UNIVERSITI PUTRA MALAYSIA

ANTIOXIDANT AND FUNCTIONAL COSMECEUTICAL PROPERTIES OF LEAVES OF THREE MELASTOMATACEAE SPECIES IN NANOEMULSION SYSTEM FOR TOPICAL APPLICATIONS

NUR FAUWIZAH BINTI AZAHAR

IPPH 2020 5

ANTIOXIDANT AND FUNCTIONAL COSMECEUTICAL PROPERTIES OF LEAVES OF THREE MELASTOMATACEAE SPECIES IN NANOEMULSION SYSTEM FOR TOPICAL APPLICATIONS

By

NUR FAUWIZAH BINTI AZAHAR

Thesis Submitted to the School of Graduated Studies, Universiti Putra Malaysia, in Fulfilment of the Requirements for Degree of Doctor of Philosophy

September 2019

Abstract of the thesis presented to the Senate of Universiti Putra Malaysia in fulfillment of requirement for the degree of Doctor of Philosophy

ANTIOXIDANT AND FUNCTIONAL COSMECEUTICAL PROPERTIES OF LEAVES OF THREE MELASTOMATACEAE SPECIES IN NANOEMULSION SYSTEM FOR TOPICAL APPLICATIONS

By

NUR FAUWIZAH BINTI AZAHAR

September 2019

Chairman : Associate Professor Siti Salwa Abd Gani, PhD
Faculty : Halal Products Research Institute

Melastomataceae commonly known as "Senduduk" has been recognized for its potential for the treatment of various ailments. The leaves of *Melastoma malabathricum L., Clidemia hirta (L.) D. Don* and *Melastoma malabathricum varr. alba* were studied for their antioxidant and functional cosmeceuticals properties. The levels of total antioxidant activities were evaluated using multiple assay and the result shows the correlation and cluster analysis (CA) were found that different antioxidant assays significantly correlated at ($P<0.05$). The high total antioxidant assay can be seen mainly from the ethyl acetate and methanolic extract of three *Melastoma* species. The functional cosmetic properties such as sun protection factor (SPF), anti-tyrosinase (whitening activity) and anti-microbial test were noticed to be influenced by the more polar solvents. The simplex centroid mixture design was found to be the best tools and was successfully developed the optimal ratio composed of 30:40:30 mixtures. The leaves of *Melastoma* leaves species exhibited positive result for tannin/polyphenolic, flavonoids and also saponin. Terpenes, terpenoids, hydrocarbon, fatty acid derivatives, phenol and carbohydrate (amino acids) were significant bioactive compounds identified in the *Melastoma* leaves using GCMS. Rutin and quercetin of flavonoid compounds were also detected using HPLC. The highlights of the development and characterization of nanoemulsion formulation revealed that the cream has smooth and silky texture and exhibited *Melastoma* nanoemulsion can act as natural photoprotective agents and natural inhibitors for elastase and collagenase activity on skin. The *in vivo* results showed *Melastoma* nanoemulsion can be used significantly as good moisturizing cream as it increases the hydration level and reduce the rate of transpiration (TEWL) after 30 minutes of application and presents as a good anti-wrinkles properties after four weeks of applications. Hence, the innovations of nanoemulsion of plant based materials containing active extract of *Melastoma* leaves yield good and effective

cosmeceutical products particularly for improving skin conditions and ready to be utilized as one of the cosmeceutical ingredients.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk Ijazah Doktor Falsafah

ANTIOKSIDA DAN SIFAT-SIFAT FUNGSI KOSMETIK DARIPADA TIGA JENIS SPESIS DAUN MELASTOMATACEAE DALAM SISTEM NANOEMULSI UNTUK APLIKASI TOPIKAL

Oleh

NUR FAUWIZAH BINTI AZAHAR

September 2019

Pengerusi : Profesor Madya Siti Salwa Abd Gani, PhD
Fakulti : Institut Penyelidikan Produk Halal

Melastomataceae yang lazimnya dikenali sebagai " Senduduk "telah mendapat perhatian atas potensinya untuk merawat pelbagai jenis penyakit. Daun spesies senduduk ungu, senduduk bulu dan senduduk putih dikaji untuk unsur-unsur antioksida dan sifat-sifat kosmetik. Tahap jumlah aktiviti antioksida diukur dengan menggunakan pelbagai kaedah dan statistik korelasi dan kluster hirarki (CA) analisis mendapati variasi antioksida menghasilkan korelasi ($P<0.05$). Sifat-sifat kosmetik dalam daun *Melastoma* seperti faktor perlindungan matahari (SPF), anti-tyrosinase (aktiviti pemutihan) dan ujian anti-mikrob juga dipengaruhi oleh pelarut yang lebih cenderung polar. Reka bentuk campuran (MDE) "simplex centroid" telah berjaya digunakan sebagai alat terbaik untuk menentukan nisbah optimum antioksida iaitu 30:40:30. Analisis fitokimia, menunjukkan bahawa keseluruhan daun *Melastoma* positif terhadap tannin/polifenol, flavonoid dan juga saponin. Sebatian bioaktif seperti terpenes, terpenoid hidrokarbon, derivatif asid lemak, fenol dan juga karbohidrat (amino acid) telah dikenalpasti melalui GCMS. Rutin dan quercetin dari sebatian flavonoid dapat dikesan dalam optimum campuran daun *Melastoma.* Pembangunan produk nanoemulsi dengan menggunakan campuran tiga jenis daun *Melastoma* sebagai bahan aktif mendapati bahawa krim yang telah dihasilkan mempunyai tekstur licin dan kajian *in vitro* menunjukkan, krim nanoemulsi *Melastoma* berpotensi bertindak sebagai agen pelindung matahari semulajadi dan agen perencat untuk aktiviti elastase dan kollagenase pada kulit. Keputusan *in vivo* menunjukkan, krim nanoemulsi *Melastoma* dapat meningkatkan tahap penghidratan dan pengurangan kadar transpirasi (TEWL) selepas 30 minit penggunaannya dan menunjukkan sifat-sifat anti-kedutan selepas 4 minggu penggunaan. Kesimpulannya, melalui hasil kajian, tumbuhan semulajadi dari krim nanoemulsi *Melastoma* dapat memberikan kesan yang terbaik terutamanya dalam memperbaiki kesihatan kulit hasil daripada sebatian bioaktif antioksida yang terdapat dalam

campuran daun *Melastoma* serta sedia digunakan sebagai salah satu bahan formulasi untuk produk kosmetik.

ACKNOWLEDGEMENTS

In The Name of ALLAH, The Most Merciful and Most Beneficent

Allhamdulilah, all praises, glory and thanks to Allah, the almighty lord of the universe. Peace and blessing to Nabi Muhammad S.A.W., all the prophets, his families and all muslims. Only by His grace and mercy, this thesis can be completed.

First and foremost, I would like to express my sincere gratitude to Assoc. Prof. Dr. Siti Salwa Abd. Gani, Dr. Uswatun hasanah binti Zaidan and Dr. Paiman bin Bawon for patiently guiding me through the course of this thesis to its eventual end enlightening me scientifically and resolving my technical crises. Their patience, critics, motivation and immense knowledge throughout this study is greatly appreciated.

Special thanks are extended to my beloved family where i am very thankful to my parents Azahar bin Othman and Aishah binti Salleh, my brother and sister, my grandfather Salleh bin Yunos and special love for my late grandmother Allmarhum Rokiah binti Othman for their continuous prayers, encouragements, endless love and kindness in my life. The holistic life during conducting this research is unable to achieve without the companion from all of you,

I would also like to acknowledge the financial support from Fundamental Research Grant Scheme (FRGS) under Ministry of Higher Education, Malaysia and Graduate Research Fellowship (GRF) for many ways contributed to the success of my thesis. Thank you.

This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Doctor of Philosophy. The members of Supervisory Committee were as follows:

Siti Salwa Abd Gani, PhD
Associate Professor
Faculty of Agriculture
Universiti Putra Malaysia
(Chairman)

Uswatun Hasanah Zaidan, PhD
Senior Lecturer
Faculty of Biotechnology and Biomolecular Sciences
Universiti Putra Malaysia
(Member)

Paiman Bawon, PhD
Senior Lecturer
Faculty of Forestry
Universiti Putra Malaysia
(Member)

ZALILAH MOHD SHARIFF, PhD
Professor and Dean
School of Graduate Studies
Universiti Putra Malaysia

Date:

Declaration by graduate student

I hereby confirm that:

- this thesis is my original work;
- quotations, illustrations, and citations have been duly referenced;
- this thesis has not been submitted previously or concurrently for any other degree at any other institutions;
- intellectual property from the thesis and copyright of thesis are fully owned by Universiti Putra Malaysia, as according to the Universiti Putra Malaysia (Research) Rules 2012;
- written permission must be obtained from supervisor and the office of Deputy Vice-Chancellor (Research and Innovation) before thesis is published (in the form of written, printed or in electronic form) including books, journals, modules, proceedings, popular writings, seminar papers, manuscripts, posters, reports, lecture notes, learning modules or any other materials as stated in the Universiti Putra Malaysia (Research) Rules 2012;
- there is no plagiarism or data falsification/fabrication in the thesis, and scholarly integrity is upheld as according to the Universiti Putra Malaysia (Graduate Studies) Rules 2003 (Revision 2012-2013) and the Universiti Putra Malaysia (Research) Rules 2012.The thesis has undergone plagiarism detection software.

