CHARACTERIZATION OF BIOACTIVE COMPOUNDS AND ANTIBACTERIAL STUDY OF PITAYA PEEL EXTRACT EXTRACTED THROUGH MICROWAVE ASSISTED EXTRACTION METHOD

MUHAMMAD AZLAN BIN NAZERI

MASTER OF SCIENCE

UNIVERSITI MALAYSIA PAHANG

SUPERVISOR'S DECLARATION

We hereby declare that We have checked this thesis and in our opinion, this thesis is adequate in terms of scope and quality for the award of the degree of Master of Science

____

(Supervisor's Signature)

Full Name : DR. NORASHIKIN BINTI MAT ZAIN

Position : SENIOR LECTURER

Date :

____

(Co-supervisor's Signature)

Full Name : DR. NURUL AINI BINTI AZMAN

Position : SENIOR LECTURER

Date :

STUDENT'S DECLARATION

I hereby declare that the work in this thesis is based on my original work except for quotations and citation which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at Universiti Malaysia Pahang or any other institutions.

____

(Student's Signature)

Full Name : MUHAMMAD AZLAN BIN NAZERI

ID Number : MKC 15029

Date :

CHARACTERIZATION OF BIOACTIVE COMPOUNDS AND ANTIBACTERIAL STUDY OF PITAYA PEEL EXTRACT EXTRACTED THROUGH MICROWAVE ASSISTED EXTRACTION METHOD

MUHAMMAD AZLAN BIN NAZERI

Thesis submitted in fulfillment of the requirements
for the award of the degree of
Master of Science

Faculty of Chemical & Natural Resources Engineering

UNIVERSITI MALAYSIA PAHANG

OCTOBER 2018

Dedicated to my parents

ACKNOWLEDGEMENTS

Firstly, I would like to acknowledge the efforts of my supervisor, Dr Norashikin Binti Mat Zain especially, for the opportunity to carry out my project in such a great working environment. I have benefited greatly from her keen scientific insights and ability to conceptualize complex ideas in a simple format. I have gained a lot from her vast wealth of biotechnology knowledge and scientific curiosity. I am extremely appreciative of all efforts and help, and very happy to be part of the research team. Thank you for being such a wonderful person and mentor to me.

To my co-supervisor, Dr Nurul Aini Binti Azman, I am grateful for your continuous advice and encouragement. Her presence is absolutely valuable, especially with all sorts of necessary information she has imparted for the successful completion of this project.

My sincerest gratitude also goes to all teaching and non-teaching staff alike of the University Malaysia Pahang (UMP). This has been an amazing opportunity that I am really glad I have fully exploited it. I would like to thank all of my friends and colleagues for their support and effort in assisting me during data collection, data analysis and other critical stages in my master study.

My greatest appreciation nevertheless goes to Allah the Almighty (S.W.T), for my life and His benevolence for my family, health, education, career and every other aspect of my life.

Finally, I would also wish to express my gratitude to my mother, Zaharah Binti Salim, who has been my absolute best friend. I am forever grateful for your parental care, encouragement, moral and financial support. I also really appreciate my siblings' fervent support and prayers throughout this process.

ABSTRAK

Kulit pitaya dilihat sebagai sejenis sampah yang berpotensi, terutamanya di dalam industri makanan kerana jus ekstraknya boleh digunapakai sebagai pewarna semulajadi. Selain itu, ia juga mengandungi sebatian bioaktif yang bermanfaat dan mempunyai nilai komersil kerana sebatian bioaktifnya dapat menyumbang kepada sifat antioksidan dan antibakteria. Secara tidak langsung, sebatian bioaktif ini juga boleh memberi kesan yang baik kepada kesihatan manusia. Walaupun kulit pitaya mempunyai potensi, masalah dalam industri adalah kulit pitaya dibuang sebelum rawatan terutamanya dalam industri pemprosesan makanan tanpa memberi pertimbangan terhadap kesan sampingan ke atas alam sekitar. Walau bagaimanapun, kajian adalah terhad dalam menganalisa sebatian bioaktif kulit pitaya dengan menggunakan kaedah hijau, iaitu menggunakan air dan pengekstrakan berketuhar (MAE) sebagai pelarut dan alat untuk proses pengekstrakan masing-masing. Oleh sebab itu, objektif utama kajian ini adalah untuk mengkaji keadaan terbaik MAE untuk memperolehi nilai tertinggi kandungan fenolik (TPC). Seterusnya keadan terbaik MAE di gunakan untuk pengekstrakan sebatian bioaktif daripada kulit pitaya iaitu sebatian mineral dan phenolic. Kemudian, mencirikan kandungan kimia dan analisis aktiviti antibakteria daripada ekstrak kulit pitaya boleh dikaji. Teknik pengering beku telah digunakan untuk menghilang semua kandungan air yang ada di dalam kulit pitaya sebelum meneruskan pengekstrakan bagi memastikan kulit pitaya dapat disimpan untuk masa yang lama sebelum dianalisa. Kesan parameter MAE seperti kuasa, suhu, masa, dan berat sampel telah ditentukan. Induktif bergandingan spectrometer pancaran plasma-optik (ICP-OES) dan kromatografi cecair berprestasi ultra tinggi bergandingan spectrometer jisim (UHPLC-ESI-QTRAP-MSMS) telah digunapakai untuk mencirikan kandungan mineral dan jenis sebatian fenolik daripada ekstrak kulit pitaya. Analisis antibakteria ekstrak kulit pitaya dilakukan terhadap Gram-positif, *Staphylococcus aureus (S. aureus)* ATCC 6538 dan Gram-negatif, *Escherichia coli (E. coli)* ATCC 8739 untuk mengukur perubahan zon inhibitasi. Selain itu, asai masa perencatan kinetik telah digunakan untuk memerhati lengkung pertumbuhan bakteria. Dua jenis perisian digunakan iaitu SPSS dan CCLASS untuk menentukan keadaan MAE yang terbaik berdasarkan signifikasi nilai TPC dan untuk mengesahkan data kandungan mineral dari ekstrak kulit pitaya masing-masing. Di samping itu, perubahan struktur mikroskopik kulit pitaya untuk sebelum dan selepas pengekstrakan melalui MAE telah diperhatikan. Hasilnya mendedahkan bahawa nilai TPC maksimum diperhatikan pada kuasa 400 W, suhu 45 °C, dan masa hubungan 20 minit untuk ekstrak 1.2 g kulit pitaya dalam 50 mL air dengan nilai TPC maksimum yang diperoleh adalah masing-masing 5.808, 5.800, 5.723, dan 5.708 mg GAE/g kulit kering. Parameter keadaan terbaik ini telah disahkan dengan menggunakan analisis statistik, SPSS dengan Bonferroni post hoc. TPC yang ditunjukkan dalam ekstrak cecair diukur dalam mg GAE/g. Selain itu, unit IC_{50} (Perencatan Penghalang) ditentukan daripada larutan ekstrak dengan menggunakan parameter keadaan terbaik MAE dan 2,2, diphenyl-1-picrylhydrazil (DPPH) sebagai radikal bebas sintetik. Nilai IC_{50} yang didapati daripada kajian ini ialah 0.52 mL/mL. Tambahan pula, 12 daripada 24 unsur telah dikenalpasti, termasuk Ba, Ca, Cu, Cd, Fe, K, Mg, Mn, Na, Ni, Sr dan Zn. Selain itu, 13 sebatian fenolik adalah padanan yang bagus dengan pangkalan pada spectrometer jisim. Walau bagaimanapun, ekstrak kulit pitaya tidak memberi sebarang kawasan zon inhibinasi, tetapi mempunyai kesan kecil terhadap kajian asai masa perencatan kinetik. Ringkasnya, ekstrak kulit pitaya diperkaya dengan kandungan mineral berharga dan sebatian fenolik, bersama-sama dengan sifat antibakteria yang rendah. Selain itu, mikroskop pengimbasan elektron (SEM) menunjukkan bahawa kemusnahan dinding sel kulit pitaya yang disebabkan oleh radiasi gelombang mikro dari MAE adalah punca utama untuk pengekstrakan yang lebih cepat bagi sebatian bioaktif. Kesimpulannya, pengambilan sebatian bioaktif dari kulit pitaya mempunyai aplikasi yang berpotensi, di mana pada masa yang sama dapat mengurangkan sisa yang dihasilkan oleh industri pemprosesan makanan.

