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June 2020

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Message from the President

IKM moving forward – 2020 and beyond

As we enter into the second half 2020, the global Covid-19 pandemic has just reached a new peak with more than 10 million cases worldwide and more than half a million deaths. Many countries, including USA, Brazil and many others, are still experiencing spikes in coronavirus cases of late. The war again Covid-19 is far from over.

Fortunately for Malaysia, we are coming to a lower end of this pandemic and we are going into a new normal as our ways of life for the next few years at least.

1. Till end of 2020

For the rest of 2020, we are going into a consolidation period. Two major events, the International Congress of Pure & Applied Chemistry (ICPAC KK) and the 20th Malaysian International Chemistry Congress (20MICC), both to be held in Kota Kinabalu, Sabah, have been postponed to March 2021. Some courses in the IKM Professional Centre have also being postponed or cancelled. Starting from July onwards, we are restarting all the programmes scheduled for the second half of 2020. The 53rd Annual General Meeting (53AGM) will be held on Saturday, 25 July 2020 at the Berjaya Times Square Hotel, Kuala Lumpur. I hope that as many members will show up to show your support for IKM. Another major event is the Malam Kimia 2020 which will be held on 4 December 2020 at the same Berjaya Times Square Hotel in Kuala Lumpur.

Having said all of the above, what plans do we have for the future for IKM?

2. From 2020 to 2022 – Short Term

We have a number of big projects and events for IKM in the coming decade. First, for short term from 2020 to 2022, we have the following projects in mind:

- Digitalisation of IKM
- Tan Sri Law Hieng Ding Foundation
- Accreditation of chemistry programmes in Malaysian universities

3. From 2020 to 2026 – Medium Term

From the medium term from 2020 to 2025, we have the following:

- IUPAC 2025
- MACRO 2026
- JPA Special Grade for Government Chemist / Ali Kimia

4. Long Term until 2028

For long term development until 2028, we propose the following:

- Wisma IKM
- Continuous Professional Development
- Membership Development
- IKM 60th Anniversary

All these projects and events require the involvement of IKM members in order for us to achieve the targets. We hope to mobilise all IKM members to work together towards making IKM a strong, dedicated and influential professional scientific organisation in Malaysia recognised by the chemistry community all over the world.

Thank you and with best wishes.

Datuk ChM Dr Soon Ting Kueh
President, Institut Kimia Malaysia
Date: 30th June 2020

Hazard Pictograms on Hand Sanitizer

Assoc. Prof. ChM Dr. Goh Choo Ta
Institute for Environment and Development (LESTARI)
Universiti Kebangsaan Malaysia (UKM)

The use of hand sanitizer during COVID-19

In January 2020, the novel coronavirus disease (COVID-19) has spread from Wuhan City, the capital of Hubei province to the rest of China, and eventually spreading globally within a short period (Wu et al. 2020). Due to wide spread of COVID-19 globally, World Health Organization (WHO) have made a decision on 11 March 2020, that COVID-19 can be characterized as a pandemic (WHO 2020a). As of 6 May 2020, there were 3,595,662 confirmed cases of COVID-19, 247,652 confirmed deaths and the COVID-19 is affecting 215 countries, areas or territories, with the highest confirmed cases of COVID-19 (i.e. 1,171,185 cases) were reported in USA (WHO 2020b).

COVID-19 is still spreading, as the respiratory virus can easily be transmitted via airborne (droplets) and direct or indirect contact. In order to reduce and eliminate spreading of COVID-19, healthcare professionals are advising public to practice personal hygiene, keeping social distance and wear appropriate personal protective equipment (PPE).

One of the measures to enhance personal hygiene is by applying hand sanitizer, especially alcohol-based hand sanitizer. Alcohol-based hand sanitizers normally contain active ingredients such as ethanol or isopropyl alcohol. In some commercial hand sanitizers, manufacturers might add inactive ingredients such as aloe vera and tea tree oil, to provide moisturizing or fragrance effects. In April 2010, WHO published 2 formulations for alcohol-based hand rub, where the ingredients for both formulations are shown in Table 1 (WHO 2010). The WHO recommended hand rub formulations (i.e. formulation with 80% of ethanol or formulation with 75% of isopropyl alcohol) have been proven to inactivate the coronavirus (Kratzel et al. 2020).

Although using soap is more effective to clean our hands, hand sanitizers are convenient and easy to use. In addition, hand sanitizers are portable and do not require water in the cleaning process. Figure 1 shows a commercial hand sanitizer containing 75% ethanol, where the label of this hand sanitizer depicts 2 hazard pictograms (on the left of Figure 1) with red border and a black colour symbol in the middle – fire and exclamation mark, respectively. Perhaps not all of us are aware that these hazard pictograms are also known as GHS pictograms, where GHS stands for 'Globally Harmonised System of Classification and Labelling of Chemicals'.

GHS – A system developed by United Nations

GHS is a system developed by United Nations to harmonise chemical classification criteria and hazard communication elements at the international level. Before the establishment of GHS, although many countries already have their own systems and requirements

WHO Formulation 1 (Final concentration)	**WHO Formulation 2 (Final concentration)**
Ethanol 80% (v/v), Glycerol 1.45% (v/v), Hydrogen peroxide 0.125% (v/v), Sterile distilled or boiled cold water	Isopropyl alcohol 75% (v/v), Glycerol 1.45% (v/v), Hydrogen peroxide 0.125% (v/v), Sterile distilled or boiled cold water

Table 1 WHO formulations for alcohol-based hand rub (*Source: WHO 2010)*

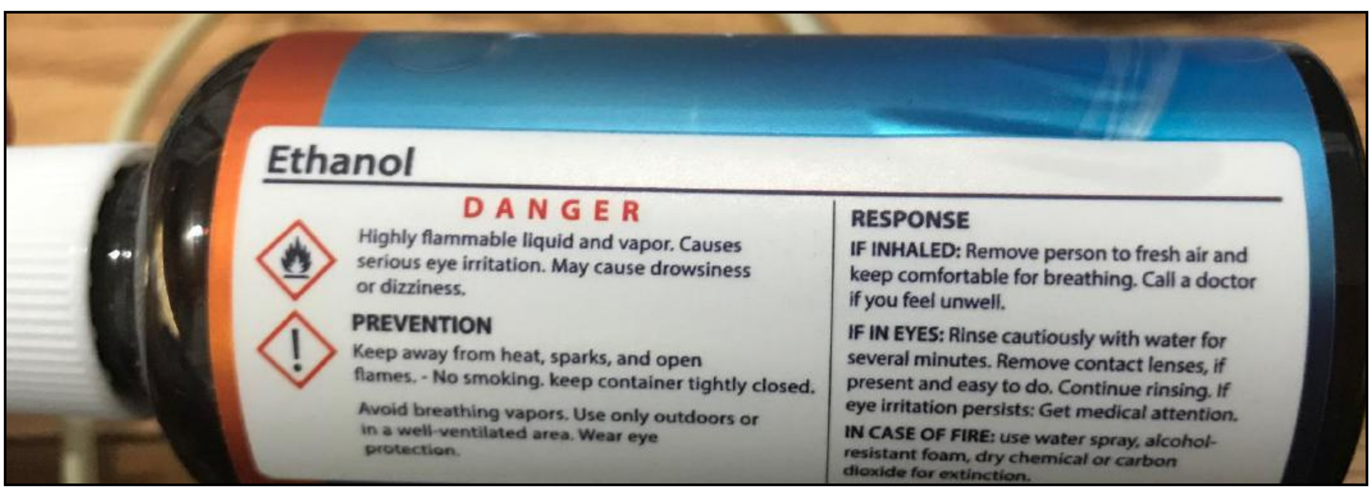

Figure 1 Example of a commercial hand sanitizer containing 75% ethanol


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for classifying chemicals, these requirements may be similar from one country to another, they are usually not the same due to different cut-off values or endpoints. This will lead to different classification results for the same chemical.

For example, a country might set the cut-off value for a hazard category different compare to the cut off value agreed by international organisations, therefore the chemicals classified in this country might have the potential becoming 'less hazardous' compare to the same chemical classified in other countries. Furthermore, this will cause confusion among the chemical users when the chemicals are crossing countries' borders, e.g. different classification for the same chemical were found in the premise, hence appropriate control measures to reduce chemical risks cannot be identified.

Figure 2 The GHS pictograms
Source: United Nations 2019

By taking into different chemical classification system that exist in different countries, with the culmination of more than a decade of work by multidisciplinary experts, United Nations has developed the GHS in July 2003. The objectives of GHS are to: (i) enhance the protection of human health and the environment by providing an internationally comprehensive system for hazard communication; (ii) provide a recognised framework for those countries without an existing system; (iii) reduce the need for testing and evaluation of chemicals; and (iv) facilitate international trade in chemicals whose hazards have been properly assessed and identified on an international basis.

The GHS is a voluntary system (i.e. non-legally binding instrument) that does not require countries to become signatories. Considering the fact that different countries have different practices in managing chemicals, and also aiming to provide flexibility for countries in adopting the voluntary system, the GHS allows countries, or competent authorities, to adopt appropriate components in the GHS.
There are 2 aspects covered by GHS – (i) the classification criteria to determine physical hazards, health hazards and environmental hazards; and (ii) hazard communication. Table 2 shows the hazard classes covered by the GHS (8th revised edition). For the hazard communication, the GHS focuses on chemical label and safety data sheet (SDS), where the elements of hazard communication include the pictograms, hazard statements, precautionary statements and signal words. Figure 2 shows the 9 GHS pictograms, it is noted that each of the pictogram is in diamond shape and having red borders. The symbols in the middle (in black colour) varied among them.

Physical Hazards:	**Health Hazards:**
1) Explosives	1) Acute Toxicity
2) Flammable Gases	2) Skin Corrosion/Irritation
3) Aerosols & Chemicals Under Pressure	3) Serious Eye Damage/Eye Irritation
4) Oxidizing Gases	4) Respiratory or Skin Sensitization
5) Gases Under Pressure	5) Germ Cell Mutagenicity
6) Flammable Liquids	6) Carcinogenicity
7) Flammable Solids	7) Reproductive Toxicity
8) Self-Reactive Substances & Mixtures	8) Specific Target Organ Toxicity – Single Exposure
9) Pyrophoric Liquids	9) Specific Target Organ Toxicity – Repeated Exposure
10) Pyrophoric Solids	10) Aspiration Hazard
11) Self-Heating Substances & Mixtures	
12) Substances which in contact with water release flammable gases	**Environmental Hazards:**
13) Oxidizing Liquids	1) Hazardous to the Aquatic Environment
14) Oxidizing Solids	2) Hazardous to the ozone layer
15) Organic Peroxides	
16) Corrosive to Metals	
17) Desensitized explosives	

Table 2 Hazard classes covered by the GHS (8th revised edition) Source: United Nations 2019

GHS implementation in Malaysia

Chemicals are commonly handled by industrial workers in different ways, including using chemicals as raw materials for manufacturing or formulation processes, moving or carrying chemicals from one area to another within the same premises, and storing chemicals in appropriate locations.

In order to convey or communicate hazard information to the industrial workers, the Department of Occupational Safety and Health (DOSH) has gazetted the Occupational Safety and Health (Classification, Packaging and Labelling of Hazardous Chemicals) Regulations 1997 (also known as CPL Regulations 1997) to ensure chemicals are classified and labelled according to Malaysia's requirements.

With the establishment of GHS by the United Nations, the CPL Regulations 1997 was revoked and replaced with the Occupational Safety and Health (Classification, Labelling and Safety Data Sheet of Hazardous Chemicals) Regulations 2013 (also known as CLASS Regulations 2013).

Under the provisions of CLASS Regulations 2013, any person who supplies a hazardous chemical, including a principal supplier and subsidiary supplier must comply with the CLASS Regulations 2013. 'Principal supplier' means a supplier who formulates, manufactures, imports, recycles or reformulates a hazardous chemical; whereas 'subsidiary supplier' means a supplier who repacks, distributes or retails a hazardous chemical. It is supplier's obligation to classify, package and label the hazardous chemicals, as well as to prepare SDS in accordance with the requirement of CLASS Regulations 2013. Principal supplier should also prepare classification record that make available for inspection by the authority.

The CLASS Regulations 2013 only stipulates the desired chemical classification results, but not the classification criteria. Thus, DOSH has incorporated the classification criteria and hazard communication elements in the Industrial Code of Practice on Chemicals Classification and Hazard Communication 2014 (also known as ICOP 2014). The ICOP 2014 is a legal binding document and it is in accordance with the 3rd revised edition of the GHS purple book. Both CLASS 2013 and ICOP 2014 are complementing each other.

The industrial workplace is the leading sector for GHS implementation in Malaysia, but the implementation in other sectors are relatively slow, such as the consumer sector. Although the CLASS Regulations 2013 has been gazetted, it only applies to chemicals at the workplace, for example, it excludes consumer chemicals that are not being used at the workplace, such as detergent or paint.

However, the challenge facing by the manufacturers is they are unable to control the use of the consumer chemicals manufactured by them, where some of the consumer chemicals might be used at the workplace. If this happens, the manufacturer will have the responsibility to classify their consumer chemicals based on the CLASS Regulations 2013. Due to this dilemma, some manufacturers have taken the voluntary initiatives to classify and label their consumer chemicals according to CLASS Regulations 2013. By practising the voluntary initiative, manufacturers will no longer need to worry whether their consumer chemical is being used at the workplace, or outside the workplace.

Some of the consumer chemicals in Malaysia, such as hand sanitizer containing ethanol, have been classified and labelled according to CLASS Regulations 2013. Thus, the label of these hand sanitizers will have the GHS pictograms that is shown in Figure 1.

However, it is important to emphasize that not all hand sanitizers containing ethanol will have GHS pictograms because if the hand sanitizers are not being used at the workplace, then it is just solely a voluntary initiative by the manufacturers. Such circumstance might lead to confusion among the public when purchasing hand sanitisers, where some consumers might wrongly interpret that hand sanitizers without GHS pictograms is 'safer' compare to those hand sanitizers with GHS pictograms. In fact, the hazard properties for the hand sanitizers containing ethanol are almost the same!

Conclusion

By using hand sanitizer as an example, implementing GHS in consumer sector is important. Hence, all consumer chemicals, including hand sanitizer containing ethanol should be classified and labelled using the same criteria and requirement. In this regard, the hazard information conveyed to consumer will be consistent and harmonised.

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The Journey of Chloroquine & Hydroxychloroquine for COVID-19 Treatment

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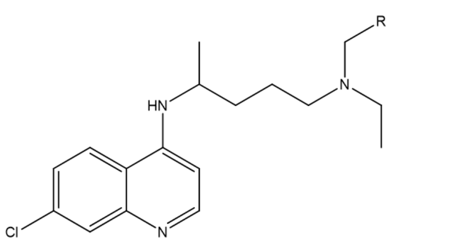
Chloroquine and its derivative, hydroxychloroquine, are drugs that have been used worldwide for more than 70 years. They are part of the World Health Organization (WHO) model list of essential medicines. They are also cheap and their clinical safety profile is well established. Chloroquine is a drug sold under the brand name Aralen, and also sold as a generic medicine. This drug is primarily prescribed in the form of a base tablet or salt tablet (phosphate) for the treatment and prevention of malaria and amebiasis. The side effects of chloroquine are irreversible damage to the retina, deafness, tinnitus (ringing in the ears), reduced hearing, increased liver enzymes, loss of appetite, vomiting, nausea, and diarrhoea.