Signature: _____ Date:_____

Name and Matric No.: Nur Fauwizah binti Azahar and GS50489

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

AA	Ascorbic acid
ABTS	2,2'- azino-bis (3-ethylbenzothiazoline-6-sulfonic acid
ANOVA	Analysis of variance
BHT	Butylated hydroxytoluene
C. hirta	*Clidemia hirta (L.) D. Don*
DPPH	1,1-diphenyl-2-picryhdrazyl assay
FRAP	Ferric reducing antioxidant power
GCMS	Gas chromatography- mass spectrometry
M.M Linn	*Melastoma malabathricum Linn*
M.M var. alba	*Melastoma malabathrium var. alba*
nm	Nanometer
o/w	Oil in water
PDI	Polydispersity index
SPF	Sun protection factor
TAC	Total anthocyanin content
TCC	Total carotenoid content
TFC	Total flavonoid content
TPA	Total phosphomolybdate assay
TPC	Total phenolic content
TEM	Transmission electron microscopy
TEWL	Transepidermal water loss
UV	Ultraviolet radiation

CHAPTER 1

INTRODUCTION

1.1 Research Background

Cosmetics are essentials products used throughout the world for maintaining and enhancing the general appearance of face and other parts of the body. They include creams, lotions, moisturizers, face mask, shampoo, hair oil, nail polish and conditioners. A financial analysis reported by a French-based company estimated that the cosmetic industry has an annual turnover of US$170 billion and its indicated that it will continue to grow exponentially (Wang et al., 2015). As the cosmetic industry grows, more studies are done to improve products to fulfil consumer's satisfaction by using natural ingredients and innovate on the most effective delivery system.

Over the years, plant-based materials have been increasingly used due to safety concerns as they are less toxic as compared to synthetic drugs and chemicals. Moreover, according to Nizioł-ŁukaszewskaNizio et al. (2018) nowadays, industry demands multifunctional cosmetic ingredients primarily in natural origins as their complex bioactive and chemical compositions are able to deliver multi-faceted activity towards problematic skin conditions such as moisturizing, soothing, and nourishing effects using just one active ingredients. Research done by Ya et al. (2015) showed that several chemicals isolated from plants can be used as whitening agents which control the overproduction of melanin synthesis. This is due to the fact that plants can synthesize major chemical compounds which can be sorted by their chemical class, functional groups and biosynthetic origin into primary and secondary metabolites (Ahirrao et al., 2011). For instance, there are a number of compounds extracted from plants such as phenols, flavones, alkaloid, and tannin that have shown antioxidant properties against unwanted radical species. A study done by Mansur et al. (2016) revealed that plant extract incorporated with antioxidant properties are of utmost interest in the phyto-cosmetic field as they provide molecules that could inactivate radical oxygen species (ROS) by restoring skin homeostasis therefore, preventing premature aging of the skin. Moreover, the biological function of the skin will be improved and in turn will improve the appearance, radiance and texture of the skin from the application of natural ingredients (Taofiq et al., 2016).

Melastomataceae are widely distributed in tropical and subtropical areas of the world and comprises 170 genera and 4600 species in total (Costa et al., 2015). The genus of *M. malabathricum linn, Clidemia. hirta and M. malabathricum var. alba* are popularly known in Malays community as " senduduk ungu, senduduk bulu and senduduk putih" respectively. They can be found growing in mountain forests,

lowland, and also on cleared land such as roadsides. This plant can be differentiated by the colour of the flower petals which are light-pink magenta, dark-purple magenta and white (Haron et al., 2015). Traditionally, these plants are used by old folks to treat various diseases such as inflamed wounds, diarrhea, pox scars, bleeding, dysentery, gastric ulcers, epilepsy, and remedy for skin infections (Jamalnasir et al., 2013; Lopez et al., 2016; Zakaria et al., 2011). Various pharmacological activities were also reported from *M. malabathricum Linn*, *C. hirta* and *M. malabathricum var*. *alba* such as antioxidant, antiulcer, antimicrobial and anticancer activities (Basu et al., 2016; Danladi et al., 2015; Hamid et al., 2018; Ismail et al., 2017 and Zabidi et al., 2012).

Recently, nano research has been exploited with the increasing use of engineered nanoparticles (ENPs) in numerous industries such as analytical, cosmeceuticals, pharmaceuticals and others (Soriano et al., 2018). This is because the revolution of the application of nanotechnology can improve the analytical properties of results, analytical processes, and produce high ends products. For example, pharmaceutical technology, especially nanomedicines have higher capability to deliver effectively to the targeted site. Nanotechnology (nanomedicines) remains to be the most suitable approach due to the small size of the droplets which are in the nano range of 100-600 nm (Zainol et al., 2015). Moreover, it has been proven that nanomaterials are the most efficient and reliable delivery systems as they can elevate the solubility, absorption and bioavailability (Alexander et al., 2016).

Nano-emulsion or nanocream has been an active cosmeceutical, pharmaceuticals and personal care product for topical formulations and a tool to enhance the delivery of active ingredients to problematic skin. For instance, there is a number of developed nano-emulsion formulations containing various plants extract applied topically. One of them is dogwood fruits (*Cornus mas*) berries which is an active ingredients in cosmetic emulsions (Nizioł-ŁukaszewskaNizio et al., 2018). Alexander et al. (2016) cited that many researchers and scientists have used the nanomedicines as the delivery system of plant bioactive or herbal extracts into the problematic organs. This shows that the application of cosmeceutical and pharmaceutical nanotechnology from natural sources grows tremendously among the researchers.

Hence, the aim of the present study was to develop a nanoemulsion containing mixtures of extract from the leaves of Melastomataceae family species (*M. malabathricum Linn*, *Clidemia hirta* and *M. malabathricum var*. *alba*). To this end, the *in vitro* and *in vivo* evaluation of the efficacy and safety of this formulation as well as assessment of therapeutic properties of these plants were studied for its antioxidant and functional cosmetic properties.

1.2 Problem Statement

Despite the erratic progresses in conventional cosmeceutical products in the last 20 years, to date available products for the treatment of various skin related diseases were often limited in efficacy and could triggered many unwanted side effects such as itching, rashes, dehydrated skin, peeling skin and many more. In order to response to these circumstances, scientists all over the world were eager working in the area of new cosmeceutical discovery to identify new sources of agents with highest potential in the treatment of skin illness. Usage of medicinal plant is one of the alternative treatments which play an important role and can be exploited into discovering novel cosmeceuticals or pharmaceutical drugs since plant- based or natural drugs have less or no negative side effects or toxicity. The therapeutic value of medicinal plant had been identified for many decades by traditional healers and old-folk practices. For instance, some medicinal plants able to treat wounds, eczema, sinuses, lowering blood pressure, constipation and stimulate the reproductive organs. Moreover, due to remarkable and therapeutic values in some of medicinal plant, they can synthesizes numerous of active agent where they are used to combat all sorts of pathogens and other substances in the human body. Thus, researcher all around the world believed that plants have great biomedical potential and possessed wide range of bioactive chemical compounds via secondary metabolites that can be used to treat various human illness and other degenerative diseases especially in the area of cosmeceuticals for not only enhancing human beauty but at the same time able to encounter and treat problematic skin.

1.3 Objectives

The general objective of this study was to investigate the phytochemical of three different Melastomataceae family species namely (*M. malabathricum Linn*, *Clidemia hirta* and *M. malabathricum var. alba*) for its antioxidants and functional cosmeceuticals activities and its efficacy as nanoemulsion system for stratum corneum applications.

The specific objectives are as follow:

i. To compare the three different *Melastoma* species (*M. malabathricum Linn*, *Clidemia hirta* and *M. malabathricum var. alba*) using different solvent polarity.

ii. To determine the antioxidant activities and functional cosmeceutical properties of three different *Melastoma* leaves extract.

iii. To develop and optimize *Melastoma* leaves mixture based cosmeceutical formulation by using mixture design expert (MDE).

iv. To evaluate the preliminary and phytochemical analysis of optimized *Melastoma* leaves mixture and its bioactive compounds via spectrophotometric method.

v. To evaluate the efficacy of active mixture of *Melastoma* leaves based nano-cosmeceuticals via *in vitro* and *in vivo* studies for stratum corneum applications.

1.4 Significance of Study

This study will explore the antioxidant capacity and its functional cosmeceutical properties in three *Melastoma* species (*M. malabathricum linn, Clidemia hirta and M. malabathricum var. alba*) or locally known as " senduduk ungu, senduduk bulu and senduduk putih" respectively. The therapeutic values on these plants will be benefit to human beings for cosmeceutical applications related to skin aging and other degenerative diseases. In addition, it will help to increase the economic value of the abundant natural plant sources to achieve a sustainable and environmentally production and utilization. Therefore, this study is proposed to be the new potential cosmetic ingredients from botanical sources and environmental friendly to consumers.

1.5 Scope of Study

This study is outlined into five phases in exploring the three *Melastoma* species (*M. malabathricum linn, Clidemia Hirta and M. malabathricum var. alba*) extract as alternative active ingredients in a nanoemulsion cosmeceuticals formulations. The first phase is the extraction of three different *Melastoma* species using three different solvent extraction of hexane, ethyl acetate and methanol. In second phase, the antioxidant potential of three different *Melastoma* species were discovered where multiple of antioxidant assays were used to define its level and activities. In addition, the potential of three different *Melastoma* species were subjected into various functional cosmeceutical assay such as sun protection factor (SPF), anti-microbial and whitening effects. In third phase, the three different *Melastoma* leaves species with highest antioxidant activity were subjected into mixture design experiment (MDE) for its optimization study. Next, the preliminary phytochemicals and identification of bioactive compounds in the mixture of *Melastoma* leaves extracts were screened. Finally, the nanoemulsion formulation was developed containing an active from the mixture of *Melastoma* leaves extracts and their physicochemical properties as well as its efficacy were evaluated via *in vitro* and *in vivo* studies.