ABSTRACT

Pitaya peel is a potential form of fruit waste, especially within the food industry, mainly because its juice extract can be applied as natural coloring. It also contains beneficial bioactive compounds with commercial value, along with antioxidant and antibacterial properties that have a good impact upon the human health. With such potentials of the pitaya peel, unfortunately, it is discarded without treatment in food processing industries by ignoring the side effects it has towards the environment. Only a handful of studies have analyzed the bioactive compounds of pitaya peel extract via green method, which applies water and microwave assisted extraction (MAE) as solvent and tool for the respective extraction processes. Thus, the key objective of the current study is determining the best conditions of MAE in attaining the maximum total phenolic content (TPC) value. These conditions have been applied in extracting bioactive compounds from the pitaya peel, specifically mineral and phenolic compounds. Then, the chemical contents are characterized before the antibacterial activity of the extracts can be analysed and studied. Freeze dryer technique was used to remove the water content in the pitaya peel before extraction so that the pitaya peel can be stored for a longer period prior to analysis. The effects of MAE parameters, such as power, temperature, sample weight, and time, were determined. Inductively coupled plasma-optical emission spectrometry (ICP-OES) and ultra-high performance liquid chromatography coupled mass spectrometer (UHPLC-ESI-QTRAP-MSMS) had been utilized to analyze the mineral content and the type of phenolic compounds found in pitaya peel extract. The antibacterial analysis of pitaya peel extract was performed against Gram-positive, *Staphylococcus aureus (S. aureus)* ATCC 6538, and Gram-negative, *Escherichia coli (E. coli)* ATCC 8739, to determine the modification that took place at the inhibition zone. Time-kill kinetics assay was applied to monitor the bacterial growth curve. Additionally, two software programs were employed; SPSS and CCLASS, in order to determine the best condition of MAE based on significant variance between TPC mean value and validated data of mineral content from pitaya peel extract, respectively. The microscopic structural changes of pitaya peel before and after extraction on MAE had been observed as well. The outcomes revealed that the maximum TPC values were retrievable at 400 W power, 45 °C temperature, and 20 min contact time to extract 1.2 g of pitaya peel in 50 mL of water at 5.808, 5.800, 5.723, and 5.708 mg GAE/g dried peel, respectively. These best condition parameters were verified via SPSS with Bonferroni post hoc. The TPC values recorded from the liquid extract was measured in mg GAE/g, while Inhibitory Concentration unit (IC_{50}) was determined from the extract by applying the best condition parameters of MAE and 2,2, diphenyl-1-picrylhydrazil (DPPH) reagents as synthetic free radicals. The IC_{50} value recorded in this study was 0.52 mL/mL. Furthermore, 12 out of 24 elements were identified, including Ba, Ca, Cu, Cd, Fe, K, Mg, Mn, Na, Ni, Sr, and Zn, whereas 13 phenolic compounds significantly matched the mass spectral database. Nevertheless, the pitaya peel extract had no inhibition zone area, but displayed a small effect on the time-kill kinetics analysis. In short, pitaya peel extract seems to be enriched with valuable mineral contents and phenolic compounds, along with low antibacterial properties. The scanning electron microscopy (SEM) demonstrated that cell wall disruption of pitaya peel caused by microwave radiation from MAE appeared to be the main reason for rapid extraction of bioactive compounds. As a conclusion, the extraction bioactive compounds from pitaya peel exhibited potential application that could substantially reduce wastes produced by the food processing industry.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF SYMBOLS

%	Percentage
°C	Degree Celcius
mm	Millimetre
mL	Millilitre
rpm	Rotation per Minute
°C	Degree Celcius
min	Minute
g	Gram
W	Watt
hr	Hour
w/v	Weight per Volume
nm	Nanometre
Mg/l	Milligram per Litre
s	Second
mM	Milimole
µL	Microlitre
m/z	Mass To The Charge Ratio
µm	Micrometre
R_T	Retention Time
cm	Centimetre
mg/ml	Milligram per Millilitre
ug/ml	Microgram per Millilitre
CFU/mL	Coliform Unit per Millilitre
hr	Hour

LIST OF ABBREVIATIONS

OFAT	One Factor At The Time
IC_{50}	Inhibitory Concentration
DPPH	2,2, diphenyl-1-picrylhydrazyl
QC	Quality Control
ICP-OES	Inductively Coupled Plasma-Optical Emission Spectrometry
UHPLC-ESI-QTRAP-MSMS	Ultra High Performance Liquid Chromatography Coupled Mass Spectrometer
HPLC	High Performance Liquid Chromatography
SEM	Scanning Electron Microscopy
Al	Aluminium
As	Arsenic
Ba	Barium
Be	Berylilium
Bi	Bismuth
Cd	Cadmium
Ca	Calcium
Cr	Chromium
Co	Cobalt
Cu	Copper
Fe	Iron
Pb	Lead
Li	Lithium
Mg	Magnesium
Mn	Manganese
Mo	Molybdenum
Ni	Nickel
K	Potassium
Na	Sodium
Sr	Strontium
Ti	Titanium

V	Vanadium
Y	Yittrium
Zn	Zinc
SPSS	Statistic Package for Social Science
ANOVA	One-Way Analysis of Variance
SD	Standard Deviation
SE	Standard Error
RSM	Response Surface Methodology
RDA	Recommended Daily Amount
AAS	Atomic Absorption Spectroscopy
GFAAS	Graphite Furnace Atomic Absorption Spectroscopy
MAE	Microwave Assisted Extraction
UAE	Ultrasound Assisted Extraction
CSE	Conventional Solvent Extraction
ASE	Accelerated Solvent Extraction
GRAS	Generally Recognized As Safe Solvent
TPC	Total Phenolic Content
MAD	Microwave Assisted Distillation
MIS	Microwave Integrated Soxhlet Extraction
SFME	Solvent Free Microwave Extraction
Uv-Vis	Ultra Violet Visible Spectrometer
GAE	Gallic Acid Equivalent
HCL	Hydrochloric Acid
DV	Dual View
RF	Radio Frequency
TSA	Tryptone Soya Agar
TSB	Tryptone Soya Broth
OD	Optical Density
N.D	Not Detected
LOD	Limit Of Detection
IEC	Inter Element Correction
MSF	Multi Spectral Fitting

CLSI	Clinical and Laboratory Standard Institute
LQSI	Laboratory Quality Services International
MS	Mass Spectrometer
S.aureus	*Staphylococcus aureus*
E.coli	*Escherichia coli*
H. undatus	*Hylocereus undatus*
H. polyrhizus	*Hylocereus polyrhizus*
S. megalanthus	*Selinecereus megalanthus*

REFERENCES

Ajila, C., Naidu, K., Bhat, S., & Rao, U. P. (2007). Bioactive compounds and antioxidant potential of mango peel extract. *Food chemistry, 105*(3), 982-988.

Ali, F., Ranneh, Y., Ismail, A., & Esa, N. M. (2015). Identification of phenolic compounds in polyphenols-rich extract of Malaysian cocoa powder using the HPLC-UV-ESI—MS/MS and probing their antioxidant properties. *Journal of food science and technology, 52*(4), 2103-2111.

Aludatt, M. H., Rababah, T., Alhamad, M. N., Al-Mahasneh, M. A., Almajwal, A., Gammoh, S., Ereifej, K., Johargy, A., & Alli, I. (2017). A review of phenolic compounds in oil-bearing plants: Distribution, identification and occurrence of phenolic compounds. *Food chemistry, 218*, 99-106.