Hydroxychloroquine on the other hand is an arthritis drug that also been used to treat and prevent malaria. It is also prescribed in a base or sulphate salt tablet. Hydroxychloroquine, nevertheless, is less toxic and sold under the brand name Plaquenil as well as other generic medicine. The reported side effects of hydroxychloroquine include irritability, headache, weakness, hair lightening or hair loss, stomach upset, dizziness, muscle pain, nausea, and itching. The mechanism of action of chloroquine and hydroxychloroquine on malarial parasites is still unknown clearly. However, it is believed that they may prevent malarial parasites from breaking down (metabolizing) haemoglobin in human red blood cells. Both these drugs are effective against the malarial parasites *Plasmodium vivax*, *Plasmodium malariae*, *Plasmodium ovale*, and susceptible strains of *Plasmodium falciparum*. The active site of their molecule is at the basic chain (see the moiety circled on the molecular structure in Figure 1). Both drugs are metabolised inside the body into their active components which are desethylchloroquine (DSC) and bisdesethylchloroquine (BDSC) (Figure 2). Except for people with psoriasis, chloroquine and hydroxychloroquine can be safely taken by pregnant women, nursing mothers and children of all ages. However, since this drug has a long half-life, thus the dosage prescribed should be strictly followed to avoid their toxicity effect.

Chloroquine and hydrochloroquine are currently being studied for the treatment and prevention of coronavirus



Chloroquine, R = CH_3, Hydroxychloroquine, R = CH_2-OH
Figure 1: Chemical Structure of Chloroquine and Hydroxyxhloroquine

disease 2019 (COVID-19). Their great journey started from expert's opinion (particularly for their well-known immunomodulant effect), which further supported by an in vitro study revealing their effectiveness in reducing the replication of SARS-CoV-2 (the virus causing COVID-19) with an Effective Concentration (EC)90 of 6.90 µM. This dosage can be easily achievable with standard dosing. Hydroxychloroquine has been reported to be more potent than chloroquine at inhibiting the SARS-CoV-2 virus. The target of the drugs has not been clearly elucidated. However, due to their favourable penetration in the lung tissues, the drugs are described to alter the pH levels of cell membrane surface which then avoiding virus interaction. This will prevent the virus from entering and infects the cell. The favourable potential risk-benefit balance, and the low cost expenditure on the drugs for COVID-19 treatment are a major benefit for both the highly stressed healthcare systems of involved high-income countries and the underfunded healthcare systems of middle- and low-income counties. In addition Also, as mentioned earlier, there is sufficient pre-clinical rationale and evidence regarding the safety (from long-time use in clinical practice) and the effectiveness of chloroquine and hydrochloroquine for the treatment of COVID-19 to justify clinical research on the topic. With the current circumstances, these drugs were qualified for fast track institutional ethical review and in fact had received emergency use authorization (EUA) from the Food and Drug Administration (FDA) to sedate COVID-19 patients on a ventilator. Several clinical studies are ongoing on people with COVID-19 in the China, US, and other countries, but at the same time, more information is needed to know how well the drugs work to treat or prevent COVID-19. Thus far, there are reports that the drugs can keep the virus from spreading in the body and shorten the time of feeling sick. Yet, there are also concerns about their side effects including irregular heartbeat and drug interactions that may occur during administering them. A study published in a prestigious medical journals, The Lancet, report on the risk of taking the drugs alongside with an antibiotic will result in 2.6 times dying especially for the patient on ventilators due to irregular heart-rhythm. This claim was based on the analysis of electronic health record data from 15,000 patients (of 81,000 control group patients) already treated for COVID-19 at 671 hospitals on six continents where nearly patients been prescribed with chloroquine or hydroxychloroquine, alone or in combination with an antibiotic. In a few days of the report released, the WHO's paused the randomized mega trial recruitment on the drugs as an act of solidarity. The episode has left leaders of halted the enrolment of the drug trials weighing whether to restart. The claim has embed the world with perception that hydroxychloroquine and chloroquinone are poisonous which will hinder in recruiting people to further study their efficacy

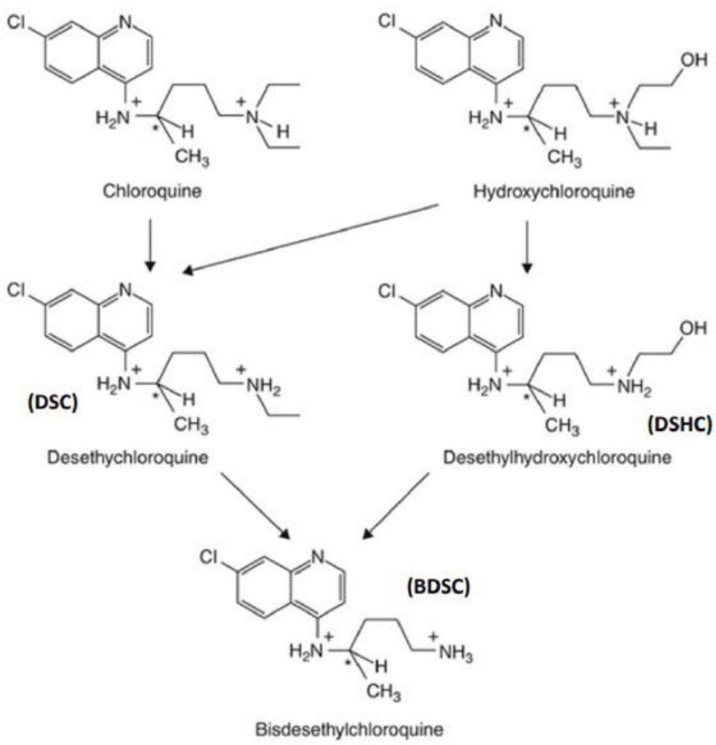


Figure 2: Putative Metabolic Pathway of Chloroquine and Hydroxychloroquine in the Body (Assessed from Chegg.com on 18th June 2020)

on COVID-19. But just as quickly, the published data on the unsafety of the drugs have begun to unravel. After a series of scientific discussion and debate, it was found there were inconsistencies in the reported data and the integrity of the research is doubtable. The secretive actions of the investor have also prompted intense scepticism. Due to withering online scrutiny pressure from researchers and amateur sleuths, The Lancet revisit the published data. More data were requested but since the author's collaborator refused to transfer the dataset, the paper was then retracted from The Lancet. Though many were disappointed with The Lancet, but the damage has been done and the clinical trials on hydroxychloroquine and chloroquinone thus continue. Although chloroquine and hydroxychloroquine are promising for the treatment of COVID-19, they should only be taken under the direction of a doctor in a clinical study or for those who are hospitalized. They should not be bought online without a prescription. Some of these drugs are strictly intended for veterinary use including to treating fish in aquariums or for use in other animals, not to treat or prevent COVID-19. The FDA reports on serious injury and death in people misusing these preparations. If side effects such as irregular heartbeats, dizziness, fainting or others were experienced while taking them, call for emergency medical treatment and be sure to tell the doctor. Currently, there is no antiviral medication specifically approved to treat COVID-19. All the treatment now only focuses on managing and relieving the symptoms. New medicines are still under clinical trials. However, apart from chloroquine/ hydroxychloroquine, the antiviral drug remdesivir, also had received EUA from the FDA to sedate people on a ventilator. Besides, several other drugs including kaletra (the combination of lopinavir and ritonavir), favipiravir and interferon beta also showed promising in vitro outcome but had limited clinical findings. These drugs (except remdesivir) are registered with the National Pharmaceutical Regulatory Agency (NPRA) Malaysia for the treatment of other illnesses and are under clinical trials for the treatment of COVID-19. Their ability in reducing the viral shedding duration and transmission are also currently under investigation. The clinical trials coming from different locations worldwide on these drugs are coordinated by WHO to ensure high-quality data where Malaysia is one of the countries listed. In addition to those coordinated by WHO, several other companies are also working on drugs which that are already in use against other related illnesses to treat people on COVID-19. Recently, a corticosteroidal drug, dexamethasone has been welcomed by WHO to treat COVID-19 patients who are critically ill. The treatment with the drug has shown that the mortality patients on ventilators was reduced by about one third, and for patients requiring only oxygen, mortality was cut by about one fifth. The benefit was nevertheless, seen only in patients seriously ill with COVID-19, and was not observed in patients with milder disease. With confirmed COVID-19 cases worldwide surpassing 8.5 million and continuing to grow, scientists are pushing forward with efforts to develop treatments to slow the pandemic and lessen the disease's damage.

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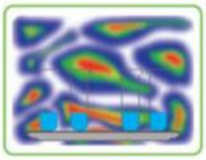

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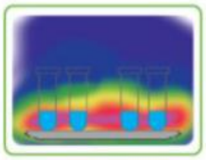

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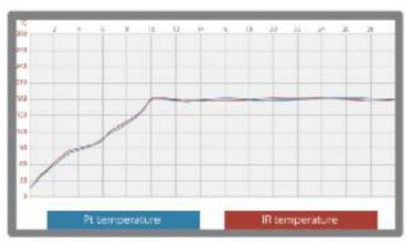

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IKM Member Selected into the Southeast Asia Women 2020 Cohort

ChM Dr. Lee Hooi Ling, an academic from Universiti Sains Malaysia (USM) and our IKM Northern Branch Committee member has recently made into the 2020 cohort of women leaders to be featured on Southeast Asian Women (SEA Women) for the Science, Education and Women Categories. Hooi Ling, said, "I am truly humbled, and at the same time honoured and thrilled to be featured on the SoutheastAsianWomen.org under those categories, as I was being informed that only 80 leading women were selected in the 2020 cohort from 10 Southeast Asia countries across 16 industries."

"Furthermore, this is the second cohort since its inception in 2019. The announcement of the selection for this cohort was delayed due to the COVID-19 outbreak, in which it was supposed to be released during International Women's Day on 8th March.

"I was really surprised upon receiving the email of the selection. I would like to take this opportunity to thank my family, USM, mentors, friends and students who are always very supportive in the early part of my career," she said.

She added, "Their confidence in me motivates me to keep on striving. I hope with this recognition, I will continue to contribute and give back to our community, particularly in the scientific and human aspects. That will be my aspiration."

SEA Women is an initiative by the Young Southeast Asia Leader's Initiative (YSEALI) Women's Leadership Academy Alumni Network, and backed by the U.S. Mission to ASEAN and Wedu, a non-profit women's leadership organisation based in Bangkok, Thailand.

The programme is aimed to educate, connect, and empower women across ASEAN to solve regional and global challenges, while increasing the visibility of women leaders in Southeast Asia, in initiatives such as women empowerment, civic engagement, environmental protection, and economic development in their respective countries. Hooi Ling who has been with the School of Chemical Sciences since 2012, specialises in the field of physical chemistry, with research interest in Nanomaterials & Nanotechnology, Green Chemistry, Surface Science and Microscale Chemistry.

She has been appointed as the first female Chair of the American Chemical Society (ACS) Malaysia Chapter for the 2018-2020 term and is one of the founding members of the ACS Malaysia Chapter since its establishment in 2014. She is also the current Chair of the Science Leadership Working Group in Young Scientists Network-Academy of Sciences Malaysia (YSN-ASM).

Hooi Ling spends much of her time in promoting Science, Technology, Engineering and Mathematics (STEM) to students and engaging in community service especially among the women folks.

For more info, Hooi Ling's profile can be accessed at http://southeastasiawomen.org/profile.html?id=b8a650c0-8604-11ea-88a4-a392eec51e47

Reference: http://southeastasiawomen.org/

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https://news.usm.my/index.php/english-news/6597-hooi-ling-chosen-to-join-cohort-of-asean-women-idol

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Innovation with Integrity

An Overview of COVID-19 Outbreak

Uma Priya Kupusamy (PhD) & Yuvaneswari Chandramoulee Swaran (PhD)
Biotechnology Division, Department of Chemistry Malaysia

Introduction
The novel coronavirus diseases (COVID-19) is an ongoing global outbreak caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) [1]. COVID-19 has been declared a pandemic disease and confirmed to affect more than 100,000 people in 100 countries across the world [2]. Globally, as of 28 June 2020, there have been 9,825,539 confirmed cases of COVID-19 and 495,388 deaths reported by the World Health Organisation (WHO) [3]. Emergence of new coronaviruses in humans happen periodically, mainly due to the high prevalence and wide distribution of coronaviruses, the large genetic diversity and frequent recombination of their genomes, and the increase of human-animal interface activities [4, 5]. To date, no specific therapeutics and vaccines are available to control this global pandemic and this has driven to a great increase in fatality rates worldwide [6]. Therefore, extensive disease control measures and prevention strategies such as global health protection systems were established in various countries to further prevent the spread of this virus across continents [7].

Epidemiology of SARS-CoV-2
Human coronaviruses which have been identified includes the Severe Acute Respiratory Syndrome Coronavirus (SARS-CoV) in 2003, Middle East Respiratory Syndrome Coronavirus (MERS-CoV) in 2012 and the latest SARS-CoV-2 in 2019 [8-10]. The first case of COVID-19 was identified from a wet animal wholesale market in Wuhan City, China in Dec 2019. Many findings showed that this virus was transmitted through wild animals sold in the wet market. Previous studies showed that exotic animals are highly susceptible and can be potential carriers of various viruses [11]. Within a month of the first outbreak, the number of cases spiked to 9,720 cases in China alone and the virus was reported to widely spread to 19 countries including Japan, Vietnam, Finland, Canada and Australia [12]. On 30th January 2020 the WHO declared COVID-19 as a Public Health Emergency of International Concern and a pandemic on 11 March 2020 [13, 14]. At the time of the press release on 11 March 2020, more than 118,000 confirmed positive cases had been reported in 114 countries resulting in 4,291 death linked to this pandemic [13]. Current evidence shows that this virus is transmitted from human to human through inhalation of droplets, contaminated hands and touching contaminated surface [15]. There has been reports that this virus remaining viable on surfaces for many days in favourable atmospheric conditions [1]. Some scientist also hypothesized that this virus could be present in stool and contaminated water supply [1]. One of the studies conducted also showed that no virus transmission occurred in pregnant women in their third trimester. This study was important because pregnant mothers are more susceptible to respiratory pathogens and pneumonia [16]. The previous world threatening outbreaks of coronavirus includes the SARS-CoV and MERS-CoV. Interestingly, COVID-19 carries different epidemiological characteristics from the SARS-CoV. Studies have shown that COVID-19 actively replicates in the upper respiratory tract and does not cause chronic abrupt onset of symptoms. Patients with this virus produce large number of virus in the respiratory system during a prodrome period and are able to carry out their active routine activities which are the major contributor to the spread of this virus. In contrast, the transmission of SARS-CoV does not occur during the prodromal period when the patients were ill and most transmission occurs when the infected individuals have severe illness. Therefore, the process to contain the SARS-CoV virus was easier compared to the current outbreak of COVID-19 [12]. In addition, patients infected with COVID-19 have shown to develop gastrointestinal symptoms such as diarrhoea which was not common in MERS-Cov and SARS-CoV patients [16].

Morphology & Pathogenesis
The RNA sequence is approximately 30,000 bases in length with a polybasic cleavage site, a characteristic known to increase pathogenicity and transmissibility in other viruses. Around one third of the RNA genome encodes for four structural proteins; spike (S), envelope (E), membrane (M) and nucleocapsid (N) which aids the virus in attaching and entering the host cell [18]. The receptors that the Spike proteins bind to are commonly found in the epithelial cells in the upper and lower respiratory tract, thus explaining the most common symptoms displayed by COVID-19 patients, which is dry cough and difficulty breathing. After entering the cell, the virus RNA is released into the cell cytoplasm. The virus RNA uses the host cell to create new virus RNA and assemble new viral particles. The new viral particles are then released into the blood stream to infect other host cells.