REFERENCES

Abd Gani, S. S., Basri, M., Abdul Rahman, M. B., Kasim, A., Abd Rahman, R. N. Z. R., Salleh, A. B., & Ismail, Z. (2010). Characterization and effect on skin hydration of engkabang-based emulsions. *Bioscience, Biotechnology and Biochemistry*, *74*(6), 1188–1193.

Abdellaoui, S. El, Destandau, E., Krolikiewicz-renimel, I., Cancellieri, P., Toribio, A., Jeronimo-monteiro, & Elfakir, C. (2014). Centrifugal partition chromatography for antibacterial bio-guided fractionation of Clidemia hirta roots. *Separation and Purification Technology*, *123*, 221–228.

Abdou, E. S., Galhoum, G. F., & Mohamed, E. N. (2018). Curcumin loaded nanoemulsions/pectin coatings for refrigerated chicken fillets. *Food Hydrocolloids*, *83*, 445–453.

Abdullah, T., Malek, A. ., & Ahmad, S. (1998). Chemical manipulation of growth and flowering in potted Melastoma Decemfidum and Tibouchina Semidecandra. Proceeding *Third International Symposium on New Floricultural Crops*, *454*, 297–301.

Aburjai, T., & Natsheh, F. M. (2003). Plants used in cosmetics. *Phytotherapy Research*, *17*(9), 987–1000.

Ahirrao, R. A., Patel, M. R., Pokal, D. M., Patil, J. K., & Suryawanshi, H. P. (2011). Phytochemical screening of leaves of Jatropha Curcas plant. *International Journal of Research in Ayuveda & Pharmacy*, *2*(4), 1324–1327.

Ahmed, D., Khan, M., & Saeed, R. (2015). Comparative analysis of phenolics, flavonoids, and antioxidant and antibacterial potential of methanolic, hexanic and aqueous extracts from adiantum caudatum leaves. *Antioxidants*, *4*(2), 394–409.

Ahmed, S. (2009). Ascorbic acid , carotenoids , total phenolic content and antioxidant activity of various genotypes of brassica oleracea encephala. *Journal of Medical and Biological Sciences*, *3*(1), 1–8.

Akbas, E., Soyler, B., & Oztop, M. H. (2018). Formation of capsaicin loaded nanoemulsions with high pressure homogenization and ultrasonication. *LWT - Food Science and Technology*, *96*, 266–273.

Akinola, A. A., Ahmad, S., & Maziah, M. (2014). Medicinal Aromatic plants total antioxidant capacity , total phenolic compounds and the effects of solvent concentration on flavonoid content in curcuma longa and curcuma xanthorhhiza rhizomes. *Medicinal & Aromatic Plants*, *3*(2), 3–6.

Alam, M. A., Syazwanie, N. F., Mahmod, N. H., Badaluddin, N. A., Ain Mustafa,

K., Alias, N., & Prodhan, M. A. (2018). Evaluation of antioxidant compounds , antioxidant activities and capsaicinoid compounds of Chili (Capsicum sp.) germplasms available in Malaysia. *Journal of Applied Research on Medicinal and Aromatic Plants*, *In press*.

Alexander, A., Ajazuddin, Patel, R. J., Saraf, S., & Saraf, S. (2016). Recent expansion of pharmaceutical nanotechnologies and targeting strategies in the field of phytopharmaceuticals for the delivery of herbal extracts and bioactives. *Journal of Controlled Release*, *241*, 110–124.

Ali, A., Akhtar, N., & Chowdhary, F. (2014). Enhancement of human skin facial revitalization by moringa leaf extract cream. *Postepy Dermatologii Alergologii*, *2*, 71–76.

Alnajar, Z. A. A., Abdulla, M. A., Ali, H. M., Alshawsh, M. A., & Hadi, A. H. A. (2012). Acute toxicity evaluation, antibacterial, antioxidant and immunomodulatory effects of Melastoma Malabathricum. *Molecules*, *17*, 3547–3559.

Amit, G., Ashawat, M. ., Shailendra, S., & Swarnlata, S. (2007). Phytosome: A novel approach towards functional cosmetics. *Journal of Plant Sciences*, *2*(6), 644–649.

Arnnok, P., Ruangviriyachai, C., Mahachai, R., Techawongstien, S., & Chanthai, S. (2012). Determination of total phenolics and anthocyanin contents in the pericarp of hot chilli pepper (Capsicum annuum L .). *International Food Research Journal*, *19*(1), 235–243.

Ashok, P. K., & Saini, B. (2013). HPLC analysis and isolation of rutin from stem bark of ginkgo biloba l. *Journal of Pharmacognosy and Phytochemistry*, *2*(4), 68–71.

Baj, T., Baryluk, A., & Sieniawska, E. (2018). Application of mixture design for optimum antioxidant activity of mixtures of essential oils from Ocimum basilicum L ., Origanum majorana L . and Rosmarinus o ffi cinalis L . *Industrial Crops & Products*, *115*, 52–61.

Balamurugan, K., Nishanthini, A., & Mohan, V. R. (2013). Anti-diarrheal activity of Melastoma malabathricum L. leaf extracts (Melastomataceae). *International Journal of Herbal Medicine*, *1*(2), 102–105.

Barry, B. W., & Warburton, B. (1968). Some rheological aspects of cosmetics. *Journal of the Society of Cosmetic Chemists*, *19*, 725–744.

Basu, S., Pal, B., & Mandal, N. C. (2016). Antimicrobial and antioxidant activities of two endophytic fungi isolated from Melastoma Malabathricum l. leaves. *International Journal of Current Pharmaceutical Research*, *8*(3), 3–7.

Benzie, I. F. F., & Strain, J. J. (1996). The ferric reducing ability of plasma (FRAP

) as a measure of ‘“ antioxidant power ”’: The FRAP assay. *Analytical Biochemistry*, *239*, 70–76.

Björklund, S., Engblom, J., Thuresson, K., & Sparr, E. (2013). Glycerol and urea can be used to increase skin permeability in reduced hydration conditions. *European Journal of Pharmaceutical Sciences*, *50*(5), 638–645.

Blois, M. S. (1958). Antioxidant determinations by the use of a stable free radical. *Nature*, *29*, 1199–1200.

Bom, S., Jorge, J., Ribeiro, H. M., & Marto, J. (2019). A step forward on sustainability in the cosmetics industry: a review. *Journal of Cleaner Production*, *225*, 270–290.

Bondari, K. (2005). Mixture experiments and their applications in agricultural research. *Proceedings of the 30h Annual SAS Users Group International Conference (SUGI 30), Statistics and Data Analysis*, (1), 1–8.

Brooks, S. J., Setter, S. D., Gough, K. L., & Setter, M. J. (2015). Increasing foliar herbicide options for controlling Clidemia Hirta (L.) D. Don. In *Twentieth Australasian Weeds Conference* (pp. 321–325).

Budecka, A., & Styczyńska, A. K. (2014). Microbiological contaminants in cosmetics – isolation and characterization. *Biotechnology and Food Sciences*, *78*(1), 15–23.

Burlando, B., Verotta, L., Laura, C., & Botiinini-Massa, E. (2010). *Herbal Principles in Cosmetics*. United States of America, CRC Press, Taylor & Francis Group.

Buruk Sahin, Y., Aktar Demirtaş, E., & Burnak, N. (2017). Mixture design: A review of recent applications in the food industry. *Pamukkale University Journal of Engineering Sciences*, *22*(4), 297–304.

Caussin, J., Gooris, G. S., & Bouwstra, J. A. (2008). FTIR studies show lipophilic moisturizers to interact with stratum corneum lipids , rendering the more densely packed. *Biochimica et Biophysica Acta*, *1778*, 1517–1524.

Chanchal, D., Pharm, M., Swarnlata, S., & Pharm, M. (2008). Novel approaches in herbal cosmetics. *Journal of Cosmetic Dermatology*, *7*, 89–95.

Chanchal, D., & Swarnlata, S. (2009). Herbal Photoprotective formulations and their evaluation. *The Open Natural Products Journal*, *2*, 71–76.

Chanda, S. V, & Nagani, K. V. (2010). Antioxidant Capacity of manilkara zapota l . leaves extracts evaluated by four in vitro methods. *Nature and Science*, *8*(10), 260–266.

Clausing, G., & Renner, S. . (2001). Molecular Phylogenetics of Melastomataceae and Memecylaceae: Implications for character evolution. *American Journal of Botany*, *88*(3), 486–498.

Costa, A. M., Bueno, K. T. L., Rosa, A. P. C. da, & Costa, J. A. V. (2019). The antioxidant activity of nanoemulsions based on lipids and peptides from Spirulina sp. LEB18. *LWT - Food Science and Technology*, *99*, 173–178.

Costa, R., & Santos, L. (2017). Delivery systems for cosmetics - From manufacturing to the skin of natural antioxidants. *Powder Technology*, *322*, 402–416.

Costa, S. C. C., Detoni, C. B., Branco, C. R. C., Botura, M. B., & Branco, A. (2015). In vitro photoprotective effects of Marcetia taxifolia ethanolic extract and its potential for sunscreen formulations. *Revista Brasileira de Farmacognosia*, *25*(4), 413–418.

Cross section of stratum corneum of skin. Retrieved 8 April 2019 from https://lifestylezz.com

Da Silva Gündel, S., dos Reis, T. R., Copetti, P. M., Favarin, F. R., Sagrillo, M. R., da Silva, A. S., & Ourique, A. F. (2019). Evaluation of cytotoxicity, genotoxicity and ecotoxicity of nanoemulsions containing Mancozeb and Eugenol. *Ecotoxicology and Environmental Safety*, *169*, 207–215.

Danladi, S., Wan-Azemin, A., Sani, Y. N., Mohd, K. S., Us, M. R., Mansor, S. M., & Dharmaraj, S. (2015). Phytochemical screening, total phenolic and total flavonoid content, and antioxidant activity of different parts of Melastoma malabathricum. *Jurnal Teknologi*, *77*(2), 63–68.