Andrade, C. K., de Brito, P. M. K., dos Anjos, V. E., & Quináia, S. P. (2018). Determination of Cu, Cd, Pb and Cr in yogurt by slurry sampling electrothermal atomic absorption spectrometry: A case study for Brazilian yogurt. *Food chemistry, 240*, 268-274.

Anli, R. E., Vural, N., & Kizilet, E. (2008). An alternative method for the determination of some of the antioxidant phenolics in varietal turkish red wines. *Journal of the Institute of Brewing, 114*(3), 239-245.

Araújo, K. M., de Lima, A., Silva, J. d. N., Rodrigues, L. L., Amorim, A. G., Quelemes, P. V., dos Santos, R. C., Rocha, J. A., de Andrades, É. O., & Leite, J. R. S. (2014). Identification of Phenolic Compounds and Evaluation of Antioxidant and Antimicrobial Properties of Euphorbia Tirucalli L. *Antioxidants, 3*(1), 159-175.

Assumpção, M., & Ferri, F. A. (2017). 1 - Scanning Electron Microscopy A2 - Róz, Alessandra L. Da. In M. Ferreira, F. d. L. Leite, & O. N. Oliveira (Eds.), *Nanocharacterization Techniques* (pp. 1-35): William Andrew Publishing.

Ayala, J., Vega-Vega, V., Rosas-Domínguez, C., Palafox-Carlos, H., Villa-Rodriguez, J., Siddiqui, M. W., Dávila-Aviña, J., & González-Aguilar, G. (2011). Agro-industrial potential of exotic fruit byproducts as a source of food additives. *Food Research International, 44*(7), 1866-1874.

Azmir, J., Zaidul, I., Rahman, M., Sharif, K., Mohamed, A., Sahena, F., Jahurul, M., Ghafoor, K., Norulaini, N., & Omar, A. (2013). Techniques for extraction of bioactive compounds from plant materials: a review. *Journal of Food Engineering, 117*(4), 426-436.

Bahrani, H., Mohamad, J., Paydar, M., & Rothan, H. A. (2014). Isolation and characterisation of acetylcholinesterase inhibitors from Aquilaria subintegra for the treatment of Alzheimer's disease (AD). *Curr Alzheimer Res, 11*(2), 206-214.

Bai, J., Wu, Y., Wang, X., Liu, X., Zhong, K., Huang, Y., Chen, Y., & Gao, H. (2018). In vitro and in vivo characterization of the antibacterial activity and membrane damage mechanism of quinic acid against Staphylococcus aureus. *Journal of Food Safety, 38*(1), e12416.

Bail, S., Stuebiger, G., Krist, S., Unterweger, H., & Buchbauer, G. (2008). Characterisation of various grape seed oils by volatile compounds, triacylglycerol composition, total phenols and antioxidant capacity. *Food chemistry, 108*(3), 1122-1132.

Balasundram, N., Sundram, K., & Samman, S. (2006). Phenolic compounds in plants and agri-industrial by-products: Antioxidant activity, occurrence, and potential uses. *Food chemistry, 99*(1), 191-203.

Balouiri, M., Sadiki, M., & Ibnsouda, S. K. (2016). Methods for in vitro evaluating antimicrobial activity: A review. *Journal of Pharmaceutical Analysis, 6*(2), 71-79.

Barber, M. S., McConnell, V. S., & DeCaux, B. S. (2000). Antimicrobial intermediates of the general phenylpropanoid and lignin specific pathways. *Phytochemistry, 54*(1), 53-56.

Bastos, D. H., Saldanha, L. A., Catharino, R. R., Sawaya, A., Cunha, I. B., Carvalho, P. O., & Eberlin, M. N. (2007). Phenolic antioxidants identified by ESI-MS from yerba maté (Ilex paraguariensis) and green tea (Camelia sinensis) extracts. *Molecules, 12*(3), 423-432.

Bayles, K. W. (2014). Bacterial programmed cell death: making sense of a paradox. *Nature Reviews Microbiology, 12*(1), 63-69.

Bellec, F., Vaillant, F., & Imbert, E. (2006). Pitahaya (Hylocereus spp.): a new fruit crop, a market with a future. *Fruits, 61*(4), 237-250.

Benedek, B., & Kopp, B. (2007). Achillea millefolium L. sl revisited: recent findings confirm the traditional use. *Wiener Medizinische Wochenschrift, 157*(13-14), 312-314.

Berdy, J. (2005). Bioactive microbial metabolites. *The Journal of antibiotics, 58*(1), 1-26.

Bernardez, L., & Andrade, L. (2015). Improved method for enumerating sulfate-reducing bacteria using optical density. *MethodsX, 2*, 249-255.

Biesaga, M. (2011). Influence of extraction methods on stability of flavonoids. *Journal of chromatography A, 1218*(18), 2505-2512.

Bousbia, N., Vian, M. A., Ferhat, M. A., Petitcolas, E., Meklati, B. Y., & Chemat, F. (2009). Comparison of two isolation methods for essential oil from rosemary leaves: Hydrodistillation and microwave hydrodiffusion and gravity. *Food chemistry, 114*(1), 355-362.

Cacace, J., & Mazza, G. (2003). Optimization of extraction of anthocyanins from black currants with aqueous ethanol. *Journal of Food Science, 68*(1), 240-248.

Cai, Y.-Z., Sun, M., & Corke, H. (2005). Characterization and application of betalain pigments from plants of the Amaranthaceae. *Trends in Food Science & Technology, 16*(9), 370-376.

Cardoso, G., Sosa-Morales, M., Ballard, T., Liceaga, A., & San Martín-González, M. (2014a). Microwave-assisted extraction of betalains from red beet (Beta vulgaris). *LWT-Food Science and Technology, 59*(1), 276-282.

Cardoso, G. A., Sosa-Morales, M. E., Ballard, T., Liceaga, A., & San Martín-González, M. F. (2014b). Microwave-assisted extraction of betalains from red beet (Beta vulgaris). *LWT - Food Science and Technology, 59*(1), 276-282.

Céspedes, C. L., El-Hafidi, M., Pavon, N., & Alarcon, J. (2008). Antioxidant and cardioprotective activities of phenolic extracts from fruits of Chilean blackberry Aristotelia chilensis (Elaeocarpaceae), Maqui. *Food chemistry, 107*(2), 820-829.

Chaiwut, P., O-ki-la, A., Phuttisatien, I., Thitilertdecha, N., & Pintathong, P. (2012). *Extraction And Stability Of Cosmetic Bioactive Compounds* Paper presented at the Mae Fah Luang University International Conference, School of Cosmetic Science, Mae Fah Luang University, Chiang Rai 57100, Thailand.

Chan, C.-H., Yusoff, R., Ngoh, G.-C., & Kung, F. W.-L. (2011). Microwave-assisted extractions of active ingredients from plants. *Journal of chromatography A, 1218*(37), 6213-6225.

Chemat, Abert-Vian, M., & Huma, Z. (2009). Microwave-assisted separations: green chemistry in action *Green chemistry research trends* (pp. 33-62): Nova Science Publishers, New York, NY.

Chemat, Lagha, A., AitAmar, H., Bartels, P. V., & Chemat, F. (2004). Comparison of conventional and ultrasound-assisted extraction of carvone and limonene from caraway seeds. *Flavour and Fragrance Journal, 19*(3), 188-195.

Chen, H.-J., Inbaraj, B. S., & Chen, B.-H. (2011). Determination of phenolic acids and flavonoids in Taraxacum formosanum Kitam by liquid chromatography-tandem mass spectrometry coupled with a post-column derivatization technique. *International journal of molecular sciences*, *13*(1), 260-285.

Chen, L., Jin, H., Ding, L., Zhang, H., Li, J., Qu, C., & Zhang, H. (2008). Dynamic microwave-assisted extraction of flavonoids from Herba Epimedii. *Separation and Purification Technology, 59*(1), 50-57.