Clinical Symptoms
The symptoms of this virus are usually fever, cough, sore throat, breathlessness and fatigue. The disease is not severe in many people, however may lead to pneumonia, acute respiratory distress syndrome and multi

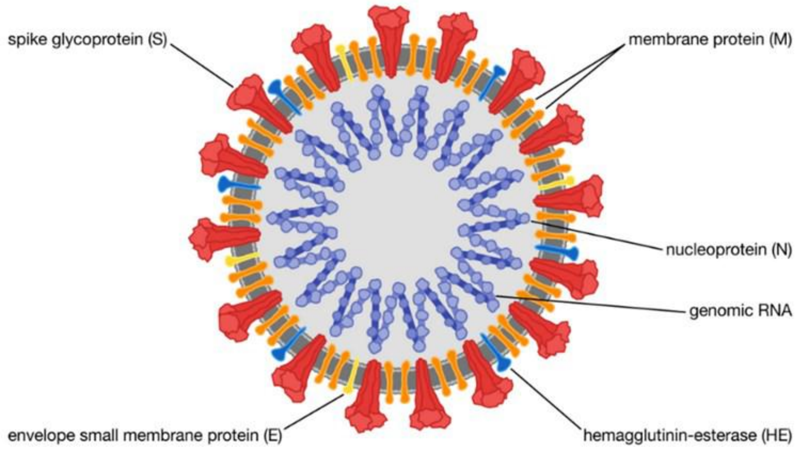

Figure 1: Morphology of Coronavirus [17]

organ dysfunction in elderly, children and immunocompromise people [1]. Other symptoms reported include sputum production, head-ache, haemoptysis, diarrhoea, dyspnoea, and lymphopenia [16]. Evidence also showed that many people are asymptomatic and infection is transmitted through large droplets generated during coughing and sneezing by symptomatic patients. The incubation period in the infected person ranges from 2 to 14 days thus patients can be infectious as long as the symptoms last and even on clinical recovery [1].

Diagnosis of SARS-CoV-2

Diagnosis of SARS-CoV-2 can be divided into two stages which are the clinical diagnosis and laboratory diagnosis. Clinical diagnosis of SARS-CoV-2 starts with the onset of symptoms such as fever, fatigue, dry cough and dyspnea, with or without nasal congestion, runny nose or other upper respiratory symptoms [19, 20]. Subsequently, a chest X-ray examination and/or chest CT scan could be carried out to observe the presence of pulmonary lesions [21]. Since the clinical symptoms of COVID-19 is similar to other known viruses that infect the upper respiratory tract, therefore, laboratory diagnosis is necessary to identify SARS-CoV-2. Reverse Transcriptase Polymerase Chain Reaction (RT-PCR) is the current standard for detection of SARS-CoV-2. The full gene sequence of SARS-CoV-2 has now been obtained, and samples can be collected from the upper (as shown in Figure 2) and lower respiratory tract of patients suspected of SARS-CoV-2 for diagnosis by RT-PCR [22]. The RT-PCR diagnosis involves specific primers being designed to bind to the nucleic acid sequence of the virus, and multiplying the nucleic acid into many copies in order to be detected by instruments. Generally reliable, robust and sensitive, RT-PCR has been widely used for the detection of viruses such as HIV and infleunza. Yet, there has been reports of high false negative results for the detection of SARS-CoV-2 using RT-PCR [23]. In response to the growing COVID-19 pandemic and shortages of molecular testing capacities in laboratories, diagnostic test manufacturers have developed rapid testing kits to detect viral antigen from nasal swabs and antibodies in the blood to aid testing outside of laboratory settings, as shown in Figure 3. Although these test kits produce faster results, typically in 30 minutes, the performance of these kits has been a point of contention. How well the tests work depends on several factors, including time from onset of illness, the concentration of virus in the specimen, the quality of the specimen collected, and the formulation of the reagents in the test kits [25]. WHO currently does not recommend the use of antigen-detecting or antibody-detecting rapid diagnostic tests for patient care [25], although Malaysia has currently adopted the use of rapid antigen test kits together with nucleic acid assays using RT-PCR for diagnosis of patients infected with SARS-CoV-2 [26, 27].

Malaysian scenario

Studies carried out shows that population densities and intensity of social contacts are two main factors which contributes to the propagation of this virus. The first case of COVID-19 was detected in Malaysia on 24 January 2020 which consisted of a group of Chinese tourist who had close contact with a Chinese national from Wuhan who was tested positive in Singapore [29, 30]. Since then till 15 February, a total of 23 COVID-19 cases were confirmed in the country which were primarily tourists from China [31]. After a two week respite in the number of COVID-19 cases, the second wave started on 28 February 2020. On 27 February 2020, a religious mass gathering was carried out in the country's capital Kuala Lumpur which involved around 19,000 participants from India, South Korea, Brunei, China, Japan and Thailand [32]. Out of 21,920 samples taken from the participants of this gathering, 1,701 samples were positive, making this the biggest cluster by far in Malaysia [32]. On 15 March 2020, another gathering was identified in Simpang Renggam, Johor where villagers gathered for a wedding ceremony which was also attended by participants from the religious mass gathering in Kuala Lumpur. This sub-cluster reported more than 200 cases. In order to control the outbreak, the Malaysian Government announced the Movement Control Order (MCO) on 16 March 2020. When the announcement was made, Malaysia had the highest number of cases in ASEAN with 553 confirmed cases [33]. Details of the number of cases after MCO was introduced is shown in Figure 4. The government also carried out the Enhanced Movement Control Order (EMCO) in areas where cases of COVID-19 were high, whereby residents were quarantined and no visitors were allowed into these areas [32]. The MCO in Malaysia took effect from 18 March 2020 to 3 May 2020, followed by the Conditional Move-

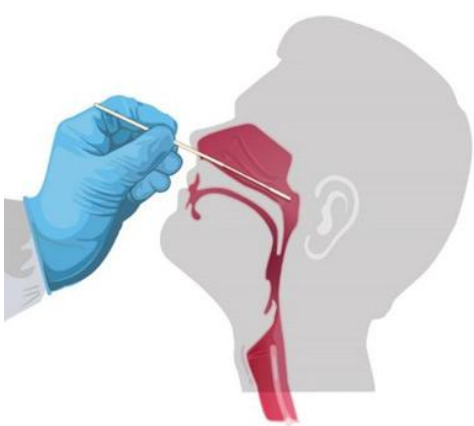

Figure 2: Swabbing of the nasopharynx for collection of COVID-19 sample [24]

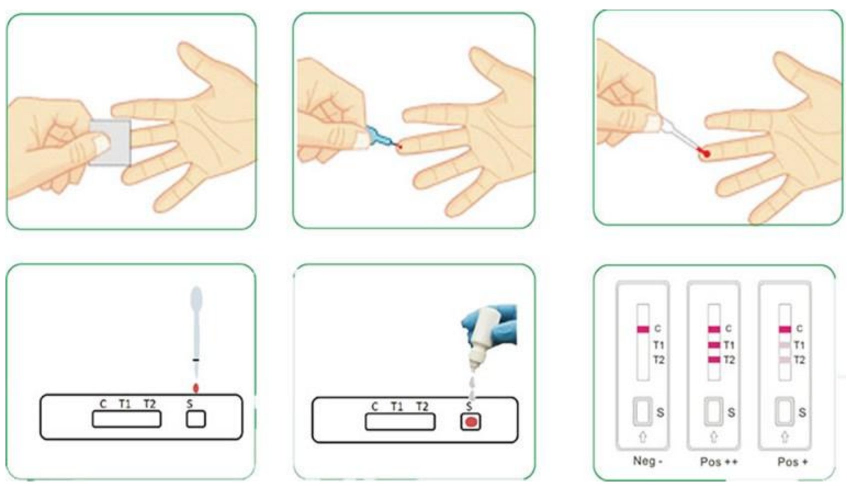

Figure 3: COVID-19 Total Antibody Rapid Test Kit [28]

ment Control Order (CMCO) from 4 May to 9 June 2020. The country entered the Recovery MCO (RMCO) on June 20 which will last until 31 August 2020. Agencies such as WHO and US Centre for Diseases Control and Prevention (CDC) has set up various prevention measures to reduce the spread of COVID-19. These prevention measures include travel restriction to high risk places, avoiding contact with symptomatic people, practicing basic hand hygiene measures and using of personal protective equipment (PPE) [35]. Malaysia was listed to be one of the first countries in the world to respond quickly to minimize the economic and social impact and to protect the people from this dangerous pandemic [11]. One of the strategies carried out by the Malaysian government was to enforce the movement control order under the Prevention and Control of Infectious Diseases Act 1988 and the Police Act 1967. Malaysians were only allowed to travel for essential needs such as grocery buying and visiting the doctor. During the period of MCO and EMCO, all types of mass gatherings, religious events, visitations and interstate travels were strictly prohibited. All government and private premises were instructed to practice social distancing at all times. [32]. MCO also restricted travelling of Malaysians abroad and foreigners into the country. Non-essential services were ordered to stop their operations and allowed employers to work from home [36]. All entry and exit points of the country were monitored by the Armed Forces and Civil Defence Force. Identification and isolation of cases by contact tracing was successfully carried out by the Ministry of Health Malaysia (MOH) [32]. Many parties took up the challenge to fill in the gaps where government machinery could not reach. During the early phase of MCO, front-liners were overwhelmed with COVID-19 cases and barely had the time for a meal break. With reports of front-liners collapsing with fatigue and insufficient supply of food, local communities got together to prepare meals and with the help of the local NGOs, these packed food were distributed to the nearby community clinics and hospitals. After a video of nurses using plastic bags as PPE suits went viral, fashion designers and prison inmates put their sewing skills to good use by sewing PPEs, which were in short supply, for medical front-liners [37, 38]. Some NGOs also helped in providing food and shelters for the homeless, the poor and those who were affected by this pandemic [39]. A website called #KitaJagaKita was also set up by a Malaysian author where financial assistance and even counselling were provided to those in need. The higher education institutions, researchers and government agencies put their knowledge and ideas together to develop technologies to aid in the battle against COVID-19. The technologies developed include COVID-19 rapid test kits, 3D printed face shields, home-brewed hand sanitisers and manufacturing of sanitizing tunnels [11]. MOH played a crucial role in containing the transmission of this disease in Malaysia by isolating and treating COVID-19 positive patients, asymptomatic carriers and those with mild symptoms at one of the several COVID-19 designated public hospitals until recovery, contrary to the practise of home quarantine applied by other countries [40]. Media through their news portals, television channels and newspapers played an important role by delivering vital information on dangers of this virus and constantly alerting the public to follow the rules during MCO and EMCO. Most importantly though, it was the rakyat, who had made a difference to the outcome of this pandemic by adhering to the rules and advice given by the authorities. A recent finding proved that Malaysians have strong knowledge about COVID-19 and full support was given to overcome this pandemic [36]. These efforts by the government, media and the people has contributed towards the reduction of COVID-19 cases in Malaysia [11].

Conclusion

All strategies and prevention measures taken have helped the Malaysian government to flatten the curve of COVID-19 cases in Malaysia. Measures such as stringent contact tracing, social distancing and travel restrictions showed the number of new COVID-19 cases to have dropped. Although quarantine, staying home and travel restrictions has been a difficult task

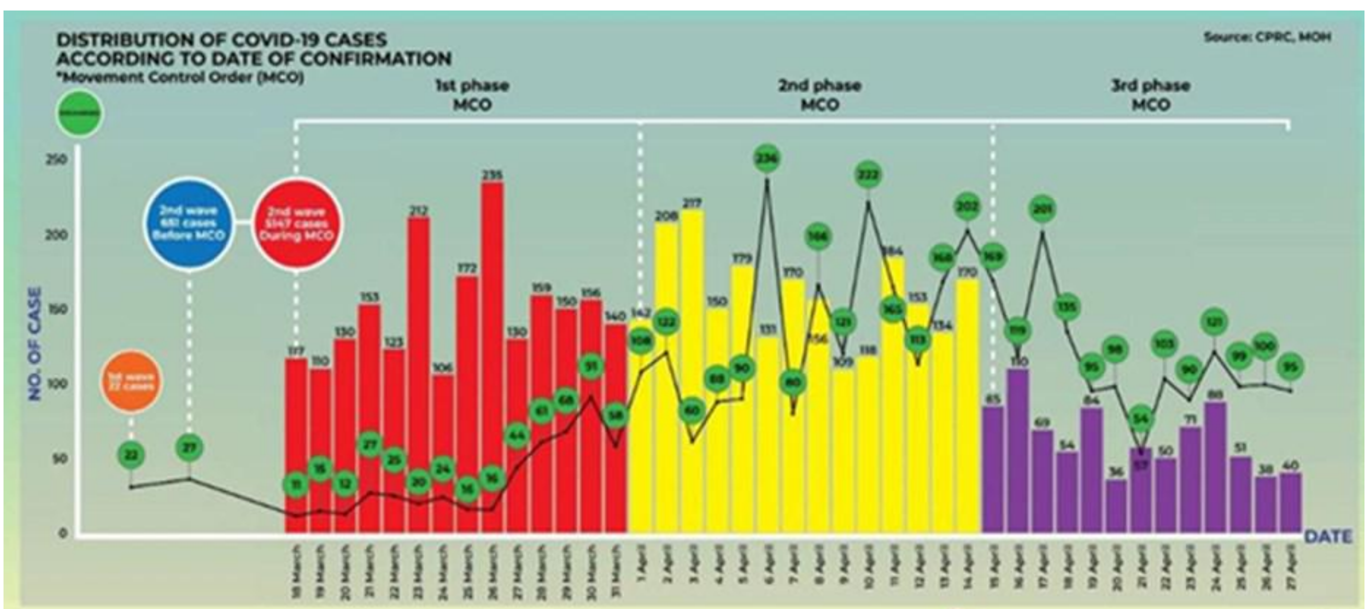

Figure 4: Distribution of COVID-19 cases in Malaysia [34]

for many, it has made us realize the importance of a balance between individual rights and public safety. This COVID-19 pandemic has also taught us the importance of being prepared for future outbreaks of similar severity. Public health officials and policy makers across the globe have come together to share valuable insights on how to improve the management of this pandemic. COVID-19 has definitely impacted the social welfare and economy in a global scale and it will not be easy to overcome the consequences of these impacts. Therefore, it is vital that all countries affected by this pandemic conduct a comprehensive evaluation in order to maintain stability when faced with similar challenges in the future.

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IKM Untold Stories

Establishment of the Federation of Commonwealth Chemical Societies

On 17 September 2019, two senior officials from the Royal Society of Chemistry (RSC), Dr Sarah Thomas and Dr Alejandra Palermo, visited IKM President and Vice President to discuss the establishment of the Federation of Commonwealth Chemical Societies. A pro-tem Committee came up with a draft Constitution and the first General Assembly was scheduled to be held in Trinidad & Tobago in May 2020 in conjunction with First Commonwealth Chemistry Congress.

Dr Sarah Thomas requested IKM to select 3 Early Career Chemists (ECC) according to the criteria given and these ECC will be invited to participate in the Congress with all expenses paid for by the Organisers. A 3-persons evaluation panel appointed by IKM Council was tasked to do the selection. The evaluation panel comprising Datin ChM Dr Zuriati Zakaria, Prof ChM Dr Ho Chee Cheong and Prof ChM Ts Dr Chan Chin Han have met and decided the three winners for ECC Travel Sponsorship:

1) Dr New Siu Yee from Nottingham University Malaysia
2) Dr Shangeetha Ganesan from Universiti Sains Malaysia
3) Dr Nur Hidayah Azeman from Universiti Kebangsaan Malaysia

The Organisers of First Commonwealth Chemistry Congress invited speakers from different parts of the world to present papers related to the UN Sustainable Development Goals (SDGs) 2030. IKM have recommended four young chemists to take part in Congress:

1) Assoc Prof ChM Dr Juan Joon Ching from Universiti Malaya
2) Assoc Prof ChM Dr Chong Kwok Feng from Universiti Malaysia Pahang
3) Dr Norwahyu Jusoh from Universiti Teknologi PETRONAS
4) Dr Izwaharyanie Ibrahim from Universiti Putra Malaysia

IKM Gold Medal & Awards Panel of Assessors 2019

IKM Council established a panel of assessors to select the winners of IKM Gold Medal, Tan Sri Datuk Amar Stephen K T Yong Award and Tan Sri Dato' Seri Law Hieng Ding Award. The panel consists of Datuk ChM Dr Soon Ting Kueh (Chairman), Assoc. Prof. ChM Dr Juan Joon Ching (Secretary), Datuk ChM Ti Thiow Hee, Prof ChM Dato' Dr Ikram M Said, Dato' ChM Dr Ong Eng Long, Dato' ChM Dr Yew Chong Hooi, Prof. ChM Dr Ho Chee Cheong, Prof. ChM Dr Ng Soon, ChM Dr Goh Lai Yoong, ChM Dr Boey Peng Lim, ChM N Hithaya Jeevan and ChM Dr Chen Seong Fong. The assessors met at IKM Board Room on 18 September 2019 to discuss and select the winners for the medal and awards.