Devehat, F. L.-L., Bakhtiar, A., Bezivin, A., Amoros, M., & Boustie, J. (2002). Antiviral and Cytotoxic Activities of Some Indonesian Plants. *Fitoterapia*, *73*, 400–405.

Dipali Gupta. (2013). UV absorbing properties of some plant derived extracts. *Research Journal Chemisty Environmental Sciences,1,* 34-36.

Donsì, F., & Ferrari, G. (2016). Essential oil nanoemulsions as antimicrobial agents in food. *Journal of Biotechnology*, *233*, 106–120.

Durst, P. B., & Sankaran, K. V. (2011). Invasives-Koster's Curse (Clidemia hirta). *Newsletter of The Asia-Pacific Forest Invasive Species Netwrok (APFISN)*, *32*.

Ekere, N. R., Ihedioha, J. N., & Ayogu, J. (2014). Assessment of some heavy metals in facial cosmetic products. *Journal of Chemical and Pharmaceutical Research*, *6*(8), 561–564.

El-aziz, R. A., Abbassy, M. M. S., & Hosny, G. (2017). Health Risk assessment of

some heavy metals in cosmetics in common use. *International Journal of Environmental Science and Toxicology Research*, *5*(3), 53–62.

Elkington, B. G., Southavong, B., Sydara, K., Souliya, O., Vanthanouvong, M., Nettavong, K., & Soejarto, D. D. (2009). Biological evaluation of plants of Laos used in the treatment of tuberculosis in Lao traditional medicine. *Pharmaceutical Biology*, *47*(1), 26–33.

Fadil, M., Fikri-benbrahim, K., Rachiq, S., Ihssane, B., Lebrazi, S., Chraibi, M., … Farah, A. (2018). Combined treatment of Thymus vulgaris L ., Rosmarinus officinalis L . and Myrtus communis L . essential oils against Salmonella typhimurium : Optimization of antibacterial activity by mixture design. *European Journal of Pharmaceutics and Biopharmaceutics*, *126*, 211–220.

Faizah, H. ., Kamariah, A. ., & Edwards, D. (2005). Pollination ecology of a pioneer shrub (Melastoma Malabathricum L.) in Brunei Darussalam. In *Conference on Forestry & Forest Products Research* (pp. 399–403).

Fidrianny, I., Darmawati, A., & Sukrasno. (2014). Antioxidant capacities from different polarities extracts of cucurbitaeae leaves using FRAP, DPPH assay and correlation with phenolic, flavonoid, carotenoid content. *International Journal of Pharmacy and Pharmaceutical Sciences*, *6*(2), 858–862.

FDA. (2001). Sunscreen drugs products for over the counter human use. Department of health, education and welfare, USA. F*ederal Registration 64/27687*, 276.

FDA. (2017). Microbiological methods and bacteriological analytical manual. United States of America Food and Drug Administration. Retrieved on 20181203 at https://www.fda.gov/Cosmetics/GuidanceRegulation/GuidanceDocuments/default.htm.

Fokuhl, J., & Müller-goymann, C. C. (2013). Modified TEWL in vitro measurements on transdermal patches with different additives with regard to water vapour permeability kinetics. *International Journal of Pharmaceutics*, *444*, 89–95.

Foo, L. W., Salleh, E., & Hana, S. N. (2017). Green extraction of antimicrobial bioactive compound from piper betle leaves: Probe type ultrasound-assisted extraction vs supercritical carbon dioxide extraction. *Chemical Engineering Transactions*, *56*, 109–114.

García, M. C., Monteagudo, E., & Dicelio, L. E. (2011). A comparative study of a novel lipophilic phthalocyanine incorporated into nanoemulsion formulations : photophysics , size , solubility and thermodynamic stability. *Dyes and Pigments*, *91*, 208–214.

George, C., Shirin, H., Varghese, R., Priya, C. L., & Rao, K. V. B. (2013). Phytochemical composition , antioxidant studies and hptlc analysis of curcuma

amada linn. *Research Journal of Pharmaceutical , Biological and Chemical Sciences*, *4*(3), 1187–1195.

Ghasemzadeh, A., Jaafar, H. Z. E., & Rahmat, A. (2010). Antioxidant activities, total phenolics and flavonoids content in two varieties of malaysia young ginger (zingiber officinale roscoe). *Molecules*, *15*, 4324–4333.

Giorgio, A., Miele, L., Bonis, S. De, Conforti, I., Palmiero, L., Guida, M., … Aliberti, F. (2018). Microbiological stability of cosmetics by using challenge test procedure. *Journal of Pure and Applied Microbiology*, *12*(1), 23–28.

Gopinathan, K., Cleary, G. W., & Lane, M. E. (2012). The structure and function of the stratum corneum. *International Journal of Pharmaceutics*, *435*(1), 3–9.

Gül, A., & Pehlivan, T. (2018). Antioxidant activities of some monofloral honey types produced across Turkey. *Saudi Journal of Biological Sciences*, *25*(6), 1056–1065.

Gündel, S., Callegaro, M., Kerche, M., Reis, F., Marquezan, P., Oliveira, A. De, & Ferreira, A. (2018). Basil oil-nanoemulsions : Development , cytotoxicity and evaluation of antioxidant and antimicrobial potential. *Journal of Drug Delivery Science and Technology*, *46*, 378–383.

Gupta, A., Eral, H. B., Hatton, T. A., & Doyle, P. S. (2016). Nanoemulsions: formation, properties and applications. *Soft Matter*, *12*, 2826–2841.

Halla, N., Fernandes, I. P., Heleno, S. A., Costa, P., Boucherit-otmani, Z., Boucherit, K., & Barreiro, M. F. (2018). Cosmetics preservation : a review on present strategies. *Molecules*, *23*, 1–41.

Hamid Abd, H., Ramli, A. N. M., Zamri, N., & Yusoff M, M. (2018). UPLC-QTOF / MS-based phenolic pro fi ling of Melastomaceae , their antioxidant activity and cytotoxic effects against human breast cancer cell. *Food Chemistry*, *265*, 253–259.

Hammer, K. A. (2015). Treatment of acne with tea tree oil (melaleuca) products: A review of efficacy, tolerability and potential modes of action. *International Journal of Antimicrobial Agents*, *45*(2), 106–110.

Haron, N. W., Anuar, N., & Veeramohan, R. (2015). The taxonomic significance of leaf micromorphology in the genus Melastoma L. (Melastomataceae). *Sains Malaysiana*, *44*(5), 643–650.

Herh, P., Tkachuk, J., Wu, S., Bernzen, M., & Rudolph, B. (1998). *The rheology of pharmaceutical and cosmetic semisolids*. America laboratory, 12-14.

Horbowicz, M., Kosson, R., Grzesiuk, A., & Debski, H. (2008). Anthocyanins of fruits and vegetables - their occurrence , analysis and role in human nutrition. *Vegetable Crops Research Bulletin*, *68*, 5–22.

Ibegbulam-Njoku, P. N., & Chijioke-osuji, C. C. (2016). Microbiological evaluation of cosmetics products sourced in Aba city. *International Journal of Scientific Reports*, *2*(4), 74–80.

Ifesan, B. O. T., Fashakin, J. F., Ebosele, F., & Oyerinde, A. . (2013). Antioxidant and antimicrobial properties of selected plant leaves. *European Journal of Medicinal Plants*, *3*(3), 465–473.

Illustration reaction of antioxidant and free radical. Retrieved 5 April 2019 from https://webnat.com

Illustration of Human Skin Layer. Retrieved 7 April 2019 from https://steemit.com

Ismail, I. N., Razak, W. R. W. A., Sidik, N. B. J., & Said, S. S. M. (2017). Antibacterial activity of flower , leave and stem extract of Melastoma decemfidum. *International Journal of Life Sciences Biotechnology and Pharma Research*, *6*(1), 13–17.

Jaios, E. S., Rahman, S. A., Ching, S. M., Kadir, A. A., Desa, M. N. M., & Zakaria, Z. A. (2016). Possible mechanisms of antinociception of methanol extract of Melastoma Malabathricum leaves. *Revista Brasileira de Farmacognosia*, *26*, 586–594.

Jamalnasir, H., Wagiran, A., Shaharuddin, N. A., & Samad, A. A. (2013). Isolation of high quality RNA from plant rich in flavonoids, Melastoma decemfidum Roxb ex. Jack. *Australian Journal of Crop Science*, *7*(7), 911–916.

Jennifer, C., Stephie, C. ., Abhishri, S. ., & Shalini, B. . (2012). A review on skin whitening property of plant extracts. *International Journal of Pharma and Bio Sciences*, *3*(4), 332–347.

Jiao, D., Shi, C., Yuan, Q., An, X., & Liu, Y. (2018). Mixture design of concrete using simplex centroid design method. *Cement and Concrete Composites*, *89*, 76–88.

Joffry, S. M., Yob, N. J., Rofiee, M. S., Affandi, M. M. R. M. M., Suhaili, Z., Othman, F., & Zakaria, Z. A. (2012). Melastoma malabathricum (L .) Smith ethnomedicinal uses , chemical constituents , and pharmacological properties : a review. *Evidence- Based Complementary and Alternative Medicine*, 1–48.

Joshi, L. S., & Pawar, H. A. (2015). Herbal cosmetics and cosmeceuticals: an overview. *Natural Products Chemistry & Research*, *3*(2), 1–8.

Karim, A.A. (2014). Phenolic composition, functional cosmetic properties of Cocoa pod extract snd its effect as active ingredients in Halal anti-wrinkles gel. *PhD thesis*, Universiti Putra Malaysia.