Cheok, C. Y., Mohd Adzahan, N., Abdul Rahman, R., Zainal Abedin, N. H., Hussain, N., Sulaiman, R., & Chong, G. H. (2018). Current trends of tropical fruit waste utilization. *Critical reviews in food science and nutrition, 58*(3), 335-361.

Chew, K., Khoo, M., Ng, S., Thoo, Y., Wan Aida, W., & Ho, C. (2011). Effect of ethanol concentration, extraction time and extraction temperature on the recovery of phenolic compounds and antioxidant capacity of Orthosiphon stamineus extracts. *International Food Research Journal, 18*(4).

Cong, X., Bing, W., Yi-Qiong, P., Jian-Sheng, T., & Tong, Z. (2017). Advances in extraction and analysis of phenolic compounds from plant materials. *Chinese Journal of Natural Medicines, 15*(10), 721-731.

Correa, L. B., Pádua, T. A., Seito, L. N., Costa, T. E. M. M., Silva, M. A., Candéa, A. L. P., Rosas, E. C., & Henriques, M. G. (2016). Anti-inflammatory Effect of Methyl Gallate on Experimental Arthritis: Inhibition of Neutrophil Recruitment, Production of Inflammatory Mediators, and Activation of Macrophages. *Journal of natural products, 79*(6), 1554-1566.

Dahmoune, F., Boulekbache, L., Moussi, K., Aoun, O., Spigno, G., & Madani, K. (2013). Valorization of Citrus limon residues for the recovery of antioxidants: evaluation and optimization of microwave and ultrasound application to solvent extraction. *Industrial Crops and Products, 50*, 77-87.

Dahmoune, F., Nayak, B., Moussi, K., Remini, H., & Madani, K. (2015). Optimization of microwave-assisted extraction of polyphenols from Myrtus communis L. leaves. *Food chemistry, 166*, 585-595.

Dai, J., & Mumper, R. J. (2010). Plant phenolics: extraction, analysis and their antioxidant and anticancer properties. *Molecules, 15*(10), 7313-7352.

Danilatos, G. D. (2013). Implications of the figure of merit in environmental SEM. *Micron, 44*, 143-149.

Dartsch, P. C., Kler, A., & Kriesl, E. (2009). Antioxidative and antiinflammatory potential of different functional drink concepts in vitro. *Phytotherapy Research, 23*(2), 165-171.

Das, K., Tiwari, R., & Shrivastava, D. (2010). Techniques for evaluation of medicinal plant products as antimicrobial agents: current methods and future trends. *Journal of medicinal plants research, 4*(2), 104-111.

Delgarm, N., Sajadi, B., Azarbad, K., & Delgarm, S. (2018). Sensitivity analysis of building energy performance: A simulation-based approach using OFAT and variance-based sensitivity analysis methods. *Journal of Building Engineering, 15*, 181-193.

Denev, P., Ciz, M., Ambrozova, G., Lojek, A., Yanakieva, I., & Kratchanova, M. (2010). Solid-phase extraction of berries' anthocyanins and evaluation of their antioxidative properties. *Food chemistry, 123*(4), 1055-1061.

Desai, M., Parikh, J., & Parikh, P. (2010). Extraction of natural products using microwaves as a heat source. *Separation & Purification Reviews, 39*(1-2), 1-32.

Dhillon, G. S., Kaur, S., & Brar, S. K. (2013). Perspective of apple processing wastes as low-cost substrates for bioproduction of high value products: a review. *Renewable and sustainable energy reviews, 27*, 789-805.

Ding, P., Chew, M. K., Abdul Aziz, S., Lai, O. M., & Abdullah, J. O. (2009). Red-fleshed pitaya (Hylocereus polyrhizus) fruit colour and betacyanin content depend on maturity. *International Food Research Journal, 16*(2), 233-242.

Doughari, J. (2006). Antimicrobial activity of Tamarindus indica Linn. *Tropical Journal of Pharmaceutical Research, 5*(2), 597-603.

Duba, K. S., Casazza, A. A., Mohamed, H. B., Perego, P., & Fiori, L. (2015). Extraction of polyphenols from grape skins and defatted grape seeds using subcritical water: Experiments and modeling. *Food and Bioproducts Processing, 94*, 29-38.

Dudkiewicz, A., Tiede, K., Loeschner, K., Jensen, L. H. S., Jensen, E., Wierzbicki, R., Boxall, A. B., & Molhave, K. (2011). Characterization of nanomaterials in food by electron microscopy. *TrAC Trends in Analytical Chemistry, 30*(1), 28-43.

Dufour, C., & Loonis, M. (2005). Regio-and stereoselective oxidation of linoleic acid bound to serum albumin: identification by ESI–mass spectrometry and NMR of the oxidation products. *Chemistry and physics of lipids, 138*(1), 60-68.

Eskilsson, C. S., & Björklund, E. (2000). Analytical-scale microwave-assisted extraction. *Journal of chromatography A, 902*(1), 227-250.

Espinel, A., Canton, E., Fothergill, A., Ghannoum, M., Johnson, L., Jones, R., Ostrosky-Zeichner, L., Schell, W., Gibbs, D., & Wang, A. (2011). Quality Control Guidelines for Amphotericin B, Itraconazole, Posaconazole and Voriconazole Disk Diffusion Susceptibility Tests on Non-supplemented Mueller-Hinton Agar (CLSI M51-A document) of Nondermatophyte Filamentous Fungi. *Journal of clinical microbiology*, JCM. 00393-00311.

Esquivel, P., Stintzing, F. C., & Carle, R. (2007a). Phenolic compound profiles and their corresponding antioxidant capacity of purple pitaya (Hylocereus sp.) genotypes. *Zeitschrift für Naturforschung C, 62*(9-10), 636-644.

Esquivel, P., Stintzing, F. C., & Carle, R. (2007b). Pigment pattern and expression of colour in fruits from different Hylocereus sp. genotypes. *Innovative Food Science & Emerging Technologies, 8*(3), 451-457.

Europian Commision. (2006). Commission Regulation (EC) No 1881/2006 of 19 December 2006 setting maximum levels for certain contaminants in foodstuff: 2006R1881-EN-01.09. 2014-014.001-1.

Falcão, S. I., Vilas-Boas, M., Estevinho, L. M., Barros, C., Domingues, M. R., & Cardoso, S. M. (2010). Phenolic characterization of Northeast Portuguese propolis: usual and unusual compounds. *Analytical and bioanalytical chemistry, 396*(2), 887-897.

Fan, M., Qin, K., Ding, F., Huang, Y., Wang, X., & Cai, B. (2016). Identification and differentiation of major components in three different “Sheng-ma” crude drug species by UPLC/Q-TOF-MS. *Acta Pharmaceutica Sinica B.*

Fang, X., Wang, J., Hao, J., Li, X., & Guo, N. (2015). Simultaneous extraction, identification and quantification of phenolic compounds in Eclipta prostrata using microwave-assisted extraction combined with HPLC–DAD–ESI–MS/MS. *Food chemistry, 188,* 527-536.

Farhat, A., Fabiano-Tixier, A.-S., Maataoui, M. E., Maingonnat, J.-F., Romdhane, M., & Chemat, F. (2011). Microwave steam diffusion for extraction of essential oil from orange peel: Kinetic data, extract’s global yield and mechanism. *Food chemistry, 125*(1), 255-261.

Farhat, A., Fabiano-Tixier, A.-S., Visinoni, F., Romdhane, M., & Chemat, F. (2010). A surprising method for green extraction of essential oil from dry spices: microwave dry-diffusion and gravity. *Journal of chromatography A, 1217*(47), 7345-7350.

Farsi, M. A., & Lee, C. Y. (2008). Optimization of phenolics and dietary fibre extraction from date seeds. *Food chemistry, 108*(3), 977-985.

Fathilah, A. (2011). Piper betle L. and Psidium guajava L. in oral health maintenance. *Journal of medicinal plants research, 5*(2), 156-163.