IKM Headquarters & Branches Meeting on Administrative & Financial/Accounting Matters 2019

IKM branches' Chairpersons and Treasurers were invited to IKM Headquarters for 1-day briefing on administrative and financial matters on 10 May 2019. The briefing comprised of the following:

- Opening Remarks by IKM President, Datuk ChM Dr Soon Ting Kueh
- Administrative and management matters of branches by IKM Hon. Secretary, Assoc Prof ChM Dr Juan Joon Ching
- Financial matters and accounting procedures by IKM Hon. Treasurer, ChM Steven Tea Hing San
- Duty and responsibilities of Branch Committee & officials by IKM Vice President, Datin ChM Dr Zuriati Zakaria

IKM Refresher Course For LMIC Part 1 Examination 2019

The course was conducted at IKM Professional Centre, Taman Tun Dr Ismail, Kuala Lumpur during weekends from 29 June - 22 September 2019. A total of 26 participants attended the course. IKM President, Datuk ChM Dr Soon Ting Kueh presented attendance certificates to the participants on 22 September 2019.

Second Joint Technical Committee-Institut Kimia Malaysia (JTC-IKM) Dialogue Session to Discuss Chemistry Degree Programme Standards to be Implemented by Malaysian Qualifications Agency (MQA) for Local Universities

A second dialogue session with stakeholders to discuss chemistry degree programme standards was organized by IKM on 17 April 2019 at Novotel Kuala Lumpur City Centre Hotel. The Dialogue session was well attended by stakeholders from the relevant government agencies, universities and chemistry related industries. A total of 51 representatives were present covering various sectors of the stakeholders, namely government authorities (MQA, DOSH, BOMBA, JKM); education service providers (IPTS and IPTA); research institutions (NMIM, FRIM, MNA, Sime Darby Plantation Berhad); analytical testing laboratories and major chemical industry players. The dialogue session was officiated by Datuk ChM Dr Soon Ting Kueh, IKM President. At the session, member of individual module presented their view and feedback on the five modules of the draft degree programme. These valuable feedbacks will be compiled and incorporated into a final draft chemistry program standards for IKM Council endorsement. The finalised chemistry program standards will be submitted to MQA. The Code of Practice for Programme Accreditation (COPPA) document comprising the seven (7) areas of evaluation can then be prepared by the respective Higher Education Providers (HEPs) based on the Chemistry Degree Programme Standards approved by MQA.

MyNEXT 2019 - Optimises Benefits For Malaysian Associations

Malaysia Association neXt or MyNext is an annual congregation of Malaysian association leaders and professionals. Initiated by Malaysia Convention & Exhibition Bureau (MyCEB) this premier conference presents a niche nexus to access cutting-edge insights, exchange ideas, network, express thoughts and debate issues that impact the future growth sustainability of associations in Malaysia. Held in Kuala Lumpur Convention Centre, the conference aims in providing education and networking opportunity for Malaysian associations from the experts. IKM President, Datuk ChM Dr Soon Ting Kueh participated in this conference. This event recorded a total of 120 delegates and expected to increase in coming years.

Chinese New Year Dinner hosted by ECMI ASIA SDN BHD

ECMI ASIA Sdn Bhd hosted annual Chinese New Year dinner for IKM Council Members on 21 January 2020 at Unique Seafood Restaurant Petaling Jaya, Selangor.

Karnival Kimia Malaysia (K2M) Committee Member Awarded Tokoh Guru Kebangsaan 2020

Lee Saw Im was born in Penang in 1964 and grew up in Kedah. Born in an impoverished family, she worked diligently in succeeding her degree in Science with Education at Universiti Sains Malaysia in 1989 with the intention of contributing to nation building. Her hard work was then awarded with the Bachelor of Science degree in Education (Hons), which sparked her journey as a 'teacher'. She was commissioned as a Second Lieutenant of the Territorial Army Regiment in 1988.

She was first placed at SMK Berhala Darat in Sandakan during December 1989 before moving to SMK Bandar Baru Sentul in May 1991. During 1998, she was selected to partake in the *Guru Bestari* Course and then continued her placement in S.M. Bukit Bintang (P) in the year 1999. Finally, she was transferred to SMK Seri Bintang Utara. Throughout her career in the field of education, she has served as an excellent educator for over 30 years. During her term of service, she was promoted as the Head of Science and Mathematics Department in 2006 and Senior Acting Assistant in 2009. In recognition of her service, she was promoted to DG 54 Chemistry Excellent Teacher in 2019. In addition, she was appointed as state and national master trainer to contribute in activities such as Chemistry workshops, Standard Document Curriculum and Assessment (DSKP) Chemistry Form 4 and 5 organized by the Curriculum Development Division, MOE, Green Technology and workshops on enhancing the professionalism of chemistry teachers. She has also been appointed as the President of the Federal Territory Excellent Teacher Council since 2016. Under her presidency, various activities such as the WPKL Professionalism Colloquium 2018, the Education Exhibition 2017 - 2019 and the National Teacher Training

Conference of Malaysia in 2019 were carried out.

Besides working in the classroom, she is also active in co-curricular activities. She always believes in the virtue of balancing work both curriculum and co-curricular activities. Holding strongly to her belief, she has demonstrated a high level of commitment throughout her service and received numerous awards at state and international level. Recently on May 16, Teacher's Day 2020, she received the honor of being an excellent teacher from the Honorable Prime Minister, Tan Sri Muhyiddin Mohd Yassin for her excellent service, involvement, and achievement. In 2019, she received the Global Teacher Award organised by AKS Education, an India-based education research company aimed at recognising efforts by teachers from around the globe. It was held in New Delhi on Sept 15. She was selected as the best candidate to represent Malaysia for the 1st Ki Hajar Dewantara Award in 2016 organised by SEAMEO QITEP in Science (SEAQIS), Bandung, Indonesia. The Ki Hajar Dewantara Award was dedicated to appreciate science teachers' dedication. The nominees of the award are selected based on their outstanding achievements, contribution, and dedication in science education as well as their innovations. She did not disappoint Malaysia by being awarded 1st place in The Best Science Teacher in Southeast Asia for 1st Ki Hajar Award. She also initiated an action research which was successfully presented at the national level in 2019. Her action study, entitled "BoCaps Merry Go Round", aims to improve students' ability to comprehend the formation of ions and ionic compounds. Her action research was selected by the Educational Planning and Policy Research Division for publication and presentation at the National Re-

search Conference on 27 September 2019. This success was appreciated by the Tun Hussien Onn Teacher Foundation (YGTHO) with sponsors of RM 5000 for a presentation abroad. She was then awarded the Award of Honor for presenting her research at the 20th International Conference on Teaching, Education & Learning 2019, Dubai. Ms. Lee also contributes to the Chemistry curriculum as a panel for the Standard and Curriculum Chemistry Standard for Forms 4 and 5, which is organized by the Curriculum Development Division, KPM. She has contributed as a committee for Karnival Kimia Malaysia (K2M) 2019 and as a speaker for Fun Learning Chemistry 2019.

During the COVID-19 scenario, she explored the possibility of online teaching and generously shared her insights in various webinars. She was invited by SEAMEO QITEP In Science, Indonesia as panel for the Webinar on Science Teaching-Learning Innovation in the New Normal with the title “The Challenges and Initiatives” on 24 June 2020. In addition, she was also invited by SEAMEO Secretariat for SEAMEO Special e-Forum on Reaching the Unreached and Teachers Call to Action During COVID-19 Pandemic on 30 June 2020 to present “Experience of Teacher: A case of Malaysia”. She also did her sharing for Webinar Searching for Global Teachers: A Share , Institute of Teacher Education of the College of Special Education 2020 and Action Research Talk 2020, eDidik Malaysia. In addition she also contributes as a mentor to her STEM students. The team achievements are as follows:

1) BIEA 2020 International STEM Youth Innovation Competition by British International Education Association, London - Raising Star Award, Best Report Award and Best Video Award
2) National Science Challenge - Champion for 2015, 2016 and 2017
3) Malaysia-China STEM Collaboration 2019 – Best Presenter, Best Team, Most Talented, Overall 2nd Place and Overall 1st Place
4) International Conference of Young Scientists 2019 - Gold and Bronze medal
5) International Conference of Young Scientists – Gold medal
6) IET Faraday Challenge State 2019 – 1st Runner up
7) IET Faraday Challenge National 2019 – 2nd Runner up
8) BEGIN Challenge 2018, Engineering Faculty, University of Malaya – Champion Team
9) STEP National Innovation 2016 – Gold medal

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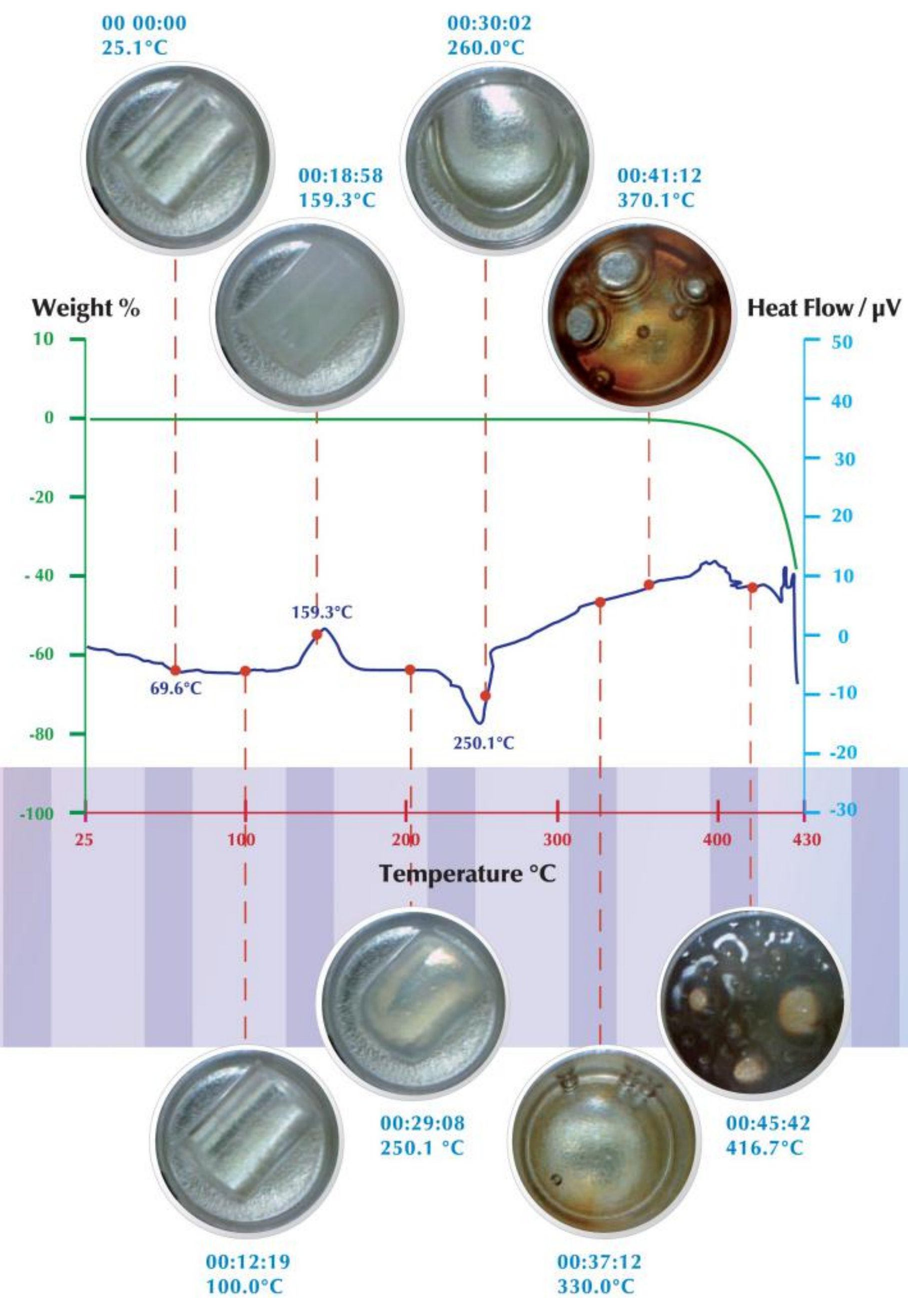

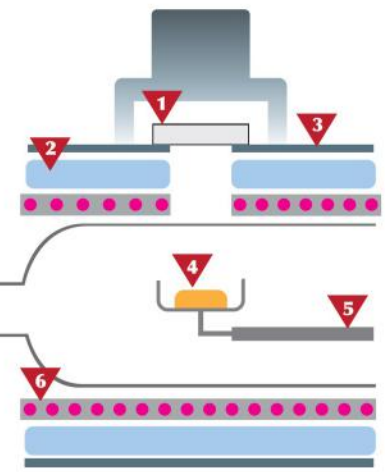

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Cytotoxicity Assay of Plant-Mediated Super Paramagnetic Iron Oxide Nanoparticles using Walnut Green Husk Extract

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Abstract
Synthesis of Super Paramagnetic iron oxide nanoparticles (SPION) has attracted increasing interest due to their importance in biomedical and technological applications. To investigate the ability of *Juglans regia* (*J. regia*) green husk extract in *J. regia*/Fe_3O_4 nanoparticles (NPs) size control, they were synthesized through co-precipitation method by using *J. regia* extract and without it. For both tests, other experimental conditions were same. According to High resolution transmission electron microscopy, the mean diameter and standard deviation of Fe_3O_4 and *J. regia*/Fe_3O_4 NPs synthesized using co-precipitation method were 12.60 ± 2.87 and 5.77 ± 1.66 nm respectively. These results showed that *J. regia*/Fe_3O_4 NPs synthesized using extract have a smaller size than nanoparticles fabricated by co-precipitation method; moreover, green husk extract plays the main role as stabilizing and capping agent. The obtained results of Powder X-ray diffraction (PXRD), High resolution transmission electron microscopy (HR-TEM), Field emission scanning electron microscopy (FESEM), and Energy dispersive X-ray (EDX) are in good agreement with each other and confirm the high purity of fabricated magnetic nanoparticles using *J. regia* extract. Based on the zeta potential result of *J. regia*/Fe_3O_4 NPs has sufficient value for the stability of solution, the *J. regia*/Fe_3O_4 NPs showed sufficient stability. Vibrating sample magnetometer (VSM) revealed that the *J. regia*/Fe_3O_4 NPs due to their proper magnetic properties have high saturation magnetization and low coercivity. Moreover, the *J. regia*/Fe_3O_4 NPs prepared by extract have stronger magnetic properties compared with those fabricated without extract by co-precipitation method. (Chang et al. 2012). According to FTIR outcome shows that the *J. regia* could be coated on the Fe_3O_4 in a successful manner. The non-toxic effect of *J. regia*/Fe_3O_4 NPs concentration below 1000 μg/ml was observed in the studies of in vitro cytotoxicity on normal and cancerous cell lines, respectively. The dose-dependent toxicity made it a suitable candidate for various medical applications.