Karim, A. A., Azlan, A., Ismail, A., Hashim, P., Gani, A. S. S., Zainudin, B. H., & Abdullah, N. A. (2014). Phenolic composition, antioxidant, anti-wrinkles, and tyrosinase inhibitory activities of cocoa pod extract. *BMC Complementary and Alternative Medicine*, *14*, 1–13.

Katsouli, M., Polychniatou, V., & Tzia, C. (2017). Optimization of water in olive oil nano-emulsions composition with bioactive compounds by response surface methodology. *LWT - Food Science and Technology*, *89*, 740–748.

Kavanaugh, E.E. (2018). Tentative final monograph for OTC sunscreen. *Cosmetics, Toilets and Fragrance Association*. Retrievd on 20180705 at www.fda.gov.gov/ohrms/dockets/daily

Khoo, H. ., Azlan, A., Ismail, A., & Abas, F. (2013). Response surface methodology optimization for extraction of phenolics and antioxidant capacity in defatted dabai parts. *Sains Malaysiana*, *42*(7), 949–954.

Kuppusamy, P., Lee, K. D., Song, C. E., Ilavenil, S., Srigopalram, S., Arasu, M. V., & Choi, K. C. (2018). Quantification of major phenolic and flavonoid markers in forage crop Lolium multiflorum using HPLC-DAD. *Brazilian Journal of Pharmacognosy*, *28*, 282–288.

Ladeira, C., Sanches, F., Lima, D., Fernanda, M., Guelfi, G., Regina, S., & Iouko, E. (2016). Multi-response optimisation of the extraction solvent system for phenolics and antioxidant activities from fermented soy flour using a simplex-centroid design, *197*, 175–184.

Lan, W., Lin, S., Li, X., Zhang, Q., & Qin, W. (2017). Chemical composition of the leaf and stem essential oil of Adenophorae Radix. *Advances in Materials, Machinery, Electronics*, 1–5.

Lee, J., Choi, C. S., Bae, I., Choi, J. K., Park, Y., & Park, M. (2018). A novel , topical , nonsteroidal , TRPV1 antagonist , PAC-14028 cream improves skin barrier function and exerts anti-inflammatory action through modulating epidermal differentiation markers and suppressing Th2 cytokines in atopic dermatitis. *Journal of Dermatological Science*, *91*, 184–194.

Li, Y., Liu, B., Jiang, L., Regenstein, J. M., Jiang, N., Poias, V., & Wang, Z. (2019). Interaction of soybean protein isolate and phosphatidylcholine in nanoemulsions: A fluorescence analysis. *Food Hydrocolloids*, *87*, 814–829.

Libman, A., Bouamanivong, S., Southavong, B., Sydara, K., & Soejarto, D. D. (2006). Medicinal plants : An important asset to health care in a region of Central Laos. *Journal of Ethnopharmacology*, *106*, 303–311.

Lieb, L. M., Nash, R. A., Matias, J. R., & Orentreich, N. (1988). A new in vitro method for transepidermal water loss : A possible method for moisturizer

evaluation. . *Journal of the Society of Cosmetic Chemists*, *39*, 107–119.

Lima, R. B. S., Rocha, L. F., Melo, M. R. S., Costa, J. S., Picanço, N. S., Lima, E. S., … Pohlit, A. M. (2015). In vitro and in vivo anti-malarial activity of plants from the Brazilian Amazon. *Malaria Journal*, *14*, 1–14.

Lin, D., Xiao, M., Zhao, J., Li, Z., & Xing, B. (2016). An overview of plant phenolic compounds and their importance in human nutrition and management of type 2 diabetes. *Molecules*, *21*, 1–19.

Lippold, B. C., & Hackemuller, D. (1990). The influence of skin moisturizers on drug penetration in vivo. *International Journal of Pharmaceutics*, *61*, 205–211.

Lodén, M. (2012). Effect of moisturizers on epidermal barrier function. *Clinics in Dermatology*, *30*(3), 286–296.

Lopez, T., Corbin, C., Falguieres, A., Doussot, J., Hano, C., Montguillon, J., & Laine, E. (2016). Secondary metabolite accumulation , antibacterial and antioxidant properties of in vitro propagated Clidemia hirta L . extracts are influenced by the basal culture medium. *Comptes Rendus Chimie*, *19*, 1071–1076.

Malek, S. N. A., Lee, G. S., Hong, S. L., Yaacob, H., Wahab, N. A., Weber, J. F., & Shah, A. (2011). Phytochemical and cytotoxic investigations of curcuma mangga rhizomes. *Molecules*, *16*, 4539–4548.

Mamat, S. S., Fauzi, M., Kamarolzaman, F., Yahya, F., Mahmood, N. D., Shahril, M. S., & Zakaria, Z. A. (2013). Methanol extract of Melastoma malabathricum leaves exerted antioxidant and liver protective activity in rats. *BMC Complementary and Alternative Medicine*, *13*(326), 12.

Mambro, V. M. Di, & Fonseca, M. J. V. (2005). Assays of physical stability and antioxidant activity of a topical formulation added with different plant extracts. *Journal of Pharmaceutical and Biomedical Analysis*, *37*, 287–295.

Mansur, M. C. P. P. R., Leitão, G. S., Cerqueira-coutinho, C., Vermelho, A. B., Silva, R. S., Presgrave, O. A. F., & Santos, E. P. (2016). In vitro and in vivo evaluation of efficacy and safety of photoprotective formulations containing antioxidant extracts. *Revista Brasileira de Farmacognosia*, *26*(2), 251–258.

Mansur, J.S., Breder, M.V.R., Mansur, M.C.A., & Azulay R.D. (1986). Determination of sun protection factor fr spectrophotometry. *Anais Brasileiros De Dermatologia*, *6(14)*, 121-124.

Martins, F.J., Caneshi, C.A., Veira, J.L.F., Barbosa, W., & Raposo, N.R.B. (2016). Antioxidant activity and potential photoproective from amazon native flora

extracts. *Journal of Photochemistry and Photobiology*, *161*, 34-39.

Martins, N. N., Osamu, I. L., & Kolawole, A. J. (2016). Evaluation of heavy metals in some cosmetic products in Lagos Nigeria. *International Journal of Science & Society Yabatech*, *4*(1), 16–24.

Mathangi, T., & Prabhakaran, P. (2013). DPPH free radical scavenging activity of the extracts of the aquatic fern Marsilea quadrifolia Linn. *International Journal of Current Microbiology and Applied Sciences*, *2*(10), 534–536.

Mccallion, R., & Wan, A. L. (1995). In vivo evaluation of the effects of moisturisers on transepidermal water loss using factorial designs. *Journal of Pharmaceutics*, *113*, 247–255.

Mcclements, D. J., & Li, Y. (2010). Structured emulsion-based delivery systems : Controlling the digestion and release of lipophilic food components. *Advances in Colloid and Interface Science*, *159*(2), 213–228.

Mele´ndez, P. A., & Capriles, V. A. (2006). Antibacterial properties of tropical plants from Puerto Rico. *Phytomedicine*, *13*, 272–276.

Merinal, S., & Viji Stella Boi, G. (2012). in vitro antioxidant activity and total phenolic content of leaf extracts of Limonia crenulata (Roxb). *Journal Natural Products Plant Resource*, *2*(1), 209–214.

Michalek, I. M., Benn, E. K. T., Dos Santos, F. L. C., Gordon, S., Wen, C., & Liu, B. (2019). A systematic review of global legal regulations on the permissible level of heavy metals in cosmetics with particular emphasis on skin lightening products. *Environmental Research*, *170*, 187–193.

Mierziak, J., Kostyn, K., & Kulma, A. (2014). Flavonoids as Important molecules of plant interactions with the environment. *Molecules*, *19*, 16240–16265.

Mohamad Adam, N. A., Jaafar Sidik, N., Osman, N. I., & Wan Abdul Razak, W. R. (2016). In vitro regeneration and phytochemical profile of medicinal plant Melastoma Decemfidum. *International Journal of Pharmaceutical Sciences Review and Research*, *37*(08), 36–41.

Moreira, G. C., & Dias, F. D. S. (2018). Mixture design and Doehlert matrix for optimization of the ultrasonic assisted extraction of caffeic acid , rutin , catechin and trans -cinnamic acid in Physalis angulata L . and determination by HPLC DAD. *Microchemical Journal*, *141*, 247–252.

Muhammed, H. J. (2011). Bacterial and Fungal contamination in three brands of cosmetic marketed in iraq. *Iraqi Journal Pharmaceutical Sci*ences, *20*(1), 38–42.

Mukherjee, P. K., Biswas, R., Sharma, A., Banerjee, S., Biswas, S., & Katiyar, C.

K. (2018). Validation of medicinal herbs for anti-tyrosinase potential. *Journal of Herbal Medicine*, *14*, 1–16.

Munhoz, V. M., Longhini, R., Souza, J. R. P., Zequi, J. A. C., Leite, E. V. S., Lopes, G. C., & Mello, J. C. P. (2014). Extraction of flavonoids from Tagetes patula : process optimization and screening for biological activity. *Revista Brasileira de Farmacognosia*, *24*(5), 576–583.

Musa, N., Musa, N., Ibrahim, W. N., Ariff Shariat, M. Z., Zamani, A. I., Abdullah, M. R., & Awang Soh, A. S. (2011). Methanolic activities of selected weeds on bacteria isolated from Macrobrachium rosenbergii Larvae. *Thai Journal of Veterinary Medicine.*, *41*(4), 535–539.

Musini, A., Rao, M. J. P., & Giri, A. (2013). Phytochemical investigations and antibacterial activity of Salacia oblonga Wall ethanolic extract. *Annals of Phytomedicine*, *2*(1), 102–107.