Fattouch, S., Caboni, P., Coroneo, V., Tuberoso, C., Angioni, A., Dessi, S., Marzouki, N., & Cabras, P. (2008). Comparative analysis of polyphenolic profiles and antioxidant and antimicrobial activities of tunisian pome fruit pulp and peel aqueous acetone extracts. *Journal of Agricultural and Food Chemistry, 56*(3), 1084-1090.

Fattouch, S., Caboni, P., Coroneo, V., Tuberoso, C. I., Angioni, A., Dessi, S., Marzouki, N., & Cabras, P. (2007). Antimicrobial activity of Tunisian quince (Cydonia oblonga Miller) pulp and peel polyphenolic extracts. *Journal of Agricultural and Food Chemistry, 55*(3), 963-969.

Fernández, A., Pereira, E., Freire, M., Valentao, P., Andrade, P., González-Álvarez, J., & Pereira, J. (2013). Influence of solvent on the antioxidant and antimicrobial properties of walnut (Juglans regia L.) green husk extracts. *Industrial Crops and Products, 42*, 126-132.

Ferreres, F., Grosso, C., Gil-Izquierdo, A., Valentão, P., Mota, A. T., & Andrade, P. B. (2017). Optimization of the recovery of high-value compounds from pitaya fruit by-products using microwave-assisted extraction. *Food chemistry, 230,* 463-474.

Fguira, L. F.-B., Fotso, S., Ameur-Mehdi, R. B., Mellouli, L., & Laatsch, H. (2005). Purification and structure elucidation of antifungal and antibacterial activities of newly isolated Streptomyces sp. strain US80. *Research in Microbiology, 156*(3), 341-347.

Figueiredo, A. C., Barroso, J. G., Pedro, L. G., & Scheffer, J. J. (2008). Factors affecting secondary metabolite production in plants: volatile components and essential oils. *Flavour and Fragrance Journal, 23*(4), 213-226.

Flórez, N., Conde, E., & Domínguez, H. (2015). Microwave assisted water extraction of plant compounds. *Journal of Chemical Technology and Biotechnology, 90*(4), 590-607.

Gadkari, P. V., Kadimi, U. S., & Balaraman, M. (2014). Catechin concentrates of garden tea leaves (Camellia sinensis L.): extraction/isolation and evaluation of chemical composition. *Journal of the Science of Food and Agriculture, 94*(14), 2921-2928.

Gfrerer, M., & Lankmayr, E. (2005). Screening, optimization and validation of microwave-assisted extraction for the determination of persistent organochlorine pesticides. *Analytica Chimica Acta, 533*(2), 203-211.

Ghisoni, S., Chiodelli, G., Rocchetti, G., Kane, D., & Lucini, L. (2017). UHPLC-ESI-QTOF-MS screening of lignans and other phenolics in dry seeds for human consumption. *Journal of Functional Foods, 34*, 229-236.

Giap, G. E., & Kosuke, N. (2014). Sensitivity analysis using Sobol 'variance-based method on the Haverkamp constitutive functions implemented in Richards' water flow equation. *Malaysian Journal of Soil Science, 18*, 19-33.

Golmakani, M.-T., & Rezaei, K. (2008). Comparison of microwave-assisted hydrodistillation withthe traditional hydrodistillation method in the extractionof essential oils from Thymus vulgaris L. *Food chemistry, 109*(4), 925-930.

Gorinstein, S., Zachwieja, Z., Folta, M., Barton, H., Piotrowicz, J., Zemser, M., Weisz, M., Trakhtenberg, S., & Màrtín-Belloso, O. (2001). Comparative contents of dietary fiber, total phenolics, and minerals in persimmons and apples. *Journal of Agricultural and Food Chemistry, 49*(2), 952-957.

Grimaldo, O., Terrazas, T., García-Velásquez, A., Cruz-Villagas, M., & Ponce-Medina, J. F. (2007). Morphometric analysis of 21 pitahaya (Hylocereus undatus) genotypes. *Journal of the Professional Association for Cactus Development, 9*, 99-117.

Gudiña, E. J., Rodrigues, A. I., de Freitas, V., Azevedo, Z., Teixeira, J. A., & Rodrigues, L. R. (2016). Valorization of agro-industrial wastes towards the production of rhamnolipids. *Bioresource technology, 212*, 144-150.

Guo, N., Ling, G., Liang, X., Jin, J., Fan, J., Qiu, J., Song, Y., Huang, N., Wu, X., & Wang, X. (2011). In vitro synergy of pseudolaric acid B and fluconazole against clinical isolates of Candida albicans. *Mycoses, 54*(5).

Guo, Z., Jin, Q., Fan, G., Duan, Y., Qin, C., & Wen, M. (2001). Microwave-assisted extraction of effective constituents from a Chinese herbal medicine Radix puerariae. *Analytica Chimica Acta, 436*(1), 41-47.

Guzman, J. D. (2014). Natural cinnamic acids, synthetic derivatives and hybrids with antimicrobial activity. *Molecules, 19*(12), 19292-19349.

Hafsa, J., ali Smach, M., Khedher, M. R. B., Charfeddine, B., Limem, K., Majdoub, H., & Rouatbi, S. (2016). Physical, antioxidant and antimicrobial properties of chitosan films containing Eucalyptus globulus essential oil. *LWT-Food Science and Technology, 68*, 356-364.

Harivaindaran, K., Rebecca, O., & Chandran, S. (2008). Study of Optimal Temperature, pH and Stability of Dragon Fruit (Hylocereus polyrhizus). *Pakistan Journal of Biological Sciences, 11*(18), 2259-2263.

Hawrył, M., Hawrył, A., & Soczewiński, E. (2002). Application of normal-and reversed-phase 2D TLC on a cyanopropyl-bonded polar stationary phase for separation of phenolic compounds from the flowers of Sambucus nigra L. *JPC-Journal of Planar Chromatography-Modern TLC, 15*(1), 4-10.

Hayat, K., Hussain, S., Abbas, S., Farooq, U., Ding, B., Xia, S., Jia, C., Zhang, X., & Xia, W. (2009). Optimized microwave-assisted extraction of phenolic acids from citrus mandarin peels and evaluation of antioxidant activity in vitro. *Separation and Purification Technology, 70*(1), 63-70.

Hemwimon, S., Pavasant, P., & Shotipruk, A. (2007). Microwave-assisted extraction of antioxidative anthraquinones from roots of Morinda citrifolia. *Separation and Purification Technology, 54*(1), 44-50.

Hoa, T., Clark, C., Waddell, B., & Woolf, A. (2006). Postharvest quality of Dragon fruit (Hylocereus undatus) following disinfesting hot air treatments. *Postharvest Biology and technology, 41*(1), 62-69.

Hossain, M. B., Rai, D. K., Brunton, N. P., Martin-Diana, A. B., & Barry-Ryan, C. (2010). Characterization of phenolic composition in Lamiaceae spices by LC-ESI-MS/MS. *Journal of Agricultural and Food Chemistry, 58*(19), 10576-10581.

Hox, J. J., Moerbeek, M., & van de Schoot, R. (2017). *Multilevel analysis: Techniques and applications*: Routledge.

Hu, B., Zhou, K., Liu, Y., Liu, A., Zhang, Q., Han, G., Liu, S., Yang, Y., Zhu, Y., & Zhu, D. (2018). Optimization of microwave-assisted extraction of oil from tiger nut (Cyperus esculentus L.) and its quality evaluation. *Industrial Crops and Products, 115*, 290-297.

Inglese, P., Basile, F., & Schirra, M. (2002). Cactus pear fruit production. *Cacti Biology and Uses. University of California Press, USA*, 163-183.

Ismail, N. S. M., Ramli, N., Hani, N. M., & Meon, Z. (2012). Extraction and characterization of pectin from dragon fruit (Hylocereus polyrhizus) using various extraction conditions.(Pengekstrakan dan pencirian pektin daripada buah naga (hylocereus polyrhizus) menggunakan pelbagai keadaan pengekstrakan). *Sains Malaysiana, 41*(1), 41-45.

Järup, L. (2003). Hazards of heavy metal contamination. *British medical bulletin, 68*(1), 167-182.