Keywords: Super Paramagnetic iron oxide nanoparticles, *Juglans regia,* green husk, X-Ray Diffraction analysis.

1.0 Introduction

Current development in nanotechnology has advanced the nanoscience field and it has become popular and among the most studied area of science in the past twenty years. Nanoparticles (NPs) are generally defined as particles with a measurement of 100 nm or less in diameter with the particular feature that mainly size-dependent (Darezereshki, Ranjbar, and Bakhtiari 2010). Research on NPs has become attractive due to its superior and unique characteristics as opposed to other materials (Shanks, Hodzic, and Ridderhof 2006) that had led to their application in a wide array of fields. Some of these characteristics or properties include the thermal, catalytic, and optical properties as well as being an electrical conductor and in use for biological applications (Shameli, Ahmad, Yunus, Ibrahim, et al. 2010). The attractive properties are the result of its high surface energy as well as a high ratio in the surface to volume with comparatively minute sizes. The NPs' synthesis in the polymeric media has shown promise due to the processing ease, solubility, lesser toxicity, with the potential to control the resulting NPs' growth (Shameli, Ahmad, Yunus, Rustaiyan, et al. 2010). Superparamagnetic iron oxide nanoparticles (SPION) are inorganic nanomaterials of ferromagnetic substances with sizes between 1–100 nm. Owing to the nano sizes, SPION is super paramagnetic (ability to have zero magnetism in the absence of external magnetic field). This enables the particles to have large magnetic susceptibility and single magnetic domain. Super paramagnetism occurs when the size of a ferromagnetic material is so small that the ambient thermal energy is sufficient to induce free rotation of the entire crystallite (Qiao, Yang, and Gao 2009). SPION can be classified into two: SPION with hydrodynamics sizes greater than 50nm (coating included) and those with sizes less than 50 nm which are called ultra-small super paramagnetic iron oxide nanoparticles (USPION). The two common forms of SPION are Magnetite (Fe_3O_4) and Maghemite (γ-Fe_2O_3). SPION has got wide spread applications in several areas including magnetic fluids, catalysis, environmental remediation, data storage, and biomedical research and development (Sodipo and Aziz 2016). This is due to easy synthesis and magnetically controllable property of the nanoparticles. In addition, SPION offers several properties that allow its biomedical applications. First, it has controllable sizes 1–100 nm, which places it at dimensions smaller than or comparable to some of the biomedical system such as cell (10–100 mm), virus (20–450 nm), protein (5–50 nm) and gene (2 nm wide and10–100 nm long) (Pankhurst et al. 2003). Second, due to the super paramagnetic features of SPION, it can be manipulated and driven by an external magnetic field gradient to a particular body area and target biological entities (Chapa Gonzalez et al. 2014). This allows SPION to be applied in labelling, sensing, separation of biomolecules, drug and gene delivery (Burtea et al. 2011). Third, due to the single-domain property of SPION, it has a magnetic moment which can undergo orientational thermal fluctuations from either Brownian or Ne´el fluctuations in the presence of an external AC magnetic field to generate localized temperature up to 45–47 °C (Fortin et al. 2007). This heat is employed in hyperthermia therapy to kill cancer cells (Salas, Veintemillas-Verdaguer, and Morales 2013). Finally, SPION's super- paramagnetic behavior plus its large magnetic susceptibility cause microscopic field in homogeneity and activated phasing of protons in the presence of an external magnetic field. The successful biomedical applications of SPION depend mainly on its stability under biological environments. The major draw - backs of SPION are agglomeration and lack of affinity for biomolecules. The causes of agglomeration in SPION can be related to the high surface area, Van der Waals forces of attraction and dipole to dipole interactions between the particles (Mørup, Hansen, and Frandsen 2010). Surface modification of SPION with biocompatible materials is one the strategies used to achieve biomedical applications of SPION. A number of materials such as chitosan, glucose, carboxylic and amine group, surfactant, polymer and inorganic materials (silica or gold) can be used to modify the surface of SPION (Sodipo and Aziz 2014). In contrast to the time -consuming chemical and physical methods which involve complicated procedures, a green method is much easier and safer to use, and plant-mediated synthesis of nanoparticles is still a new scheme and the outcome is yet to be studied. There are a couple of successful studies in synthesizing Fe_3O_4-NPs by using plant extract. For instance, fruit extract of *Artemisia annua* (Basavegowda et al. 2014), leaf extract of *Perilla frutescens* (Basavegowda, Mishra, and Lee 2014), *Tridax procumbens* (Basavegowda, Mishra, and Lee 2014) and *caricaya papaya* (Latha and Gowri 2014), peel extract of *plantain* (Venkateswarlu et al. 2013), and also extract of *seaweed K. alvarezii* (Yew et al. 2016). However, there are only finite studies on the synthesis of Fe_3O_4-NPs from marine plants. Different parts of the walnut tree (*Juglans regia*) such as kernels, leaves, tree bark and also fruit green husk were utilized for both industries of pharmaceuticals and cosmetics (Stampar et al. 2006). The study by Carvalho et al. (2010) established the activity of the antioxidant in walnut leaves, seeds, and green husks, as well as in antimicrobial activities (Fernández-Agulló et al. 2013). The *J. regia* aqueous extracts were examined by Ghasemi *et al.* (2011) studied the methanolic ones (Ghasemi et al. 2011). The findings of Carvalho *et al.* (2010) display the potential of these low-cost natural materials as the source of compounds that are phenolic with activities of antimicrobial and antiradical and it also reveals that green husk knowledge should be widened(Carvalho et al. 2010). Based on past literature review, the phenols' content varies from the *J. regia*. The high-performance liquid chromatography approach utilized in determining the external standards has allowed the act of identifying six compounds that are phenolic including vanillic acid, myricetin, coumaric acid, syringic acid, juglone, and ferulic acid (COSMULESCU et al. 2010). All the above results are matching with phenols confirming that they are involved closely in the stabilizing of Fe_3O_4. This research attempted to synthesize the Fe_3O_4 NPs using room temperature the *J. regia* layers in the aqueous solution by utilizing the $FeCl_2$, $FeCl_3$, and NaOH. The purpose of using *J. regia* being the stabilizing and size control iron precursor respectively while non–toxic effect of *J. regia*/Fe_3O_4 NPs was observed in the cytotoxicity study. Based on the researcher's knowledge, this is the first attempt by any researcher in the area of *J. regia*/ Fe_3O_4 SPION characterization as well as synthesis.

2.0 Material and methods

Iron (III) chloride hexahydrate ($FeCl_3·6H_2O$) of 97% and iron (II) chloride tetrahydrate ($FeCl_2·4H_2O$) of 99% were obtained from Sigma-Aldrich (St Louis, MO, USA). NaOH of 99% was obtained from SYSTERM, ChemAR, 98% (US). The *J. regia* green husk was collected from Sorkh-e-Hesar Tehran, Iran and specimen of this plant identified by Iranian Research Institute of Plant Protection (IRIPP). The entire reagents in this attempt were of the analytical grades and were utilized as received minus other purification of sorts. The solutions were prepared in new batches utilizing the distilled water and stored in the dark to prevent photochemical-induced reactions. All the glassware utilized in the experimental processes are cleaned with the fresh solutions of HNO_3/HCl (3:1, v/v), thoroughly cleaned with double distilled water, and dried prior to use.

2.1 Extract preparation

The *J. regia* green husk were washed and dried in an oven at 40 ˚ C for 48 h. The dried green husk was then ground into a mill, stored in glass bottles and kept at room temperature until further analyses. The finely ground *J. regia* green husk (1 g) was added to the 100 ml of the boiling water for 30 min. and then was filtered. The concentrated extracts were kept in dark place at 4 °C for future use.

2.2 Synthesis of *J. regia*/Fe_3O_4NPs

At the first, Fe_3O_4 NPs were synthesized through co-precipitation method using NaOH. Then, to investigate the ability of *J. regia* green husk extract in *J. regia*/ Fe_3O_4 NPs size control, the synthesis of *J. regia*/Fe_3O_4 NPs, 1 g of *J. regia* was suspended in 100 mL deionized water. The molar ratio in solution was adjusted to 1:2 by adding a measured amount of Fe^{3+} and Fe^{2+} in 80 ml of deionized water. The iron solution (5 mL) suspended with *J. regia* extract (5 mL) was stirred for 1 hr for impregnation by the external surface of *J. regia* layers to prepare *J. regia* /Fe^{3+}–Fe^{2+} nanoparticles. The 2 mL freshly prepared NaOH (2 M) was added to *J. regia* /Fe^{3+}–Fe^{2+} nanoparticles suspension under continuous stirring. The suspensions were finally centrifuged, washed three times with distilled water, and dried by oven dryer at 60 °C. Other Experimental conditions for both tests were same.

2.3 Characterization

The XRD analysis was carried out to determine the phase crystallinity and purity of the synthesized A *J. regia*/Fe_3O_4 NPs (studied by using PXRD in the small angle range of 2θ (10–80 degrees). The scan speed of 2 degrees/minutes was applied to PXRD patterns recording). The magnetic property was measured on a Lakeshore vibrating sample magnetometer at room temperature. Morphology, structure and the electron diffraction pattern of *J. regia*/Fe_3O_4 NPs were characterized by using a model JEM-2100F High resolution transmission electron microscopy (HR-TEM). The elemental analysis of the *J. regia*/Fe_3O_4 NPs, energy dispersion X-ray spectroscopy was carried out on a Shimadzu EDX700HS spectrometer attached to the SEM.

Light macroscope attached whit camera (Nikon, Eclipse, TS100, ElWD 0.3/OD75). The FTIR spectrum was utilized to recognize the functional groups existing in the synthesized compound. FTIR spectra were recorded over the range of 500–4000 cm^{-1} used the Series 100 FTIR 1650 spectro photometer (PerkinElmer,W altham,M A, USA). Zeta potential using the Particulate Systems Nano-Plus Zeta/Nano Particle Analyser, Japan, was utilized to measurement the charge of the droplet surface of solution, which may cause effects on the chemical and physical stability of the *J. regia*/Fe_3O_4 NPs (Rabinovich-Guilatt et al. 2004).

3.0 Cytotoxicity assay

Cytotoxicity is the killing ability of synthesized chemicals, naturally occurring toxins or immune-mediator cells. One of the parameter to determine cytotoxicity is by using MTT assay (3-[4,5-dimethylthiazol-2-yl]-2,5-diphenyltetrazolium bromide). Cell culture with the concentration of 2 x 103 cells/ml was prepared and was plated (100 µl/well) onto 96-well plates. The diluted ranges of sample extracts were added to each well with identified concentrations; 1000, 500, 250, 125, 62.5, 20, and 1 µg/ml further incubated for 72 hr. MTT solution was added to the end of incubation samples to the cells and continued for incubation in an incubator for 3 hours. After solubilization of the purple formazan crystals using DMSO was completed, the Optical Density (OD) of the plant's extract was measured using an ELISA reader at a wavelength of 570 nm. The cytotoxicity was recorded as the drug concentration causing 50% growth inhibition of the tumor cells (IC50 value) using the formula given below in the Eq. 1.

$$\%\text{Cell viability} = \frac{\text{OD sample (mean)}}{\text{OD control (mean)}} \times 100 \qquad (1)$$

4.0 Results and discussion

The *J. regia* green husk suspension was pale yellow, which turned to dark color after the addition of the Fe^{+3} and Fe^{+2} to the *J. regia* green husk suspension and addition of NaOH solution as a reducing agent (Fig. 1). Conventionally, preparation of magnetite nanoparticles is the base to add an aqueous mixture of Fe^{3+} and Fe^{2+} chloride at ratio a 2:1 molar.

The possible chemical equations for preparing of *J. regia*/Fe_3O_4 NPs was shown in the Eq. 2, 3: The overall reaction may be written as follows (Shameli 2013; Hribernik et al. 2012).

$$J.\ regia + H_2O_{(L)} + 2Fe^{+3} + Fe^{+2} \xrightarrow{\text{stirring}} [J.\ regia/2Fe^{+3}{:}\ 1Fe^{+2}] \qquad (2)$$

$$[J.\ regia/2Fe^{+3}{:}1Fe^{+2}] + 8OH^-_{(aq)} \rightarrow [J.\ regia/Fe_3O_4\ NPs]_{(s)} + 4H_2O_{(L)} \qquad (3)$$

4.1 X-Ray Diffraction Analysis

The research collected information regarding the synthesized NPs' crystalline nature. The XRD spectrum of J. regia green husk extract represents in Fig. 2 there is no obvious peaks due to the absence of *J. regia*/Fe_3O_4 NPs. A broad diffraction peak was represented in Fig. 2a at 28.42°, which is attributed to J. regia green husk. When the intensity of pick decrease or shifting happens, suggesting that the *J. regia*/Fe_3O_4 NPs have interaction with biomolecules present in the extract. The *J. regia*'s XRD spectrum, which is demonstrated in Fig. 2a, does not point out the peaks that are linked to the components of the crystalline given the non-availability of the *J. regia*/Fe_3O_4 NPs. However, Figure 2b demonstrates that following a 1 hr stirring, seven peaks of diffraction appears at the 2th values of 30.30, 35.68, 43.45, 53.83, 57.42, 62.93, and 74.58. The seven peaks of diffraction in this pattern are with cubic structure. The Fe_3O_4 structure is (200), (311), (400), (422), (511), (440), and (533) crystallographic planes, respectively ICDD/ICSD X'Pert High Score Plus (Ref. No. 01-075-0449). Estimation of the crystallite size of synthesized *J. regia*/Fe_3O_4 NPs can be calculated using the Debye-Scherrer equation (Raman and Doble 2014), which reveals a relationship between X-ray diffraction peak broadening and crystallite size. The Debye-Scherrer equation is shown in Eq. 4:

$$d = \frac{k\lambda}{\beta cos\theta} \qquad (4)$$

Where d is the average crystallite size of synthesized *J. regia*/Fe_3O_4 NPs, K is the Scherrer constant with a value from 0.9–1, λ is the X-ray wavelength (0.154 nm), β is the line broadening in radians, and θ is the

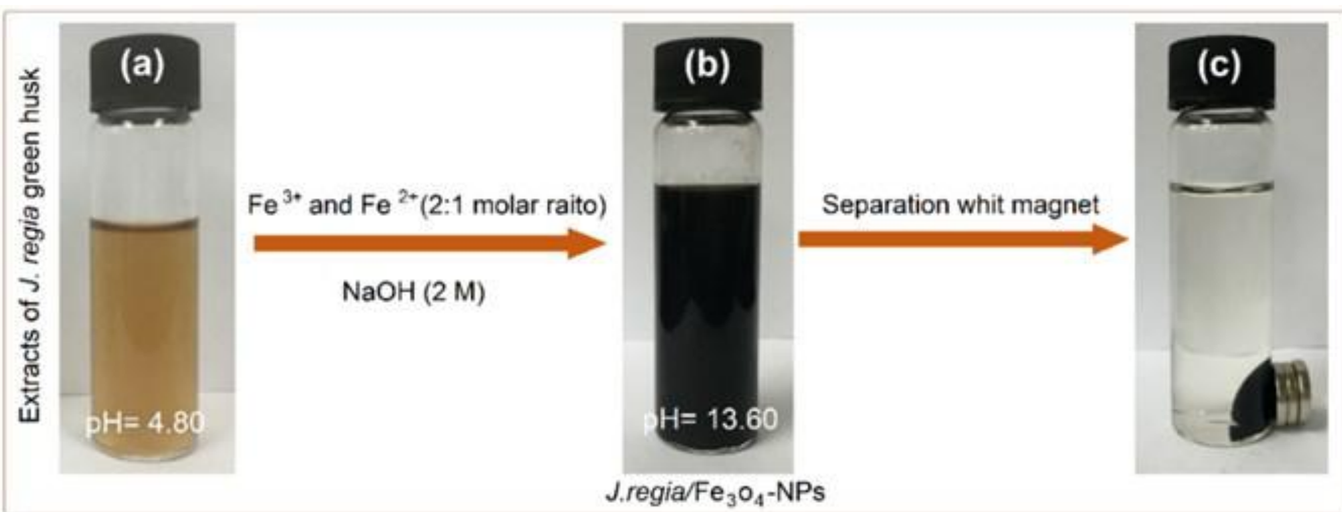

Fig. 1(a) *J. regia* extracts (**b**) *J. regia*/Fe_3O_4 NPs. (**c**) Separation of synthesized *J. regia*/Fe_3O_4 NPs from the reaction mixture using an external magnet.

