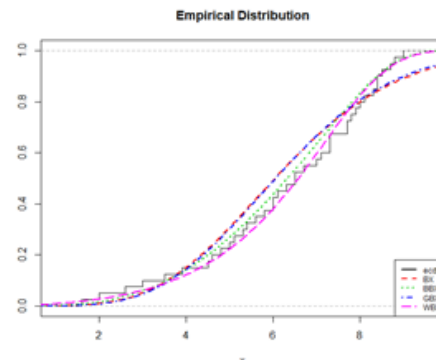


Figure 2: Empirical cdf and cdfs for time-to-failure of turbochargers diesel engine data

We illustrated the application by analysing the turbocharges diesel engine data. Table 1 provides descriptive statistics of the data such as item number (N), mean, standard deviation (SD), median, skewness (Skew), kurtosis and standard error (SE). From Table 2 the value of Akaike Information Criteria (AIC) of WBX is the smallest (compared to the other models). These data are left-skewed depicted by Figure 1. From Figure 2 we can see that the cdf of WBX distribution is very close to the empirical cdf. The results suggest that WBX is a good fit for left-skewed data and thus can be used for practical situations.

**Table 2: The ML estimates,  $-l$  and AIC of turbocharges failure data set**

Model	ML Estim.	$-l$	AIC
BBX	$\hat{\nu} = 0.119$ $\hat{\omega} = 164.8$ $\hat{\eta} = 0.121$ $\hat{\theta} = 14.056$	79.4	167
GBX	$\hat{\nu} = 2.145$ $\hat{\eta} = 0.142$ $\hat{\theta} = 2.811$	85.5	177
WBX	$\hat{\nu} = 0.0532$ $\hat{\omega} = 1.731$ $\hat{\eta} = 0.343$ $\hat{\theta} = 0.136$	79.6	165
BX	$\hat{\eta} = 0.343$ $\hat{\theta} = 2.386$	85.8	176



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## A bright future for willemite based glass-ceramics

Recently, Dr. Mohd Hafiz Mohd Zaid from a group of glass and ceramic research in Faculty of Science, UPM (including Prof. Dr. Sidek Ab Aziz, Prof. Dr. Halimah Mohamed Kamari and Assoc. Prof. Dr. Khamirul Amin Matori) in collaboration with researchers from Nagoya Institute of Technology in Japan, were carried out a research focused on the synthesis and development of willemite based glass-ceramics as a potent material for phosphor applications. Starting with their accidental discovery, the impressive range of properties and exciting potential applications of willemite based glass-ceramics indeed ensure a bright future of the research!



**Research collaboration program with researchers from Nagoya Institute of Technology in Japan**

Glass-ceramics can be referred to a material that combines two types of material to form a product that is in a class of its own between glasses and polycrystalline ceramics. Glass-ceramics can be developed by a specific controlled heat-treatment process. A significant advantage of glass-ceramics is their ability to be formed into complex shapes by the conventional glass forming techniques such as casting, blowing, pressing and rolling. Another advantage of glass-ceramics is their strength and toughness compared with their parent glasses and other conventional ceramics. High mechanical strength can be attributed to factors including the lack of pores and their resistance to abrasion.



*Demonstrates the luminescence emission colors of willemite based glass-ceramics by excitation with a weak UV lamp at 254 nm which can be used for various applications*

Willemite also known as zinc silicate ( $Zn_2SiO_4$ ) is a non-sulfide zinc deposit and firstly found in nature at Moresnet, between the Netherlands and Prussia and now known as La Calamine, Belgium. After that, the occurrence of willemite ore was found to be distributed all over the world. Willemite has a phenakite structure where in the  $Zn_2SiO_4$  crystal structure, all the atoms occupy overall site and composed of tetrahedral framework. This kind of rigid lattice, with only non-centrosymmetric cationic sites will gives the chance to develop extraordinary optical properties.

For this reason, willemite is very important and widely used as a phosphor in neon discharge lamps, fluorescent lamps, oscilloscopes, black-and-white/color televisions and many other displays and lighting devices once doped with transition metal or rare-earth ions. An impressive variety of glass-ceramics has been developed during the past few decades. Yet, many others with unusual and unforeseen properties and applications are likely to be discovered in the future.



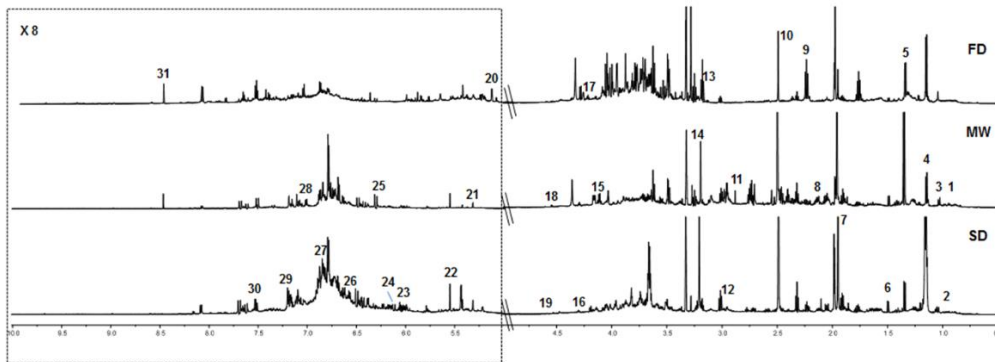
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## **Holistic View on *Orthosiphon stamineus*' Efficacies in Diabetic and Nephrotoxic Rat Models**