Nakahara, L. M., Burkhart, R. M., & Funasaki, G. Y. (1982). *Review and Status of Biological Control of Clidemia in Hawai'i*.pp. 252-265

Napagoda, M.T., Malkanthi, B.M.A.S., Abayawardana, S.A.K., Qader, M.M., & Jayasinghe, L. (2016). Photoprotective potential in some medicinal plants used to treat skin diseases in Sri Lanka. *BMC Complementary and Alternative Medicine*, *16*, 649.

Narasimham, D., Bindu, Y. H., Cheriyamundath, S., Raghavan, R., Kumari, M. K., Chandrasekhar, T., & Madassery, J. (2017). Evaluation of in vitro anticancer and antioxidant activities from leaf extracts of medicinal plant Clidemia Hirta. *International Journal of Pharmacy and Pharmaceutical Sciences*, *9*(4), 149–153.

Narayanaswamy, N., Duraisamy, A., & Balakrishnan, K. P. (2011). Screening of some medicinal plants for their antityrosinase and antioxidant activities, *3*(2), 1107–1112.

Nastiti, C. M. R. R., Ponto, T., Abd, E., Grice, J. E., Benson, H. A. E., & Roberts, M. S. (2017). Topical nano and microemulsions for skin delivery. *Pharmaceutics*, *9*(37), 1–25.

Ndjateu, F. S. T., Tsafack, R. B. N., Nganou, B. K., Awouafack, M. D., Wabo, H. K., Tene, M.,& Eloff, J. N. (2014). Antimicrobial and antioxidant activities of extracts and ten compounds from three cameroonian medicinal plants : Dissotis Perkinsiae (Melastomaceae), Adenocarpus Mannii (Fabaceae) and Barteria fistulosa (Passifloraceae). *South African Journal of Botany*, *91*, 37–42.

NiziołŁukaszewskaNizio, Z., Wasilewski, T., Bujak, T., Gaweł-Bęben, K., Osika,

P., & Czerwonka, D. (2018). Cornus mas L . extract as a multifunctional material for manufacturing cosmetic emulsions. *Chinese Journal of Natural Medicines*, *16*(4), 284–292.

Ondua, M., Njoya, E. M., Abdalla, M. A., & McGaw, L. J. (2019). Anti-inflammatory and antioxidant properties of leaf extracts of eleven South African medicinal plants used traditionally to treat inflammation. *Journal of Ethnopharmacology*, *234*, 27–35.

Ong, H. C., & Nordiana, M. (1999). Malay ethno-medico botany in Machang , Kelantan , Malaysia. *Fitoterapia*, *70*, 502–513.

Ong, J., Wilson, A., & Lym, T. (2007). Melastomataceae : Inherent economical values substantiating potential transgenic studies in the family. *Transgenic Plant Journal*, *1*(1), 237–243.

Ono, S., & Manabe, Y. (2017). Basic study on Transepidermal Water Loss (TEWL) of infants living in urban and non-urban areas and their environmental factors . *Journal of Pregnancy and Neonatal Medicine*, *1*(1), 1–6.

Orives, J. R., Galvan, D., Coppo, R. L., Henrique, C., Rodrigues, F., Angilelli, K. G., & Borsato, D. (2014). Multiresponse optimisation on biodiesel obtained through a ternary mixture of vegetable oil and animal fat : Simplex-centroid mixture design application. *Energy Conversion and Management*, *79*, 398–404.

Ouedrhiri, W., Balouiri, M., Bouhdid, S., Moja, S., Chahdi, F. O., Taleb, M., & Greche, H. (2016). Mixture design of Origanum compactum , Origanum majorana and Thymus serpyllum essential oils : Optimization of their antibacterial. *Industrial Crops & Products*, *89*, 1–9.

Oussaid, S., Chibane, M., Madani, K., & Amrouche, T. (2017). Optimization of the extraction of phenolic compounds from Scirpus holoschoenus using a simplex centroid design for antioxidant and antibacterial applications. *LWT - Food Science and Technology*, *86*, 635–642.

Padmanabhan, P., & Jangle, S. N. (2012). Evaluation of DPPH radical scavenging activity and reducing power of four selected medicinal plants and their combinations. *International Journal of Pharmaceutical Sciences and Drug Research*, *4*(2), 143–146.

Panche, A. ., Diwan, A. ., & Chandra, S. . (2016). Flavonoids: an overview. *Journal of Nutritional Science*, *5*(47), 1–15.

Prabhune, A., Jadhav, S., Kadam, D., & Aparadh, V. (2013). Free radical scavenging (dpph) and ferric reducing ability (FRAP) of some commelinaceae members. *International Journal of Biology, Pharmacy and Allied Sciences*, *2*(5), 1128–1134.

Prieto, P., Pineda, M., & Aguilar, M. (1999). Spectrophotometric quantitation of antioxidant capacity through the formation of a Phosphomolybdenum complex: Specific application to the determination of Vitamin E. *Analytical Biochemistry*, *341*, 337–341.

Rai, V. K., Mishra, N., Yadav, K. S., & Yadav, N. P. (2018). Nanoemulsion as pharmaceutical carrier for dermal and transdermal drug delivery : Formulation development , stability issues , basic considerations and applications. *Journal of Controlled Release*, *270*, 203–225.

Raimundo, G.O.J., Camila, S.J., Grasielly, R.S., Amanda, L.G., Ana, P.O., Sarah, R.G.L., Amanda, C.S.M., Jessica, S.R.S.,& Jackson, R.G.S.A. (2013). In vitro antioxidant and photoprotective activities of dried extracts from Neoglaziovia variegate (Bromeliaceae). J*ournal Applied Pharmaceutical Sciences. 3(1),* 122-127.

Rao, U. S. ., Ahmad, B. ., & Mohd, K. S. (2016). In vitro nitric oxide scavenging and anti-inflammatory activities of different solvent extracts of various parts of Musa paradisiaca. *Malaysian Journal of Analytical Sciences*, *20*(5), 1191–1202.

Re, R., Pellegrini, N., Proteggente, A., Pannala, A., Yang, M., & Rice-Evans, C. (1999). Antioxidant activity applying an improved ABTS radical cation decolorization assay. *Free Radical Biology & Medicine*, *26*, 1231–1237.

Ricaurte, L., Hernández-carrión, M., Moyano-molano, M., & Clavijo-romero, A. (2018). Physical , thermal and thermodynamical study of high oleic palm oil nanoemulsions. *Food Chemistry*, *256*, 62–70.

Ridley, B. (2007). *Rheology Modifiers for Skin Care Applications*. *Cosmetic Science Technology*.pp.159.

Robert L. Rietschel, M. . (1978). A method to evaluate skin moisturizers in vivo. *The Journal of Investigative Dermatology*, *70*, 152–155.

Roche, B. I. H. (1978). In vivo measurement of transepidermal water loss. *Journal of the Society of Cosmetic Chemists*, *29*, 573–580.

Roslen, N. A., Alewi, N. A. M., Ahamada, H., & Abdul Rasad, M. S. B. (2014). Cytotoxicity screening of Melastoma Malabathricum extracts on human breast cancer cell lines in vitro. *Asian Pacific Journal of Tropical Biomedicine*, *4*(7), 545–548.

Ryu, V., McClements, D. J., Corradini, M. G., Yang, J. S., & McLandsborough, L. (2018). Natural antimicrobial delivery systems: Formulation, antimicrobial activity, and mechanism of action of quillaja saponin-stabilized carvacrol nanoemulsions. *Food Hydrocolloids*, *82*, 442–450.

Saeedi, M., Eslamifar, M., & Khezri, K. (2019). Kojic acid applications in cosmetic and pharmaceutical preparations. *Biomedicine and Pharmacotherapy*, *110*, 582–593.

Saha, M. ., Hasan, S. M. ., Akter, R., Hossain, M. ., Alam, M. ., Alam, M. ., & Mazumder, M. E. . (2008). Free radical scavenging activity of methanol extract of the leaves of Mimusops Elengi Linn. *Bangladesh Society for Veterinary Medicine*, *6*(2), 197–202.

Saidalavi, R., Hashim, A., B, K. K., K, L. P., & Adake, P. (2017). Analysis of lead and arsenic in cosmetics and assessment of students awareness about cosmetic toxicity. *International Journal of Basic & Clinical Pharmacology*, *6*(6), 1426–1430.

Salvia-Trujillo, L., Verkempinck, S. H. E., Zhang, X., Van Loey, A. M., Grauwet, T., & Hendrickx, M. E. (2019). Comparative study on lipid digestion and carotenoid bioaccessibility of emulsions, nanoemulsions and vegetable-based in situ emulsions. *Food Hydrocolloids*, *87*, 119–128.

Santhanam, R. K., Akhtar, M. T., Ahmad, S., Abas, F., Ismail, I. S., Rukayadi, Y., & Shaari, K. (2017). Utilization of the ethyl acetate fraction of Zanthoxylum rhetsa bark extract as an active ingredient in natural sunscreen formulations. *Industrial Crops & Products*, *96*, 165–172.

Saraf, A., & Sankhala, S. (2014). Simultaneous determination of rutin and quercetin in different parts of of tecomella undulata (Seem): An endangered medicinal plant. *International Journal of Pharmacognosy and Phytochemical Research*, *6*(3), 434–439.

Sarbadhikary, S. B., Bhowmik, S., Datta, B. K., & Mandal, N. C. (2015). Antimicrobial and antioxidant activity of leaf extracts of two indigenous angiosperm species of tripura. *International Journal of Current Microbiology and Applied Sciences*, *4*(8), 643–655.

Sari, N. M., Kuspradini, H., Amirta, R., & Kusuma, I. W. (2018). Antioxidant activity of an invasive plant, Melastoma malabathricum and its potential as herbal tea product. In *IOP Conference Series: Earth and Environmental Science* (Vol. 144).