Bragg angle. Using the equation, the estimated crystallite mean size of synthesized *J. regia*/Fe_3O_4 NPs was 10.30 nm, which was calculated from the full-width of the *J. regia*/Fe_3O_4 NPs diffraction peak (Sá et al. 2014) at all 2θ. Based on the X-ray diffraction pattern, the synthesized *J. regia*/Fe_3O_4 NPs were figured out to be high purity crystalline, as no impurity peak was observed.

4.2 Morphology study

Figure 3 illustrates the HR-TEM images of *J. regia*/Fe_3O_4 NPs were synthesized through co-precipitation method using NaOH and those were synthesized using *J. regia*. Figure 3a demonstrates the agglomeration of *J. regia*/Fe_3O_4 NPs and also show that a majority of the NPs are in cubic shape. Based on Fig. 3b, particle size distribution histogram was designed based on the counted 150 NPs' size. The size of the mean particle is 12.60 nm with 2.87 nm standard deviation. Figure 3d shows the size of the mean particle is 5.77 nm with 1.66 nm standard deviation, obvious the agglomeration is reduced and smaller particles size have fabricated. Based on the Debye-Scherrer equation the crystallite size of the synthesized *J. regia*/Fe_3O_4 NPs was found to be 10.30 nm from XRD analysis, which is in an agreement with the result obtained from the HR-TEM and also the cubic structure of NPs. By comparison between HR-TEM images, it can result that the extract had a significant influence on the size of NPs and played the main role in control size process.

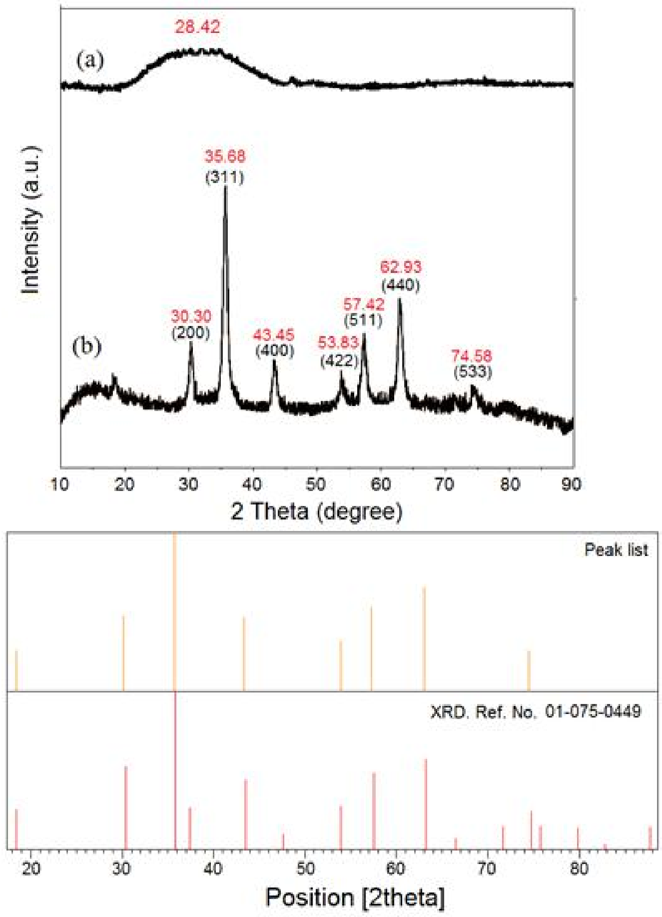

Fig. 2 the XRD of *J. regia* (a) and *J. regia*/Fe_3O_4 NPs (b) with the related peaks respectively.

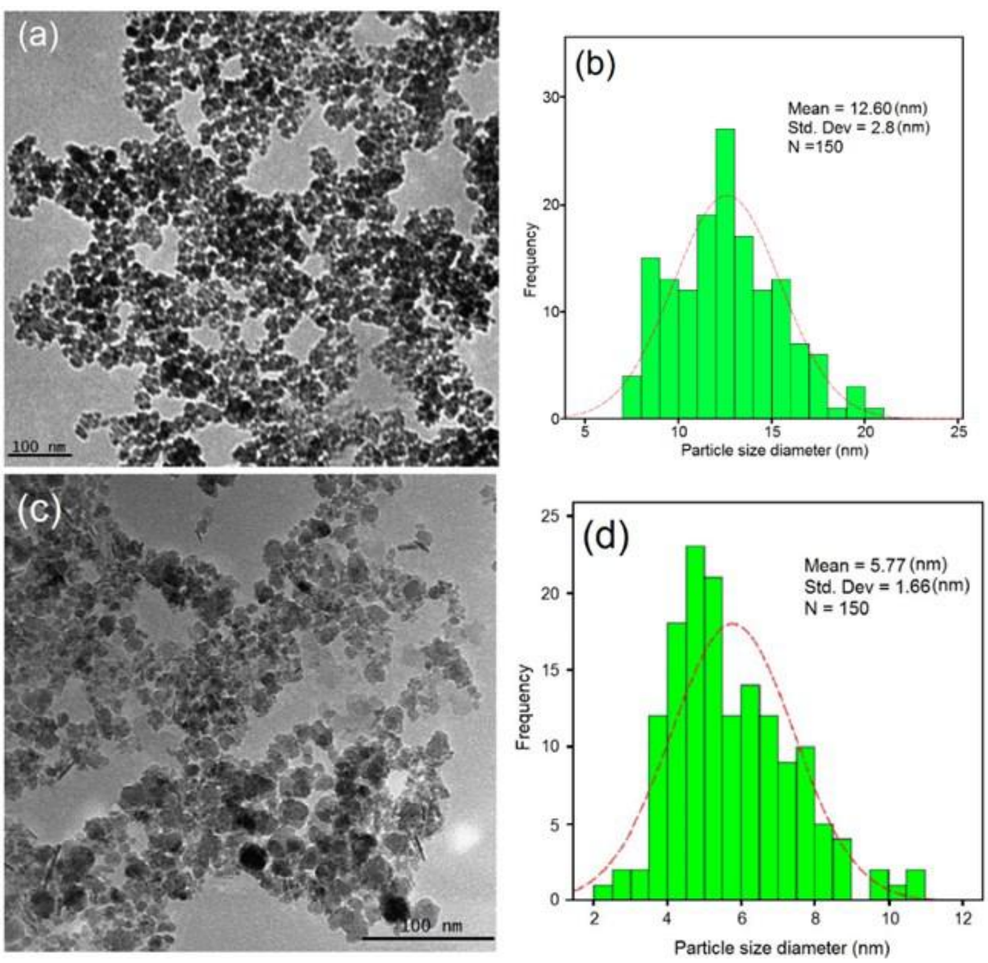

Fig. 3 HR-TEM images (a), particle size distribution histogram of Fe_3O_4 NPs (b), HR-TEM images (c) and particle size distribution histogram of *J. regia*/Fe_3O_4 NPs (d)

The HR-TEM image of *J. regia*/Fe_3O_4 NPs was shown in Fig. 4. The electron diffraction pattern and HR-TEM image confirm that *J. regia*/Fe_3O_4 NPs have good and regular crystallinity. The lattice spacing measured on the HR-TEM image was 2.53 Å. The values of d spacing between the lattice of Fe particles are in good agreement with those reported in the literature for Fe_3O_4 NPs (311), which further supported the metallic state of the supported Fe_3O_4 (Sisodiya et al. 2015). Figure. 5 depicts the size and identify the iron elements which were confirmed by FESEM image and EDX. FESEM image supports the HR-TEM that the *J. regia*/Fe_3O_4 NPs are small sizes (Figures 5a). Each element has a unique atomic structure, EDX provides information about the chemical composition of the compound. EDX is an interaction between X-rays and the compound being investigated. Therefore, when this analysis is carried out, the X-rays that are reflected off the compound give peaks. The amplitude of the peaks obtained help to identify the elements present in the compound being studied. The peak amplitude of iron starts from 0.7 to 7 Kev. Figure 5b confirms the presence of the iron elements in the compounds using EDX. The results also demonstrate the high percentage of iron present in the particles. The EDX spectra revealed the presence of iron peaks in three different areas (0.7, 6.4 and 7.0). The results indicate that the synthesized *J. regia*/Fe_3O_4 NPs are in high purity and coated with *J. regia* extract.

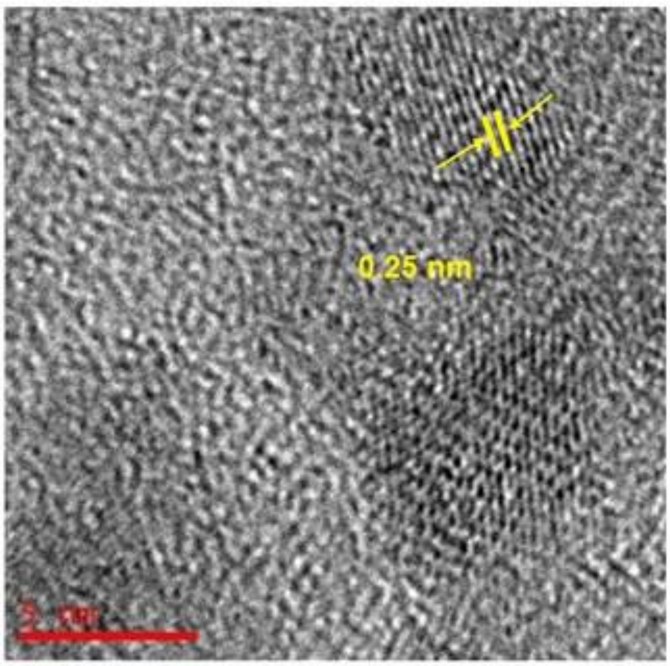

Fig. 4 The electron diffraction pattern of *J. regia*/Fe_3O_4 NPs by using the HR-TEM image.

4.3 Zeta potential analysis

The zeta potential analysis was carried out to gather information about the surface properties of the nanoparticles. This equipment is able to reveal the stability of particular systems in the long-term. A zeta value of about ±30 mV is needed for a physical suspension stabilized by the repulsion of the electrostatic role. Additionally, when a combined electrostatic as well as sterile stabilization electrostatic and steric stabilization, ±20 mV is enough (Şen and Erboz 2010). Zeta potential results have a negative value for *J. regia* and *J. regia*/Fe_3O_4 prepared at room temperature. The zeta potential of *J. regia* has a -28.68 mV value, whereas the *J. regia*/Fe_3O_4 NPs values, changed to -26.90 mV [Fig. 6(a-b)]. Based on the sufficient value for the stability of solution, the *J. regia*/Fe_3O_4 NPs showed sufficient stability. The zeta potential of the *J. regia*/Fe_3O_4 NPs is slowly reduced, however, not less than the sufficient amount for stable expression, thereby producing stable *J. regia*/Fe_3O_4 NPs.

4.4 Vibrating Sample Magnetometer

The vibrating sample magnetometer (VSM) was applied to test the magnetic properties of *J. regia*/Fe_3O_4 NPs. Magnetic characterization of the *J. regia*/Fe_3O_4 NPs (1.0 g) at room temperature is represented in Fig. 7. It can be seen from the magnetization curves that high saturation magnetization (Ms) of the *J. regia*/Fe_3O_4 NPs 53.32 emu.g^{-1} with low coercivity 32.50 G were determined. According to the magnetization curves that sample has high saturation magnetization (HMs) of the *J. regia*/Fe_3O_4 NPs because it indicated more Fe_3O_4 being trapped in the *J. regia* substance. Using the hysteresis loop presented in Figure 7b, are estimated the coercivity. Figure 7c clearly shows the synthesized *J. regia*/Fe_3O_4 NPs are able to be rapidly

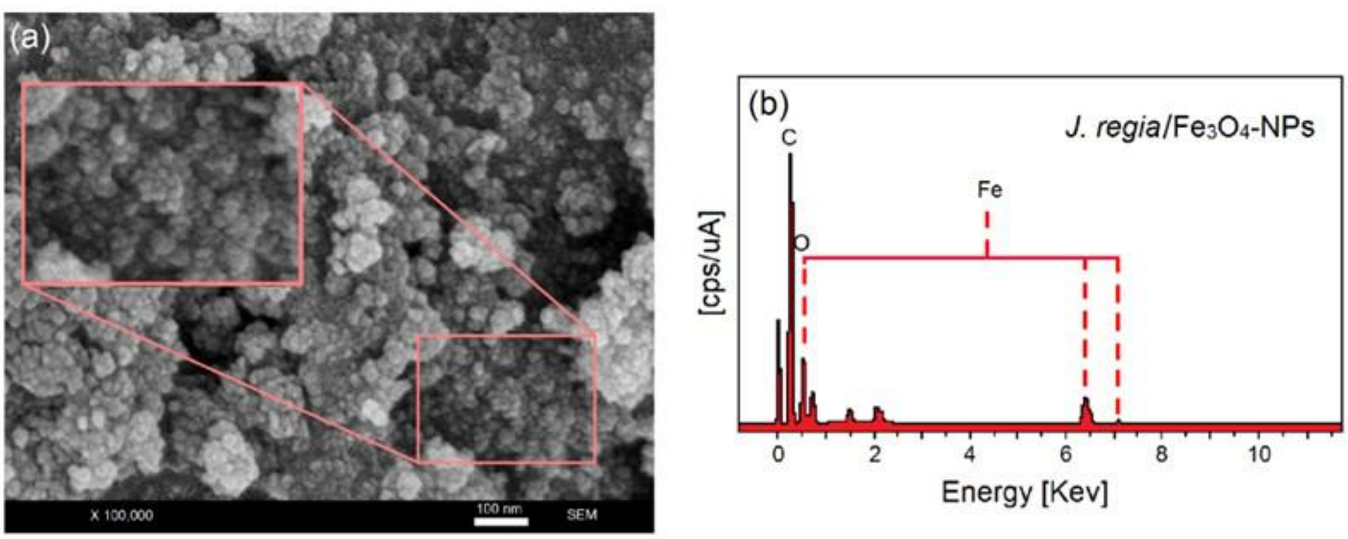

Fig. 5 FESEM micrographs (a) and EDX spectra for the *J. regia*/Fe_3O_4 NPs (b).