The strategies for the identification of bioactive constituents from a plant crude extract has been changing from time to time. Even though the reductionist - bioassay-guided approach is the most popular technique currently in practice, at times this method failed to deliver holistic information about the therapeutic potential of various chemical constituents of a crude extract. It is specifically because of its inability to identify the effect of synergism or antagonism, which is considered as the most important attribute of herbal preparation. Metabolomics being a global and comprehensive tool could overcome this disadvantage.

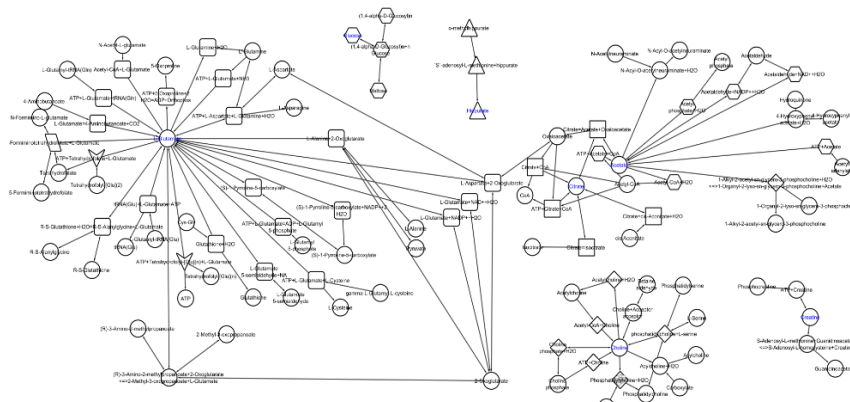
*Orthosiphon stamineus* (OS) is widely used in traditional medicine in Malaysia, Indonesia and other Southeast Asian countries as a diuretic, nephroprotective and in the cure of diabetes. Different solvent extracts of OS were studied to assess their protective efficacy in streptozotocin (STZ)-induced diabetes mellitus and cisplatin-induced nephrotoxicity using respective rat models. Aqueous extract of OS has caused a significant reduction of blood glucose level and other marker metabolites of diabetes by 14 days

of treatment with OS. The 50% aqueous ethanolic extract demonstrated amelioration against cisplatin nephrotoxicity.



*<sup>1</sup>H-NMR profiles of freeze-dried (FD), microwaved (MW) and sun shade-dried (SD) OS extracts*

Contradictory effects of the aqueous extract in increasing nephrotoxicity while normalizing the diabetic condition in rats were observed. This is an example of a traditional plant with various medicinal claims which scientifically proven to show conflicting effects in two *in vivo* biological activities, diabetes and nephrotoxicity. Many more traditional claims of other medicinal sources could be holistically evidenced on their Quality, Safety, Efficacy and Consistency (QSEC) via the metabolomics approach.



*Proposed metabolic pathways involved in OS anti-diabetic mechanism of action in rat model*



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## **Conservation of Critically Endangered Southern River Terrapins (*Batagur affinis*)**

Malaysia is ranked 12th as the world’s megadiverse countries with many endemic and endangered species. Southern River terrapin (*Batagur affinis*) is one of the endemic, critically endangered (IUCN, 2020) and royal animal to Perak with restricted distribution (can be found in Kedah, Perak and Terengganu), and a long-lived fauna that can be found in Malaysia.



*A female terrapin is nesting*

This species has been known to experience bottleneck during World War II due to excessive eggs and meat consumptions. Therefore, it is conserved since 1967 by the Department of Wildlife and National Park (PERHILITAN) at two conservation centres in Perak (the Bota Kanan Conservation Centre) and Kedah (the Wildlife Conservation Centre, Bukit Pinang). However, the current conservation practice is not improving the species population size in the two centres, and yet it keeps on declining because of low reproduction in adults and low survivability in hatchlings.



*A clutch of terrapin eggs*

Preliminary genetics research on this species at the Bota Kanan Conservation Centre, Perak to further understand the genetic factors behind the declining of this species in captivity by a team of researchers from Universiti Putra Malaysia (Dr. Nurul Izza Ab Ghani (leader), Nurul Aini Ismail, Assoc. Prof. Dr. Latifah Abd. Manaf and Prof. Dr. Ahmad Ismail) found the population is experiencing inbreeding and low genetic diversity.



*Dr Izza and team releasing the young terrapins into the river*

This research is an ongoing collaborative effort between UPM and PERHILITAN with an ultimate aim is to design a sustainable conservation plan for *Batagur affinis*. Success in this research will be a great model to improve conservation management of other endangered species in Malaysia. It will help to achieve the National Biodiversity Policy and indirectly promote Malaysia as a wildlife tourism destination.



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