Sarju, N., Samad, A. A., Ghani, M. A., & Ahmad, F. (2012). Detection and quantification of Naringenin and kaempferol in *Melastoma decemfidum* extracts by GC-FID and GC-MS. *Acta Chromatographica*, *24*(2), 221–228.

Sethi, A., Kaur, T., Malhotra, S., & Gambhir, M. (2016). Moisturizers : The slippery road. *Indian Journal of Dermatology*, *61*(3), 279–287.

Shahwar, D., Raza, M. A., Ali, T., & Ahmad, V. U. (2011). Microbial transformation

of vanillin isolated from melia azedarach to vanillyl alcohol followed by protease inhibition and antioxidant activity. *Journal of The Chemical Society of Pakistan*, *33*(5), 715–719.

Shalaby, E. A., & Shanab, S. M. M. (2013). Comparison of DPPH and ABTS assays for determining antioxidant potential of water and methanol extracts of Spirulina platensis. *Indian Journal of Geo-Marine Sciences*, *42*(5), 556–564.

Shao, Y., Wu, C., Wu, T., Li, Y., Chen, S., Yuan, C., & Hu, Y. (2018). Eugenol-chitosan nanoemulsions by ultrasound-mediated emulsi fi cation : Formulation , characterization and antimicrobial activity. *Carbohydrate Polymers*, *193*, 144–152.

Sharma, S., & Vig, A.P. (2014). Preliminary Phytochemical Screening and *In Vitro* Antioxidant Activities of *Parkinsonia aculeata Linn.* Biomed Research International. Volume 2014, 1-8.

Shu, G., Khalid, N., Chen, Z., Neves, M. A., Barrow, C. J., & Nakajima, M. (2018). Formulation and characterization of astaxanthin-enriched nanoemulsions stabilized using ginseng saponins as natural emulsifiers. *Food Chemistry*, *255*, 67–74.

Siew, Y., Zareisedehizadeh, S., Seetoh, W., Neo, S., Tan, C.-H., & Koh, H.-L. (2014). Ethnobotanical survey of usage of fresh medicinal plants in Singapore. *Journal of Ethnopharmacology*, *155*, 1450–1466.

Singleton, V., & Rossi, J. A. J. (1965). Colorimetry of total phenolics with phosphomolybdic-phosphotungtic acid reagents. *American Journal Enology Viticulture*, 144–158.

Solomon-Wisdom, G. ., Ugoh, S., & Mohammed, B. (2014). Phytochemical screening and antimicrobial activities of Annona muricata (L) leaf extract . *American Journal of Biological, Chemical and Pharmaceutical Sciences*, *2*(1), 1–7.

Soriano, M. L., Zougagh, M., Valcárcel, M., & Ríos, Á. (2018). Analytical Nanoscience and Nanotechnology : Where we are and where we are heading. *Talanta*, *177*, 104–121.

Souza, C., Patricia, M.B.G., & Maia, C. (2017). Development and photoprotective effect of a sunscreen containing the antioxidants Spirulina and dimethylmethoxy chromanol on sun-induced skin damage. *European Journal of Pharmaceutical Sciences, 104,* 52-64.

Spacino, K. R., Tavares, E., Angilelli, K. G., Moreira, I., Galão, O. F., & Borsato, D. (2016). Relative protection factor optimisation of natural antioxidants in biodiesel B100. *Industrial Crops and Products*, *80*, 109–114.

Stankovic, M. S. (2011). Total phenolic content , flavonoid concentration and antioxidant activity of Marrubium peregrinum L . extracts. *Kragujevac Journal of Sciences*, *33*, 63–72.

Stratton, D. (2010). *Koster's Curse*. *Case Studies in Ecology and Evolution*.

Subramanian, G., Meyyanathan, S. N., Karthik, Y., Karunakaranair, A., & Palanisamy, D. (2014). Development and validation of hplc method for the simultaneous estimation of quercetin and rutin in Aganosma Dichotoma (Roth) K. Schum. *International Journal of Pharmacy and Pharmaceutical Sciences*, *6*(2), 606–608.

Sulaiman, M. R., Somchit, M. N., Israf, D. A., Ahmad, Z., & Moin, S. (2004). Antinociceptive effect of Melastoma Malabathricum ethanolic extract in mice. *Fitoterapia*, *75*, 667–672.

Sumit, K., Vivek, S., Sujata, S., & Ashish, B. (2012). Herbal Cosmetics : Used for Skin and hair. *Inventi Rapid: Cosmeceuticals*, *2012*(4), 1–7.

Susanti, D., Sirat, H. M., Ahmad, F., & Ali, R. M. (2008). Bioactive constituents from the leaves of Melastoma Malabathricum l. *Jurnal Ilmiah Farmasi*, *5*(1), 1–8.

Susanti, D., Sirat, H. M., Ahmad, F., Ali, R. M., Aima, N., & Kitajima, M. (2007). Antioxidant and Cytotoxic flavonoids from the flowers of Melastoma Malabathricum L . *Food Chemistry*, *103*, 710–716.

Sutradhar, K. B., & Amin, L. (2013). Nanoemulsions: Increasing possibilities in drug delivery. *European Journal of Nanomedicine*, *5*(2), 97–110.

Tadros, T.F. (2005). Applied surfactant, principle and applications, Wiley_VCH Verlag GmbH & Co. KGaA, Weinheim.

Taofiq, O., González-paramás, A. M., Martins, A., Barreiro, F. M., & Ferreira, I. C. F. R. (2016). Mushrooms extracts and compounds in cosmetics , cosmeceuticals and nutricosmetics — A review. *Industrial Crops & Products*, *90*, 38–48.

Tareau, M. A., Palisse, M., & Odonne, G. (2017). As vivid as a weed: Medicinal and cosmetic plant uses amongst the urban youth in French Guiana. *Journal of Ethnopharmacology*, *203*, 200–213.

Thach, B. D., Dao, V. Q., Giang, T. T. L., Cang, D. T., Linh, L. N. T., Ben, T. T., & Suong, N. K. (2017). Antioxidant and antityrosinase activities of flavonoid from Blumea Balsamifera (L .) DC . leaves. *European Journal of Research in Medical Sciences*, *5*(1), 1–6.

Tomaz, D. A. A. C., Miranda, C. D. E. G., Souza, V. D. F. M. De, & Cunha, leitao

da E. V. (2012). Analysis and characterization of methyl esters of fatty acids of some Gracilaria species. *Biochemical Systematics and Ecology*, *44*, 303–306.

Trommer, H., & Neubert, R. H. H. (2006). Overcoming the stratum corneum : The modulation of skin penetration. *Skin Pharmacology and Physiology*, *19*, 106–121.

Tu, P. T. B., & Tawata, S. (2015). Anti-oxidant, anti-aging, and anti-melanogenic properties of the essential oils from two varieties of Alpinia zerumbet. *Molecules*, *20*(9), 16723–16740.

Ultraviolet radiation. Retrieved 7 April 2019 from https://fromrootssheblooms.com

Valcerde, C. L., Colmenares, A. J., & Isaza, J. H. (2015). Comparison of DPPH free radical scavenging , ferric reducing antioxidant power (FRAP), and total phenolic content of two meriania species (Melastomataceae). *Revista de Ciencias*, *19*(2), 117–124.

Vardhan, A., Khan, S., & Pandey, B. (2014). Screening of plant parts for anti-tyrosinase activity by tyrosinase assay using mushroom tyrosinase. *Indian Journal of Scientific. Research*, *4*(1), 134–139.

Vinotha, S., Thabrew, I., & Ranjani, S. S. (2014). In vitro antioxidant activity of two selected herbal medicines. *International Journal of Medical, Health, Biomedical and Pharmaceutical Engineering*, *8*(12), 787–792.

Visioscan. (1998). Information and Operating Instruction Visioscan ® VC98 and the Software SELS (Surface Evaluation of the Living Skin). *CK Electonic GmbH: Germany*, 1–53.

Wang, H. D., Chen, C., Huynh, P., & Chang, J. (2015). Exploring the potential of using algae in cosmetics. *Bioresource Technology*, *184*, 355–362.

Wang, L., Li, X., Zhang, G., Dong, J., & Eastoe, J. (2007). Oil-in-water nanoemulsions for pesticide formulations. *Journal of Colloid and Interface Science*, *314*, 230–235.

Wang, S. P., & Huang, K. J. (2004). Determination of flavonoids by high-performance liquid chromatography and capillary electrophoresis. *Journal of Chromatography A*, *1032*, 273–279.

Wang, Y., Hsu, H., & Liao, W.-L. (2008). Antibacterial activity of Melastoma candidum D . Don. *LWT-Food Science and Technology*, *41*, 1793–1798.

Wang, Y., Zhu, J., Meng, X., Liu, S., Mu, J., & Ning, C. (2016). Comparison of polyphenol , anthocyanin and antioxidant capacity in four varieties of Lonicera caerulea berry extracts. *Food Chemistry*, *197*, 522–529.

Wu, H., Chen, M., Fan, Y., Elsebaei, F., & Zhu, Y. (2012). Determination of rutin and quercetin in Chinese herbal medicine by ionic liquid-based pressurized liquid extraction-liquid chromatography- chemiluminescence detection. *Talanta*, *88*, 222–229.

Ya, W., Chun-meng, Z., Tao, G., Yi-lin, Z., & Ping, Z. (2015). Preliminary screening of 44 plant extracts for anti-tyrosinase and antioxidant activities. *Pakistan. Journal of Pharmaceutical. Sciences.*, *28*(5), 1737–1744.

Yadav, D. K., Rai, R., Kumar, N., Singh, S., Misra, S., Sharma, P., & Pratap, R. (2016). New arylated benzo[h]quinolines induce anti-cancer activity by oxidative stress-mediated DNA damage. *Scientific Reports*, *6*, 1–13.