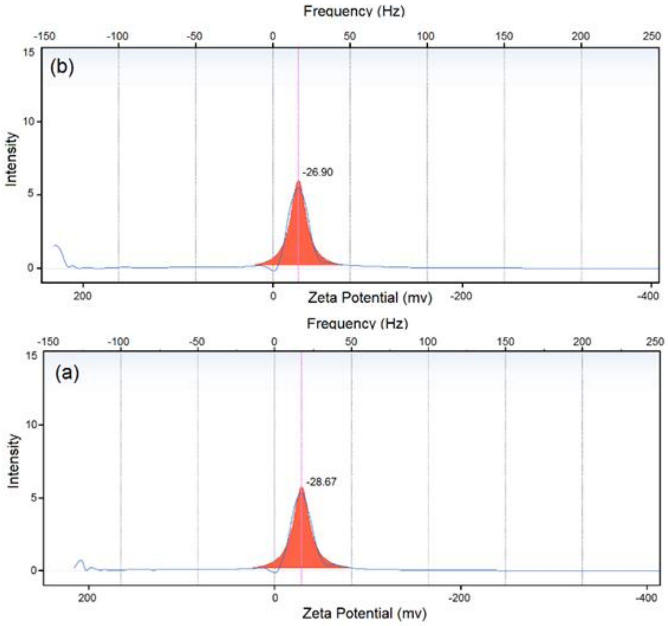

Fig. 6 Zeta potential results for *J. regia* (a), and *J. regia*/Fe_3O_4 NPs (b).

attracted by an external permanent magnet, demonstrating that the *J. regia*/Fe_3O_4 NPs have magnetic properties. After the magnet was removed, the *J. regia*/Fe_3O_4 NPs were easily dispersed by shaking.

4.5 Fourier Transform Infrared Spectroscopy Study

The FT-IR spectra of *J. regia* and *J. regia*/Fe_3O_4 NPs are demonstrated in Fig. 8. Based on the FT-IR spectrum of *J. regia* as demonstrated in Fig. 8a, the peaks for absorption at 3,405 cm^{-1} are assigned to vibrations of stretching of the groups of –OH and the 2960-2850 cm^{-1} region reflects the C–H stretch, accordingly (Chen et al. 2011). The intense at 1596 cm^{-1} band is utilized for C=C vibrations of stretching (Qin et al. 2011). The 1,400 cm^{-1} peak is utilized for the C=C aromatic stretch for aromatic vibrations in the bound

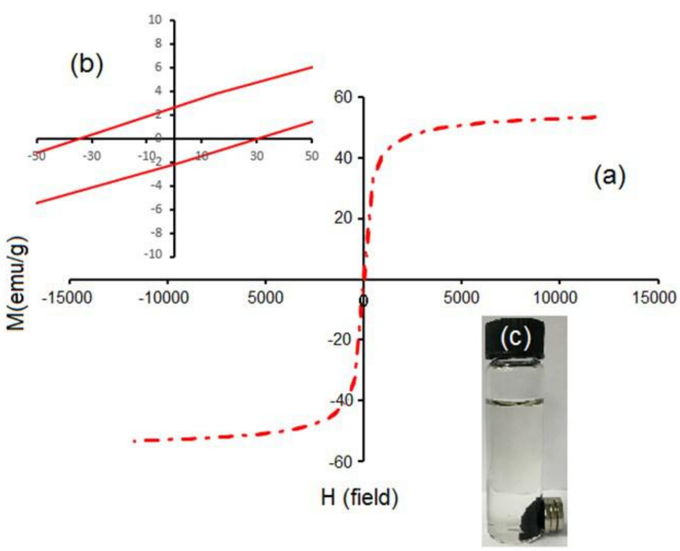

Fig. 7 Vibrating sample magnetometer plots of *J. regia*/Fe_3O_4 NPs coated with *J. regia* (a), hysteresis loop of *J. regia*/Fe_3O_4 NPs (b) and (c) Separation of synthesize *J. regia* /Fe3O4-NPs from solution using an external magnet.

lignin (Chen et al. 2011). The 1,117 cm^{-1} peak reflects the C–O stretch and bands of deformation in the lignin (Sun et al. 2005). The Fe_3O_4 presence in the J. regia's substrate is proven by the bands of adsorption at approximately 295–538 cm^{-1} which reaffirm the stretching of the Fe–O as observed in Fig. 8b (Karaoğlu et al. 2011). The bands at 1,622 cm^{-1} reveal reactions between the groups of hydroxyl on the *J. regia*/Fe_3O_4 NPs surface as well as the *J. regia* groups of carboxylate (Zhao et al. 2010). *J. regia*/Fe_3O_4 NPs in comparing with *J. regia* reveals a reduction in the adsorption peaks' intensity; the potential cause of this reduction is due to the partial reduction of the *J. regia* (Chang et al. 2012). This shift symbolizes the NPs' interaction with the extract while the changes in these peaks' intensity reveal the mineral composition creation. This outcome shows that the *J. regia* could be coated on the Fe_3O_4 in a successful manner. According to the previous study, the phenols' content varies from the *J. regia* were identifying six compounds that are phenolic including vanillic acid, myricetin, coumaric acid, syringic acid, juglone, and ferulic acid (COSMULESCU et al. 2010). All the above results are matching with phenols as represented in Fig. 9 confirming that they are involved closely in the stabilizing of Fe_3O_4 where the presence of electrons from oxygen atoms helped in the absorption of compounds on *J. regia*/Fe_3O_4 NPs.

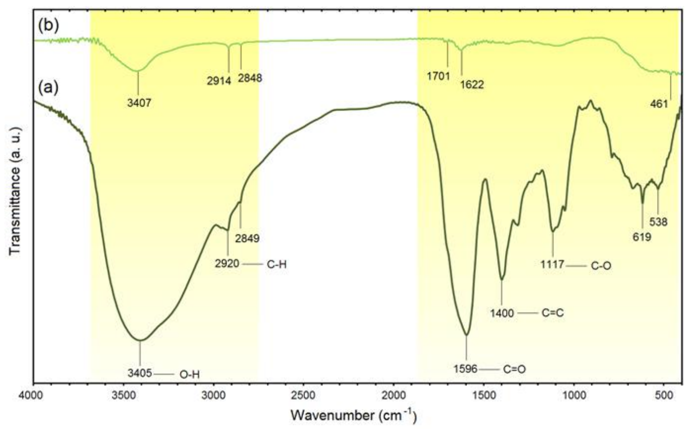

Fig. 8 FTIR spectra for *J. regia* (a), and *J. regia*/Fe_3O_4 NPs (b).

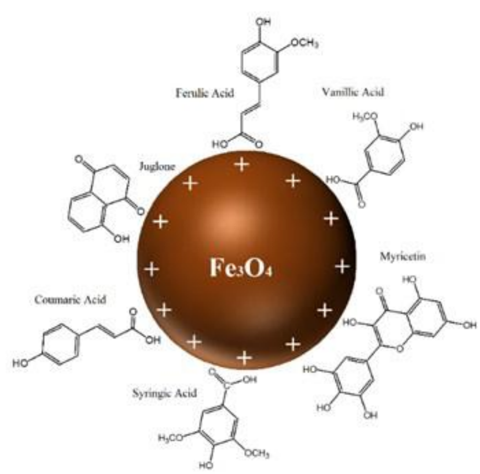

Fig. 9. Schematic of synthesized *J. regia*/Fe_3O_4 NPs interactions with activated functional groups of *J. regia*.

4.6 In Vitro Cytotoxicity Assay

As shown in Fig.10, the cytotoxicity effects of the synthesized *J. regia*/Fe_3O_4 NPs were investigated on 3T3 (Mouse Embryonic fibroblast cell lines) and HT-29 (human colorectal adenocarcinoma cell line, estrogen receptor negative) cell lines as normal and cancerous cell lines, respectively. The cells were treated with the *J. regia*/Fe_3O_4 NPs at various concentrations (1-1000 µg/ml) for 72 h and incubated at 37 ˚C. The prepared *J. regia* Green husk-coated *J. regia*/Fe_3O_4 NPs also demonstrated no significant toxicity even in concentrations up to 1000 µg/ml on normal cell lines in the resazurin reduction assay, meaning that the *J. regia*/Fe_3O_4 NPs are well tolerated by 3T3 cells (Fig. 10a). Green husk coated *J. regia*/Fe_3O_4 NPs had no toxic effect on cancerous (HT-29; 1000 µg/ml) cell lines in higher concentrations (Fig. 10b). Hence, the IC_{50} was not determined for normal and cancerous cell lines. These results have demonstrated the possibility of these *J. regia*/Fe_3O_4 NPs for different biomedical applications. In a previous study, the bio-functional starch/Fe_3O_4 NPs have non-toxic effects on normal and cancerous cervical cell lines, making them suitable candidates for various biological applications (Gholoobi et al. 2017). Figure 4 (a_1 and b_1) shows images of cell lines in the absence of *J. regia*/Fe_3O_4 NPs. In the former case, the cells are neatly connected with each other with high concentration of cells in the cell lines. Figure 4 (a_2 and b_2) represents images in the presence of *J. regia*/Fe_3O_4 NPs, bilayers of extract capped NPs interact with membrane proteins and disrupt the signalling process with the result that some of the cells were dying and also cell concentration being less than before.

5.0 Conclusion

In this research, we investigate the role of *J. regia* extract on the size control of *J. regia*/Fe_3O_4. The *J. regia*/Fe_3O_4 NPs with super paramagnetic properties using J. regia green husk as a stabilizing agent. The *J. regia*/Fe_3O_4 NPs were prepared for first time in cubic structure and the size of them was 5.77 nm with ± 1.66 nm standard deviation. The crystallite size of the synthesized *J. regia*/Fe_3O_4 NPs was found to be 10.3 nm from XRD analysis, which is in an agreement with the result obtained from the HR-TEM. The VSM results showed that iron oxide nanoparticles had strong magnetic properties. The FT-IR results of the nanoparticles are shown that *J. regia* was successfully applied in Fe_3O_4. This method is inexpensive and environmentally friendly leading to the preparation of very small iron oxide nanoparticles. Moreover, the J. regia green husk coated *J. regia*/Fe_3O_4 NPs have non-toxic effects on normal and cancerous cervical cell lines, making them suitable candidates for various biological applications. In comparison to iron oxide, super paramagnetic iron oxide nanoparticles show higher magnetic properties and it would be more effective for drug targeting in further study.

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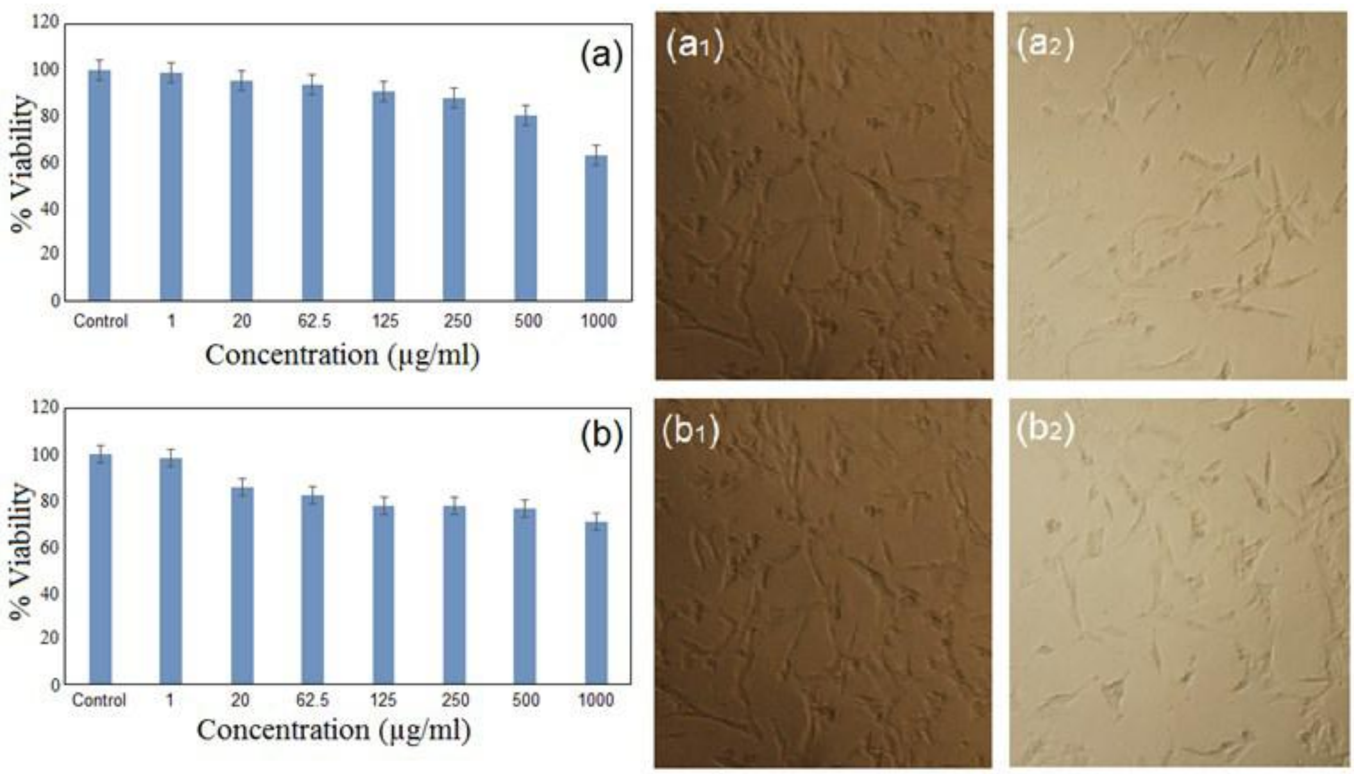

Fig. 10 MTT assays of (a) normal human fibroblast (3T3) cell line, and anticancer activity in (b) (human colorectal adenocarcinoma (HT-29) cell lines after 72 hours of treatment with *J. regia*/Fe_3O_4 NPs and microscopic images of *J. regia*/Fe_3O_4 NPs on 3T3 (control a_1 and treated cell a_2) and HT-29 (control b_1 and treated cell b_2) respectively.

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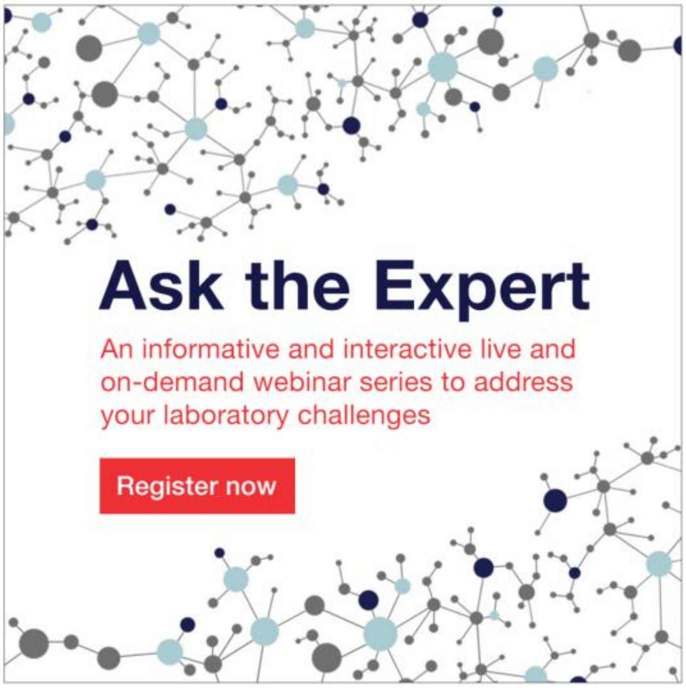

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IMM certified schemes are recognized in oil and gas, shipbuilding, construction industries etc. and by PETRONAS. Training courses for the related certification schemes are available at IMM Accredited Training Bodies.