Jayaprakash, N., Vijaya, J. J., Kaviyarasu, K., Kombaiah, K., Kennedy, L. J., Ramalingam, R. J., Munusamy, M. A., & Al-Lohedan, H. A. (2017). Green synthesis of Ag nanoparticles using Tamarind fruit extract for the antibacterial studies. *Journal of Photochemistry and Photobiology B: Biology, 169*, 178-185.

John, B., Sulaiman, C., George, S., & Reddy, V. (2014). Total phenolics and flavonoids in selected medicinal plants from Kerala. *International Journal of Pharmacy and Pharmaceutical Sciences, 6*(1), 406-408.

Kabir, F., Tow, W. W., Hamauzu, Y., Katayama, S., Tanaka, S., & Nakamura, S. (2015). Antioxidant and cytoprotective activities of extracts prepared from fruit and vegetable wastes and by-products. *Food chemistry, 167*, 358-362.

Kalt, W. (2005). Effects of production and processing factors on major fruit and vegetable antioxidants. *Journal of Food Science, 70*(1), R11-R19.

Karabegović, I. T., Stojičević, S. S., Veličković, D. T., Nikolić, N. Č., & Lazić, M. L. (2013). Optimization of microwave-assisted extraction and characterization of phenolic compounds in cherry laurel (Prunus laurocerasus) leaves. *Separation and Purification Technology, 120,* 429-436.

Karacabey, E., & Mazza, G. (2010). Optimisation of antioxidant activity of grape cane extracts using response surface methodology. *Food chemistry, 119*(1), 343-348.

Kavak, D. D., Altıok, E., Bayraktar, O., & Ülkü, S. (2010). Pistacia terebinthus extract: As a potential antioxidant, antimicrobial and possible β-glucuronidase inhibitor. *Journal of Molecular Catalysis B: Enzymatic, 64*(3), 167-171.

Kennedy, D. O., & Wightman, E. L. (2011). Herbal extracts and phytochemicals: plant secondary metabolites and the enhancement of human brain function. *Advances in Nutrition: An International Review Journal, 2*(1), 32-50.

Khalil, H. A., Bhat, A., & Yusra, A. I. (2012). Green composites from sustainable cellulose nanofibrils: a review. *Carbohydrate Polymers, 87*(2), 963-979.

Khamsah, S., Akowah, G., & Zhari, I. (2006). Antioxidant activity and phenolic content of Orthosiphon stamineus benth from different geographical origin. *Journal of Sustainability Science and Management, 1*(2), 14-20.

Kiamahalleh, M. V., Najafpour-Darzi, G., Rahimnejad, M., Moghadamnia, A. A., & Kiamahalleh, M. V. (2016). High performance curcumin subcritical water extraction from turmeric (Curcuma longa L.). *Journal of Chromatography B, 1022,* 191-198.

Kim, H., Choi, H. K., Moon, J. Y., Kim, Y. S., Mosaddik, A., & Cho, S. K. (2011a). Comparative antioxidant and antiproliferative activities of red and white pitayas and their correlation with flavonoid and polyphenol content. *Journal of Food Science, 76*(1).

Kim, H., Choi, H. K., Moon, J. Y., Kim, Y. S., Mosaddik, A., & Cho, S. K. (2011b). Comparative antioxidant and antiproliferative activities of red and white pitayas and their correlation with flavonoid and polyphenol content. *Journal of Food Science, 76*(1), C38-C45.

Klančnik, A., Guzej, B., Kolar, M. H., Abramovič, H., & MOŽINA, S. S. (2009). In vitro antimicrobial and antioxidant activity of commercial rosemary extract formulations. *Journal of Food Protection, 72*(8), 1744-1752.

Konaté, K., Mavoungou, J. F., Lepengué, A. N., Aworet-Samseny, R. R., Hilou, A., Souza, A., Dicko, M. H., & M'Batchi, B. (2012). Antibacterial activity against β-lactamase producing Methicillin and Ampicillin-resistants Staphylococcus aureus: fractional Inhibitory Concentration Index (FICI) determination. *Annals of clinical microbiology and antimicrobials, 11*(1), 18.

Kosem, N., Han, Y.-H., & Moongkarndi, P. (2007). Antioxidant and cytoprotective activities of methanolic extract from Garcinia mangostana hulls. *Sci Asia, 33*, 83-292.

Kratchanova, M., Pavlova, E., & Panchev, I. (2004). The effect of microwave heating of fresh orange peels on the fruit tissue and quality of extracted pectin. *Carbohydrate Polymers, 56*(2), 181-185.

Kvasnička, F., Čopíková, J., Ševčík, R., Krátká, J., Syntytsia, A., & Voldřich, M. (2008). Determination of phenolic acids by capillary zone electrophoresis and HPLC. *Central European Journal of Chemistry, 6*(3), 410-418.

La, S., Sia, C., GAb, A., PNa, O., & Yim, H. (2013). The effect of extraction conditions on total phenolic content and free radical scavenging capacity of selected tropical fruits' peel. *Health, 4*(2), 80-102.

Lai, J.-P., Lim, Y. H., Su, J., Shen, H.-M., & Ong, C. N. (2007). Identification and characterization of major flavonoids and caffeoylquinic acids in three Compositae plants by LC/DAD-APCI/MS. *Journal of Chromatography B, 848*(2), 215-225.

Lau, B. F., Abdullah, N., Aminudin, N., Lee, H. B., Yap, K. C., & Sabaratnam, V. (2014). The Potential of Mycelium and Culture Broth of Lignosus rhinocerotis as Substitutes for the Naturally Occurring Sclerotium with Regard to Antioxidant Capacity, Cytotoxic Effect, and Low-Molecular-Weight Chemical Constituents. *PloS one, 9*(7), e102509.

Lebellec, F., & Vaillant, F. (2011). Pitahaya (pitaya)(Hylocereus spp.) *Postharvest Biology and Technology of Tropical and Subtropical Fruits: Mangosteen to White Sapote* (pp. 247-273e): Elsevier.

Lee, Y. R., Woo, K. S., Kim, K. J., Son, J.-R., & Jeong, H.-S. (2007). Antioxidant activities of ethanol extracts from germinated specialty rough rice. *Food Science and Biotechnology, 16*(5), 765-770.

Li, H., Deng, Z., Wu, T., Liu, R., Loewen, S., & Tsao, R. (2012). Microwave-assisted extraction of phenolics with maximal antioxidant activities in tomatoes. *Food chemistry, 130*(4), 928-936.

Li, Y., Fabiano-Tixier, A. S., Vian, M. A., & Chemat, F. (2013). Solvent-free microwave extraction of bioactive compounds provides a tool for green analytical chemistry. *TrAC Trends in Analytical Chemistry, 47*, 1-11.

Li, Y., Li, S., Lin, S.-J., Zhang, J.-J., Zhao, C.-N., & Li, H.-B. (2017). Microwave-assisted extraction of natural antioxidants from the exotic Gordonia axillaris fruit: Optimization and identification of phenolic compounds. *Molecules, 22*(9), 1481.

Li, Y., Skouroumounis, G. K., Elsey, G. M., & Taylor, D. K. (2011). Microwave-assistance provides very rapid and efficient extraction of grape seed polyphenols. *Food chemistry, 129*(2), 570-576.

Lidström, P., Tierney, J., Wathey, B., & Westman, J. (2001). Microwave assisted organic synthesis—a review. *Tetrahedron, 57*(45), 9225-9283.

Lim, Y., Lim, T., & Tee, J. (2007). Antioxidant properties of several tropical fruits: A comparative study. *Food chemistry, 103*(3), 1003-1008.

Liu, L., Shen, B.-J., Xie, D.-H., Cai, B.-C., Qin, K.-M., & Cai, H. (2015). Optimization of ultrasound-assisted extraction of phenolic compounds from Cimicifugae rhizoma with response surface methodology. *Pharmacognosy magazine, 11*(44), 682.