Yahaya Khan, M., Abdul Karim, Z. A., Hagos, F. Y., Aziz, A. R. A., & Tan, I. M. (2014). Current trends in water-in-diesel emulsion as a fuel. *The Scientific World Journal*, *14*, 1–15.

Yang, L., Yan, Q. H., Ma, J. Y., Wang, Q., Zhang, J. W., & Xi, G. X. (2013). High performance liquid chromatographic determination of phenolic compounds in propolis. *Tropical Journal of Pharmaceutical Research*, *12*(5), 771–776.

Yildirim, S. T., Oztop, M. H., & Soyer, Y. (2017). Cinnamon oil nanoemulsions by spontaneous emulsification: formulation, characterization and antimicrobial activity. *LWT - Food Science and Technology*, *84*, 122–128.

Yolmeh, M., Khomeiri, M., & Ahmadi, Z. (2017). Application of mixture design to introduce an optimum cell-free supernatant of multiple-strain mixture (MSM) for Lactobacillus against food-borne pathogens. *LWT - Food Science and Technology*, *83*, 298–304.

Zaidun, N.A. & Hashim, N.H. (2019). Halal Cosmetics: Current issue and future oppoutunities. *Jurnal Pengguna Malaysia*. 74-80

Zainol, N. A., Ming, T. S., & Darwis, Y. (2015). Development and characterization of cinnamon leaf oil nanocream for topical application. *Indian Journal of Pharmaceutical Sciences*, *77*(4), 422–433.

Zakaria, Z. A., Rofiee, M. S., Mohamed, A. M., Teh, L. K., & Salleh, M. Z. (2011). In vitro antiproliferative and antioxidant activities and total phenolic contents of the extracts of Melastoma malabathricum leaves. *Journal of Acupuncture and Meridian Studies*, *4*(4), 248–256.

Zhang, L., Ravipati, A. S., Koyyalamudi, S. R., Jeong, S. C., Bartlett, J., Smith, P. T., … Vicente, F. (2013). Anti-fungal and anti-bacterial activities of ethanol extracts of selected traditional Chinese medicinal herbs. *Asian Pacific Journal of Tropical Medicine*, 673–681.

Zilla, M. K., Qadri, M., Pathania, A. S., Strobel, G. A., Nalli, Y., Kumar, S., … Ali, A. (2013). Phytochemistry bioactive metabolites from an endophytic cryptosporiopsis sp . inhabiting Clidemia hirta. *Phytochemistry*, *95*, 291–297.

BIODATA OF STUDENT

Nur Fauwizah binti Azahar was born on 29th October 1991 in Muar, Johor. She received her early education at Sekolah Kebangsaan Sri Serdang, Selangor from standard 1 to standard 6. Then she continued her secondary education at Sekolah Menengah Kebangsaan Sri Indah, Selangor and Sekolah Menengah Sains Seri Puteri, Kuala Lumpur from form 1-3 and form 4-5, respectively. After completing her Sijil Pelajaran Malaysia (SPM), she continued her studies at Matriculation level under Ministry of Education, Malaysia at Matriculation College Malacca in the year 2009/2010. After completing her matriculation level, she gained her Bachelor of Science majoring Chemistry with honours at Universiti Teknologi Mara (UiTM) and graduated in 2014.

Nur Fauwizah served as Food Technologist Researcher in private sector for one year then she continued her Master Degree programme at Universiti Putra Malaysia (UPM) majoring in Halal Products Development. Upon completion of Master, She served as Research Assistant at Halal Products Research Institute, Universiti Putra Malaysia (UPM) under special project with Jabatan Kemajuan Islam Malaysia (JAKIM) for about one year then she continued her Doctor of Philosophy at Universiti Putra Malaysia (UPM) under supervision of Assoc Prof Dr. Siti Salwa binti Abd Gani. During her study, she attended a mobility (Outbound) Program at Universiti Islam Sultan Sharif Ali, Brunei Darussalam for two weeks as an exchange student. She also was awarded a Graduate Research Fellowship (GRF) and gained experiences as laboratory demonstrator for organic chemistry at Centre of Foundation Studies for Agricultural Science, UPM.

LIST OF PUBLICATIONS

Research Papers

Nur Fauwizah Azahar, Siti Salwa Abd Gani, Uswatun Hasanah Zaidan and Paiman Bawon (2018). Photo-Protective and Anti-Oxidative Potential in the Leaves of Three Different Melastomataceae Family Species. ***International Journal of Advanced and Applied Sciences- (Accepted)***

Nur Fauwizah Azahar, Siti Salwa Abd Gani, Uswatun Hasanah Zaidan and Paiman Bawon (2018). In Vitro Whitening Properties and Antioxidative Potentials of The Extracts of Three Melastoma Leaves Species (*M. malabathricum*, *M. hirta* and *M. decemfidum*). ***Journal of Applied Sciences Research – (Accepted)***

Nur Fauwizah Azahar, Siti Salwa Abd Gani, Uswatun Hasanah Zaidan, Paiman Bawon and Mohd Izuan Effendi Halmi. The Effects of the Leaves Extract of Melastomataceae Family Species (*M. malabathricum*, *M. hirta* and *M. decemfidum*) on Antioxidant Activity and Growth of Pathogenic Bacteria. ***Malaysian Applied Biology Journal. – (Accepted)***

Nur Fauwizah Azahar, Siti Salwa Abd Gani, Uswatun Hasanah Zaidan and Paiman Bawon (2018). Melastomataceae family species (Melastoma Malabathricum L. Smith, Melastoma Malabathricum var. alba and Clidemia hirta (L.) D. Don): A review of their ethnomedicinal, chemical constituents and pharmacological properties – ***Applied Science and Technology- (Accepted)***

Nur Fauwizah Azahar, Siti Salwa Abd Gani, Uswatun Hasanah Zaidan, Paiman Bawon and Mohd Izuan Effendi Halmi. *In vitro* anti-elastase and anti-collagenase activities from the optimum antioxidants extracts of three Melastomataceae leaves species. ***BMC Complementary Alternatives Medicines – (Submitted, Under review)***

Nur Fauwizah Azahar, Siti Salwa Abd Gani, Uswatun Hasanah Zaidan, Paiman Bawon and Mohd Izuan Effendi Halmi. The efficacy of mixture *Melastoma* leaves extract (*M. Malabathricum (L*), *C. hirta* and *M. Malabathricum var. alba*) as sunscreen lotion and anti-aging cream. ***RSC Advances- (Submitted)***

Nur Fauwizah Azahar, Siti Salwa Abd Gani, Uswatun Hasanah Zaidan, Paiman Bawon and Mohd Izuan Effendi Halmi. Development and characterization of the extracts of mixture Melastoma leaves extract (*M. Malabathricum (L*), *C. hirta* and *M. Malabathricum var. alba*) nanoemulsion for topical application. ***Industrial Crops and Products- (In preparation)***

List of Conferences, Awards And Mobility Program

Conferences

Nur Fauwizah Azahar, Siti Salwa Abd Gani, Uswatun Hasanah Zaidan and Paiman Bawon. Melastomataceae Family Species (Melastoma Malabathricum L. Smith, Melastoma Malabathricum var. alba and Clidemia Hirta L. D. Don): a review of their ethnomedicinal, chemical constituents and pharmacological properties**.** The 6th International Conference of Applied Science and technology (ICAST 2019), 11-13 November 2019. Kyoto, Japan.

Nur Fauwizah Azahar, Siti Salwa Abd Gani, Uswatun Hasanah Zaidan, Paiman Bawon and Mohd Izuan Effendi Halmi. The Effects of the Leaves Extract of Melastomataceae Family Species (*M. malabathricum*, *M. hirta* and *M. decemfidum*) on Antioxidant Activity and Growth of Pathogenic Bacteria**.** 2nd International Conference on Recent Advancements in Science and Technology, 28-30 October 2019, Kuala Lumpur, Malaysia.

Nur Fauwizah Azahar, Siti Salwa Abd Gani, Uswatun Hasanah Zaidan and Paiman Bawon (2018). In Vitro Whitening Properties and Antioxidative Potentials of The Extracts of Three *Melastoma* Leaves Species (*M. malabathricum*, *M. hirta* and *M. decemfidum*). 5th International Conference on Chemical Industry and Science 2019, 1-3 February 2019, Kuching, Malaysia.

Nur Fauwizah Azahar, Siti Salwa Abd Gani, Uswatun Hasanah Zaidan and Paiman Bawon (2018). Photo-Protective and Anti-Oxidative Potential in the Leaves of Three Different Melastomataceae Family Species. 3rd Current Research on Information Technology, Mathematics, Sciences, Science and Technology (CRIMSTIC 2018). 27-29th April 2018, Melaka, Malaysia,

Awards

Nur Fauwizah Azahar, Siti Salwa Abd Gani, Uswatun Hasanah Zaidan, Ramya Vijayakumar, Nur Royhaila Mohammad and Paiman Bawon (2018). The unexplored botanical extracts: A new horizon in skin anti-aging formulation. ***SILVER AWARDS***. International Eureka Innovation Exhibition 2018, 29th - 31st October 2018, Universiti Kuala Lumpur Malaysia Spanish Institute (UniKL MSI), Kulim Hitecch Park, Kedah.

Nur Fauwizah Azahar, Siti Salwa Abda Gani, Ramya Vijayakumar and Asiah Abdullah. The unexplored botanical extracts: A new horizon in skin anti-aging formulation. ***SILVER AWARDS***. International Invention & Innovative Competition (InnIIC Series 2/2019), 2 November 2019, Palace of the Golden Horses, Selangor.

Mobility Program

Mobility Program (Outbound) at *Universiti of Sultan Sharif Ali Islamic (UNISSA), Brunei Darussalam* on 22nd October 2018 – 5th November 2018.