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For information on training and competency assessments contact IMM Secretariat.

www.iomm.org.my | +6018 911 3480 | secretariat@iomm.org.my | Institute of Materials, Malaysia

APPLICATION NOTE AN44423-EN

ROBUST SINGLE METHOD DETERMINATION OF MAJOR AND TRACE ELEMENTS IN FOODSTUFFS USING THE THERMO SCIENTIFIC ICAP PRO X DUO ICP-OES

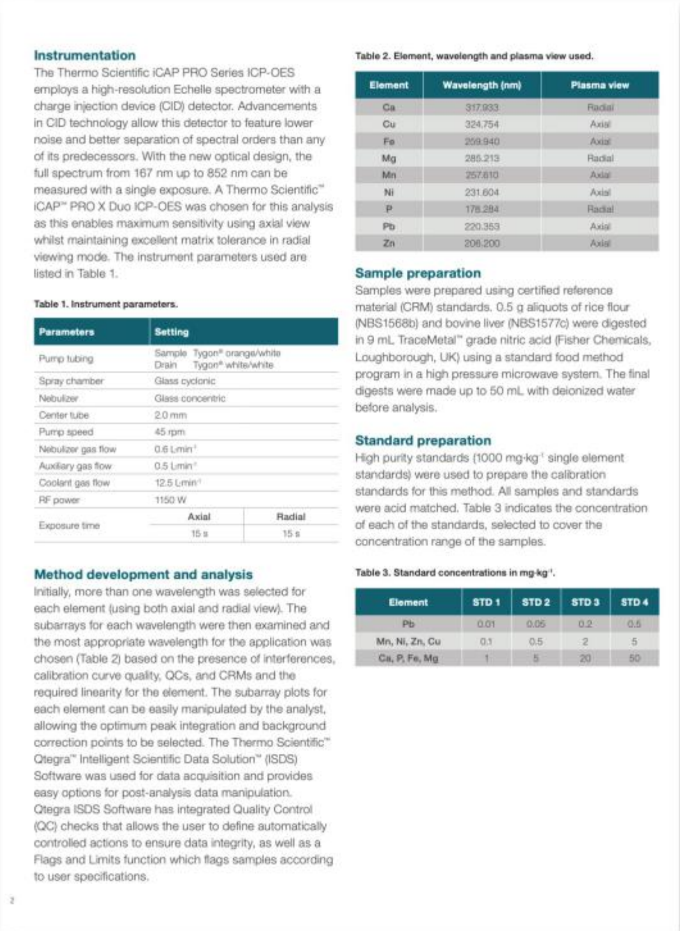
This application note demonstrates the ability of the Thermo Scientific™ iCAP™ PRO Series ICP-OES to determine trace elements and major components in foodstuffs to comply with regulations.

The authors state that food protection from potentially hazardous contaminants has become a major topic of public interest.

As well as the standard regulatory testing, it is necessary to account for contaminants, which may enter the food chain via many means, such as industrial pollution or environmental contamination, i.e. polluted rainfall on crops.

Once toxic elements are in the food chain, they can pose significant health risks. With this in mind and the increasing number of micronutrients requiring determination, it is critical that the method of testing is a rigorous and reliable one.

Download the full application note AN44423-EN at thermofisher.com/icp-oes



Instrumentation

The Thermo Scientific iCAP PRO Series ICP-OES employs a high-resolution Echelle spectrometer with a charge injection device (CID) detector. Advancements in CID technology allow this detector to feature lower noise and better separation of spectral orders than any of its predecessors. With the new optical design, the full spectrum from 167 nm up to 852 nm can be measured with a single exposure. A Thermo Scientific™ iCAP™ PRO X Duo ICP-OES was chosen for this analysis as this enables maximum sensitivity using axial view whilst maintaining excellent matrix tolerance in radial viewing mode. The instrument parameters used are listed in Table 1.

Table 1. Instrument parameters.

Parameters	Setting	
Pump tubing	Sample Tygon® orange/white Drain Tygon® white/white	
Spray chamber	Glass cyclonic	
Nebulizer	Glass concentric	
Center tube	2.0 mm	
Pump speed	45 rpm	
Nebulizer gas flow	0.6 L·min^{-1}	
Auxiliary gas flow	0.5 L·min^{-1}	
Coolant gas flow	12.5 L·min^{-1}	
RF power	1150 W	
Exposure time	Axial	Radial
	15 s	15 s

Method development and analysis

Initially, more than one wavelength was selected for each element (using both axial and radial view). The subarrays for each wavelength were then examined and the most appropriate wavelength for the application was chosen (Table 2) based on the presence of interferences, calibration curve quality, QCs, and CRMs and the required linearity for the element. The subarray plots for each element can be easily manipulated by the analyst, allowing the optimum peak integration and background correction points to be selected. The Thermo Scientific™ Qtegra™ Intelligent Scientific Data Solution™ (ISDS) Software was used for data acquisition and provides easy options for post-analysis data manipulation. Qtegra ISDS Software has integrated Quality Control (QC) checks that allows the user to define automatically controlled actions to ensure data integrity, as well as a Flags and Limits function which flags samples according to user specifications.

Table 2. Element, wavelength and plasma view used.

Element	Wavelength (nm)	Plasma view
Ca	317.933	Radial
Cu	324.754	Axial
Fe	259.940	Axial
Mg	285.213	Radial
Mn	257.610	Axial
Ni	231.604	Axial
P	178.284	Radial
Pb	220.353	Axial
Zn	206.200	Axial

Sample preparation

Samples were prepared using certified reference material (CRM) standards. 0.5 g aliquots of rice flour (NBS1568b) and bovine liver (NBS1577c) were digested in 9 mL TraceMetal™ grade nitric acid (Fisher Chemicals, Loughborough, UK) using a standard food method program in a high pressure microwave system. The final digests were made up to 50 mL with deionized water before analysis.

Standard preparation

High purity standards (1000 mg·kg^{-1} single element standards) were used to prepare the calibration standards for this method. All samples and standards were acid matched. Table 3 indicates the concentration of each of the standards, selected to cover the concentration range of the samples.

Table 3. Standard concentrations in mg·kg^{-1}.

Element	STD 1	STD 2	STD 3	STD 4
Pb	0.01	0.05	0.2	0.5
Mn, Ni, Zn, Cu	0.1	0.5	2	5
Ca, P, Fe, Mg	1	5	20	50

2

ThermoFisher SCIENTIFIC

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SMART Q
Ideal for Low Moisture

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Ideal for High Moisture

SAM 255
Ideal for Drying

Application

- Dry ingredients & food
- Plastics
- Dairy industries
- General food stuff
- Chemical
- Paint & polymer
- Tobacco & tea leaves

Safety Features

- Sealed Cavity
- Active sample temperature control especially for chemical with volatile solvent
- Flame Detection
- Active Ventilation

WORLD FASTEST MUFFLE FURNACE

Phoenix BLACK

- Reduce ashing time by **80-90%**
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- Compatible with N2 purge
- Self sealing Quartz crucible (ideal for carbon black)

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KUIZ KIMIA KEBANGSAAN MALAYSIA (K3M)

KEMENTERIAN PENDIDIKAN MALAYSIA

INSTITUT KIMIA MALAYSIA

Kuiz Kimia Kebangsaan Malaysia (K_3M) 2020

TARIKH
15 OKTOBER 2020

HARI
KHAMIS

MASA
10:00 PAGI

TEMPAT
SEKOLAH YANG MENGAMBIL BAHAGIAN

Institut Kimia Malaysia
127B, Jalan Aminuddin Baki,
Taman Tun Dr Ismail,
60000 Kuala Lumpur.

Kuiz Kimia Kebangsaan Malaysia (K_3M) 2020

Kuiz Kimia Kebangsaan Malaysia (K_3M) dianjurkan sebagai satu ujian bertulis untuk menguji kefahaman dalam ilmu Kimia di kalangan pelajar sekolah menengah di Malaysia. Kuiz ini merupakan kuiz Kimia tahunan yang dianjurkan oleh Institut Kimia Malaysia (IKM) dengan kerjasama Kementerian Pendidikan Malaysia.

Kuiz ini terbuka kepada semua pelajar sekolah menengah atas dan Pra Universiti di Malaysia. Kuiz ini akan diadakan pada jam 10.00 pagi, hari Khamis yang ketiga bulan Julai setiap tahun disekolah yang mengambil bahagian. Berikutan wabak pandemik yang melanda dunia, kuiz ini akan dijalankan pada **15 Oktober 2020**.

OBJEKTIF KUIZ

Adalah Seperti Berikut:

- Menguji tahap kefahaman dalam ilmu Kimia di kalangan pelajar sekolah menengah
- Menimbulkan minat pelajar peringkat sekolah menengah atas dan Pra Universiti terhadap Kimia
- Memajukan pendidikan Kimia di sekolah
- Memilih pelajar Kimia yang terbaik untuk mengambil bahagian dalam International Chemistry Olympiad (IChO)

PENYERTAAN KUIZ

IKM akan mengedarkan surat jemputan kepada semua sekolah menengah dan institusi pendidikan yang menawarkan khusus peringkat menengah atas dan Pra Universiti di Malaysia untuk menyertai kuiz ini. Sekolah dan institusi yang berminat untuk menyertai kuiz dikehendaki mengisi BORANG PENYERTAAN dan kembalikan bersama dengan SLIP BAYARAN kos pentadbiran yang ditetapkan kepada IKM sebelum tarikh tutup. Sila rujuk CARA BAYARAN di muka surat seterusnya.

PERHATIAN!!!

Semua borang jawapan (OMR) akan diperiksa oleh mesin pengimbas yang telah diprogramkan. Setiap pelajar hendaklah menghitamkan borang OMR dengan betul supaya tidak terdapat kesalahan ejaan didalam sijil dan keputusan yang akan dikeluarkan.

****Kami tidak akan melayani sebarang permintaan untuk sijil yang baru***

Tarikh Tutup : **21 Ogos 2020**

Tel : +603-7728 3272

Fax : +603-7728 9909

Email : k3m@ikm.org.my

Laman Web : https://ikm.org.my

FORMAT KUIZ

Kuiz ini dibahagikan kepada dua aras:

- *Aras Asas untuk pelajar Tingkatan 4, 5 dan 'O Level'*
- *Aras Lanjutan untuk pelajar untuk Tingkatan 6 dan Pra Universiti*

Sila ambil perhatian bahawa soalan kuiz tidak merangkumi hanya sukatan pelajaran SPM untuk aras Asas atau sukatan pelajaran STPM untuk Aras Lanjutan.

Kuiz ini mengandungi 40 soalan objektif; soalan adalah dalam Bahasa Melayu dan Bahasa Inggeris bagi Aras Asas dan Bahasa Inggeris sahaja bagi Aras Lanjutan. Pelajar dikehendaki menjawab kesemua soalan ini dalam masa satu jam dan dua puluh minit menggunakan borang jawapan (OMR) yang dibekalkan.

SIJIL PENYERTAAN DAN KOS PENTADBIRAN

Setiap pelajar yang menyertai kuiz ini dikehendaki membayar kos pentadbiran sebanyak RM10.00.

Yuran penyertaan ini membolehkan pelajar:

- *Menyertai Kuiz pada masa, tarikh dan tempat yang ditetapkan*
- *Membolehkan skrip jawapan mereka diperiksa*
- *Menerima sijil penyertaan*

CARA BAYARAN

Bayaran hendaklah dibuat melalui PINDAHAN ANTARA BANK (TUNAI SAHAJA). Samaada diatas talian ataupun melalui mesin ATM.

Maklumat akaun bank seperti dibawah:
Bank: **PUBLIC BANK BERHAD**
Nama Akaun: **INSTITUT KIMIA MALAYSIA**
No. Akaun: **3127 7310 17**

Selepas bayaran dibuat, mohon emailkan SLIP BAYARAN & BORANG PENYERTAAN ke alamat email ***k3m@ikm.org.my***. Mohon hubungi IKM dengan kadar segera sekiranya email Tuan/Puan tidak dibalas dalam tempoh masa 5 hari bekerja. Tidak perlu hantar melalui pos.

Kegagalan berbuat demikian akan menyebabkan penyertaan sekolah Tuan/Puan tidak diproses.

HAK HAKIM DAN IKM

Keputusan hakim adalah muktamad dan semua rayuan tidak akan dilayan. IKM berhak mengubahsuai peraturan kuiz tanpa memaklumkan kepada peserta.

KUIZ KIMIA KEBANGSAAN MALAYSIA (K_3M) 2020

- Semua peserta K_3M akan diberikan sijil penyertaan K_3M.
- Bagi pelajar yang mendapat markah tertinggi akan diberikan sijil tambahan mengikut gred iaitu Merit, Kepujian atau Cemerlang.
- Pelajar yang mendapat markah tertinggi dari setiap aras akan dijemput menghadiri Malam Kimia 2020 untuk menerima sijil *Top Scorer Award* dan hadiah wang tunai berjumlah RM500 setiap orang.
- Pelajar yang memperolehi markah tertinggi akan dipilih untuk menyertai program latihan untuk mengambil bahagian dalam *International Chemistry Olympiad* (IChO) pada tahun berikutnya.

Penerima Sijil Top Scorer Award
Kuiz Kimia Kebangsaan Malaysia (K_3M) 2019

PEMERIKSAAN DAN PENGREDAN

Guru tidak dibenarkan memberi pelajar sebarang bantuan semasa Kuiz dijalankan.

Semua borang jawapan berkomputer (OMR) akan diperiksa oleh computer.

Pelajar akan dimaklumkan skor mereka melalui sekolah.

Untuk pelajar yang menunjukkan pencapaian yang baik dalam Kuiz ini, salah satu sijil berikut akan diberikan berdasarkan skor mereka:

- *Sijil Merit*
- *Sijil Kepujian*
- *Sijil Cemerlang*

KUIZ KIMIA KEBANGSAAN MALAYSIA

K3M 2020

KEMENTERIAN PENDIDIKAN MALAYSIA

Borang Penyertaan K3M 2020

Kami ingin mengambil bahagian dalam Kuiz Kimia Kebangsaan Malaysia (K3M) 2020

Kod Sekolah : ☐☐☐☐☐☐☐☐

Nama Sekolah : ______________________________

Alamat : ______________________________

____

Poskod : ☐☐☐☐☐

Daerah : ______________________________

Negeri : ______________________________

No. Tel : ____________________ No. Fax: ____________________

Guru Penyelaras : ______________________________

____

____

No. Tel. Bimbit : ______________________________

Email Guru : ______________________________

Aras	Tingkatan	Bil. Penyertaan	Bayaran (RM10 x bil. Pelajar)
Asas	4		
	5		
Lanjutan	6 Rendah		
	6 Atas		
	Matrikulasi		
Jumlah			

**Kos pentadbiran adalah RM10.00 bagi setiap seorang pelajar. Sila nyatakan bilangan penyertaan pelajar di dalam ruangan yang disediakan diatas.*

Tandatangan Pengetua/Pen. Kanan : ______________________________

Nama Pengetua : ______________________________

Tarikh : ______________________________

Jumlah bayaran : ______________________________

Tarikh bayaran dibuat: ______________________________

Cop Sekolah

____

Tarikh : 15 Oktober 2020

Hari : Khamis

Masa : 10.00 Pagi

☑ Tidak lewat sebelum atau pada 21 Ogos 2020

☑ Penyertaan lewat tidak akan dilayan

☑ Borang penyertaan salinan fotostat adalah diterima

Bayaran hendaklah dibuat melalui **PINDAHAN ANTARA BANK ataupun DEPOSIT TUNAI sahaja**. Sama ada diatas talian ataupun melalui mesin ATM.

Maklumat akaun bank seperti dibawah:

Bank: **PUBLIC BANK BERHAD**

Nama Akaun:

INSTITUT KIMIA MALAYSIA

No. Akaun: **3127 7310 17**

Selepas bayaran dibuat, mohon emailkan

SLIP BAYARAN & BORANG PENYERTAAN

ke alamat email ini

k3m@ikm.org.my

MOHON HUBUNGI IKM DENGAN KADAR SEGERA SEKIRANYA EMAIL TUAN/PUAN TIDAK DIBALAS DALAM TEMPOH MASA 5 HARI BEKERJA.

TIDAK PERLU HANTAR MELALUI POS.

Kegagalan berbuat demikian akan menyebabkan penyertaan sekolah Tuan/Puan tidak diproses.

Untuk kegunaan pejabat

Bayaran diterima RM: ....

Tarikh : ....

No. Resit : ....

Nota: ....