López, A., Gómez-Caravaca, A. M., Pasini, F., Caboni, M. F., Segura-Carretero, A., & Fernández-Gutiérrez, A. (2016). HPLC-DAD-ESI-QTOF-MS and HPLC-FLD-MS as valuable tools for the determination of phenolic and other polar compounds in the edible part and by-products of avocado. *LWT-Food Science and Technology, 73*, 505-513.

Lou, Z., Wang, H., Zhu, S., Chen, S., Zhang, M., & Wang, Z. (2012). Ionic liquids based simultaneous ultrasonic and microwave assisted extraction of phenolic compounds from burdock leaves. *Analytica Chimica Acta, 716*, 28-33.

Lourith, N., & Kanlayavattanakul, M. (2013). Antioxidant and stability of dragon fruit peel colour. *Agro Food Ind Hi-Tech, 24*, 56-58.

Luders, L., & Mcmahon, G. (2004). The pitaya or dragon fruit (Hylocereus undatus). *Darwin: university of Darwin*.

Lyman, C. E., Newbury, D. E., Goldstein, J., Williams, D. B., Romig Jr, A. D., Armstrong, J., Echlin, P., Fiori, C., Joy, D. C., & Lifshin, E. (2012). *Scanning* *electron microscopy, X-ray microanalysis, and analytical electron microscopy: a laboratory workbook*: Springer Science & Business Media.

Mabona, U., Viljoen, A., Shikanga, E., Marston, A., & Van Vuuren, S. (2013). Antimicrobial activity of southern African medicinal plants with dermatological relevance: from an ethnopharmacological screening approach, to combination studies and the isolation of a bioactive compound. *Journal of ethnopharmacology, 148*(1), 45-55.

Magalhães, L. M., Segundo, M. A., Reis, S., & Lima, J. L. (2008). Methodological aspects about in vitro evaluation of antioxidant properties. *Analytica Chimica Acta, 613*(1), 1-19.

Mahlil, Y., Husmaini, Warnita, Mirzah, & Mahata, M. E. (2018). Using Physical and Chemical Methods to Improve the Nutrient Quality of Dragon Fruit(Hylocereus polyrhizus) Peel for Use as Feed for Laying Hens. *International Journal of Poultry Science, 17*(2), 51-56.

Majhenič, L., Škerget, M., & Knez, Ž. (2007). Antioxidant and antimicrobial activity of guarana seed extracts. *Food chemistry, 104*(3), 1258-1268.

Mandal, V., Mohan, Y., & Hemalatha, S. (2007). Microwave assisted extraction—an innovative and promising extraction tool for medicinal plant research. *Pharmacognosy Reviews, 1*(1), 7-18.

Maran, J. P., & Prakash, K. A. (2015). Process variables influence on microwave assisted extraction of pectin from waste Carcia papaya L. peel. *International journal of biological macromolecules, 73*, 202-206.

Maran, J. P., Sivakumar, V., Thirugnanasambandham, K., & Sridhar, R. (2014). Microwave assisted extraction of pectin from waste Citrullus lanatus fruit rinds. *Carbohydrate Polymers, 101*, 786-791.

Marqués, A., Cervera, M. L., & de la Guardia, M. (2012). A preliminary approach to mineral intake in the Spanish diet established from analysis of the composition of university canteen menus. *Journal of Food Composition and Analysis, 27*(2), 160-168.

Marqués, A., Domingo, A., Cervera, M. L., & de la Guardia, M. (2015). Mineral profile of kaki fruits (Diospyros kaki L.). *Food chemistry, 172*, 291-297.

Martins, S., Mussatto, S. I., Martínez-Avila, G., Montañez-Saenz, J., Aguilar, C. N., & Teixeira, J. A. (2011). Bioactive phenolic compounds: production and extraction by solid-state fermentation. A review. *Biotechnology Advances, 29*(3), 365-373.

Matharu, A. S., de Melo, E. M., & Houghton, J. A. (2016). Opportunity for high value-added chemicals from food supply chain wastes. *Bioresource technology, 215*, 123-130.

Mback, M. N., Agnaniet, H., Nguimatsia, F., Dongmo, P.-M. J., Fokou, J.-B. H., Bakarnga-Via, I., Boyom, F. F., & Menut, C. (2016). Optimization of antifungal activity of Aeollanthus heliotropioides oliv essential oil and Time Kill Kinetic Assay. *Journal de Mycologie Médicale/Journal of Medical Mycology, 26*(3), 233-243.

Mccarrell, E. M., Gould, S. W., Fielder, M. D., Kelly, A. F., El Sankary, W., & Naughton, D. P. (2008). Antimicrobial activities of pomegranate rind extracts: enhancement by addition of metal salts and vitamin C. *BMC Complementary and Alternative Medicine, 8*(1), 64.

Medana, C., Carbone, F., Aigotti, R., Appendino, G., & Baiocchi, C. (2008). Selective analysis of phenolic compounds in propolis by HPLC-MS/MS. *Phytochemical analysis, 19*(1), 32-39.

Mertens, L., Van Derlinden, E., & Van Impe, J. F. (2012). A novel method for high-throughput data collection in predictive microbiology: optical density monitoring of colony growth as a function of time. *Food microbiology, 32*(1), 196-201.

Métris, A., George, S., & Baranyi, J. (2006). Use of optical density detection times to assess the effect of acetic acid on single-cell kinetics. *Applied and environmental microbiology, 72*(10), 6674-6679.

Mhiri, N., Ioannou, I., Boudhrioua, N. M., & Ghoul, M. (2015). Effect of different operating conditions on the extraction of phenolic compounds in orange peel. *Food and Bioproducts Processing, 96*, 161-170.

Michel, T., Destandau, E., & Elfakir, C. (2011). Evaluation of a simple and promising method for extraction of antioxidants from sea buckthorn (Hippophaë rhamnoides L.) berries: Pressurised solvent-free microwave assisted extraction. *Food chemistry, 126*(3), 1380-1386.

Mizrahi, Y., Mouyal, J., Nerd, A., & Sitrit, Y. (2004). Metaxenia in the Vine Cacti Hylocereus polyrhizus and Selenicereus spp. *Annals of Botany, 93*(4), 469-472.

Mizrahi, Y., & Nerd, A. (1999). Climbing and columnar cacti: new arid land fruit crops. *Horticulture, 82*, 13.

Mizrahi, Y., Nerd, A., & Nobel, P. S. (1997). Cacti as crops. *Hort. Rev, 18*, 291-319.

Mocan, A., Vlase, L., Vodnar, D. C., Bischin, C., Hanganu, D., Gheldiu, A.-M., Oprean, R., Silaghi-Dumitrescu, R., & Crișan, G. (2014). Polyphenolic content, antioxidant and antimicrobial activities of Lycium barbarum L. and Lycium chinense Mill. leaves. *Molecules, 19*(7), 10056-10073.

Moldoveanu, S., & David, V. (2013). Chapter 6-Stationary Phases and Their Performance. *Essentials in Modern HPLC Separations. Elsevier*.

Monds, R. D., & Toole, G. A. (2009). The developmental model of microbial biofilms: ten years of a paradigm up for review. *Trends in microbiology, 17*(2), 73-87.

Monschein, M., Jaindl, K., Buzimkić, S., & Bucar, F. (2015). Content of phenolic compounds in wild populations of Epilobium angustifolium growing at different altitudes. *Pharmaceutical biology, 53*(11), 1576-1582.

Moshfeghi, N., Mahdavi, O., Shahhosseini, F., Malekifar, S., & Taghizadeh, S. K. (2013). Introducing a New Natural Product from Dragon Fruit into the Market. *International Journal of Research and Reviews in Applied Sciences, 15*(2), 269-272.

Naczk, M., & Shahidi, F. (2004). Extraction and analysis of phenolics in food. *Journal of chromatography A, 1054*(1), 95-111.

Napal, G. N. D., Defagó, M. T., Valladares, G. R., & Palacios, S. M. (2010). Response of Epilachna paenulata to two flavonoids, pinocembrin and quercetin, in a comparative study. *Journal of chemical ecology, 36*(8), 898-904.

Nayak, B., Dahmoune, F., Moussi, K., Remini, H., Dairi, S., Aoun, O., & Khodir, M. (2015). Comparison of microwave, ultrasound and accelerated-assisted solvent extraction for recovery of polyphenols from Citrus sinensis peels. *Food chemistry, 187*, 507-516.

Nazzaro, F., Fratianni, F., De Martino, L., Coppola, R., & De Feo, V. (2013). Effect of essential oils on pathogenic bacteria. *Pharmaceuticals, 6*(12), 1451-1474.

Ncube, E. N., Mhlongo, M. I., Piater, L. A., Steenkamp, P. A., Dubery, I. A., & Madala, N. E. (2014). Analyses of chlorogenic acids and related cinnamic acid derivatives from Nicotiana tabacum tissues with the aid of UPLC-QTOF-MS/MS based on the in-source collision-induced dissociation method. *Chemistry Central Journal, 8*(1), 66.

Nerd, A., & Mizrahi, Y. (1999). The effect of ripening stage on fruit quality after storage of yellow pitaya. *Postharvest Biology and technology, 15*(2), 99-105.

Nono, R., Barboni, L., Teponno, R., Quassinti, L., Bramucci, M., Vitali, L., Petrelli, D., Lupidi, G., & Tapondjou, A. (2014). Antimicrobial, antioxidant, anti-inflammatory activities and phytoconstituents of extracts from the roots of Dissotis thollonii Cogn.(Melastomataceae). *South African Journal of Botany, 93*, 19-26.

Ogawa, S., Takafuji, K., Tsubuku, S., Horie, Y., Ikegawa, S., & Higashi, T. (2017). Isotope-coded derivatization based LC/ESI-MS/MS methods using a pair of novel reagents for quantification of hydroxycinnamic acids and hydroxybenzoic acids in fermented brown rice product. *Journal of pharmaceutical and biomedical analysis, 142*, 162-170.

Pap, N., Beszédes, S., Pongrácz, E., Myllykoski, L., Gábor, M., Gyimes, E., Hodúr, C., & Keiski, R. L. (2013). Microwave-assisted extraction of anthocyanins from black currant marc. *Food and Bioprocess Technology, 6*(10), 2666-2674.

Park, S.-E., Ko, W.-K., Park, J. H., Bayome, M., Park, J., Heo, D. N., Lee, S. J., Moon, J.-H., Kwon, I. K., & Kook, Y.-A. (2016). Antibacterial effect of silver and gold nanoparticle coated modified C-palatal plate. *Journal of Nanoscience and Nanotechnology, 16*(8), 8809-8813.

Peeters, S. H., & Jonge, M. I. (2017). For the greater good: programmed cell death in bacterial communities. *Microbiological Research*.

Pereira, J. A., Oliveira, I., Sousa, A., Ferreira, I. C., Bento, A., & Estevinho, L. (2008). Bioactive properties and chemical composition of six walnut (Juglans regia L.) cultivars. *Food and Chemical Toxicology, 46*(6), 2103-2111.

Pérez, J., & Castro, M. L. (2011). Microwave-assisted extraction of phenolic compounds from wine lees and spray-drying of the extract. *Food chemistry, 124*(4), 1652-1659.

Pfaller, M., Sheehan, D., & Rex, J. (2004). Determination of fungicidal activities against yeasts and molds: lessons learned from bactericidal testing and the need for standardization. *Clinical Microbiology Reviews, 17*(2), 268-280.

Phongtongpasuk, S., Poadang, S., & Yongvanich, N. (2016). Environmental-friendly Method for Synthesis of Silver Nanoparticles from Dragon Fruit Peel Extract and their Antibacterial Activities. *Energy Procedia, 89*, 239-247.

Pinela, J., Prieto, M., Carvalho, A. M., Barreiro, M. F., Oliveira, M. B. P., Barros, L., & Ferreira, I. C. (2016). Microwave-assisted extraction of phenolic acids and flavonoids and production of antioxidant ingredients from tomato: A nutraceutical-oriented optimization study. *Separation and Purification Technology, 164*, 114-124.

Pinelo, M., Rubilar, M., Sineiro, J., & Nunez, M. (2004). Extraction of antioxidant phenolics from almond hulls (Prunus amygdalus) and pine sawdust (Pinus pinaster). *Food chemistry, 85*(2), 267-273.

Pouchou, J.-L., Boivin, D., Beauchêne, P., Le Besnerais, G., & Vignon, F. (2002). 3D reconstruction of rough surfaces by SEM stereo imaging. *Microchimica Acta, 139*(1-4), 135-144.

Prakash, J., Sivakumar, V., Thirugnanasambandham, K., & Sridhar, R. (2013). Optimization of microwave assisted extraction of pectin from orange peel. *Carbohydrate Polymers, 97*(2), 703-709.

Proestos, C., & Komaitis, M. (2008). Application of microwave-assisted extraction to the fast extraction of plant phenolic compounds. *LWT-Food Science and Technology, 41*(4), 652-659.

Quifer, P., Vallverdú-Queralt, A., Martínez-Huélamo, M., Chiva-Blanch, G., Jáuregui, O., Estruch, R., & Lamuela-Raventós, R. (2015). A comprehensive characterisation of beer polyphenols by high resolution mass spectrometry (LC–ESI-LTQ-Orbitrap-MS). *Food chemistry, 169*, 336-343.

Radwan, M. A., & Salama, A. K. (2006). Market basket survey for some heavy metals in Egyptian fruits and vegetables. *Food and Chemical Toxicology, 44*(8), 1273-1278.

Rains, J. L., & Jain, S. K. (2011). Oxidative stress, insulin signaling, and diabetes. *Free Radical Biology and Medicine*, *50*(5), 567-575.

Ramli, N. S., Ismail, P., & Rahmat, A. (2014). Influence of conventional and ultrasonic-assisted extraction on phenolic contents, betacyanin contents, and antioxidant capacity of red dragon fruit (Hylocereus polyrhizus). *The Scientific World Journal, 2014*.

Rauha, J.-P., Remes, S., Heinonen, M., Hopia, A., Kähkönen, M., Kujala, T., Pihlaja, K., Vuorela, H., & Vuorela, P. (2000). Antimicrobial effects of Finnish plant extracts containing flavonoids and other phenolic compounds. *International journal of food microbiology, 56*(1), 3-12.

Rodrigues, F., Palmeira-de-Oliveira, A., das Neves, J., Sarmento, B., Amaral, M. H., & Oliveira, M. B. (2013). Medicago spp. extracts as promising ingredients for skin care products. *Industrial Crops and Products, 49*, 634-644.

Rodríguez, P., Flórez-Fernández, N., Conde Piñeiro, E., & Domínguez González, H. (2017). Chapter 6 - Microwave-Assisted Water Extraction *Water Extraction of Bioactive Compounds* (pp. 163-198): Elsevier.

Rohman, A., Riyanto, S., Yuniarti, N., Saputra, W., Utami, R., & Mulatsih, W. (2010). Antioxidant activity, total phenolic, and total flavaonoid of extracts and fractions of red fruit (Pandanus conoideus Lam). *International Food Research Journal, 17*(1), 97-106.

Rojas, R., Sánchez-Segarra, P., Cámara-Martos, F., & Amaro-López, M. (2010). Multivariate analysis techniques as tools for categorization of Southern Spanish cheeses: nutritional composition and mineral content. *European Food Research and Technology, 231*(6), 841-851.

Ruzlan, N., Idid, S. O., Idid, S. Z., Koya, M. S., Mohamed Rehan, A., & Kamarudin, K. R. (2010). Antioxidant study of pulps and peels of dragon fruits: a comparative study. *International Food Research Journal, 17*(2), 367-375.

Şahin, S., Samli, R., Tan, A. S. B., Barba, F. J., Chemat, F., Cravotto, G., & Lorenzo, J. M. (2017). Solvent-free microwave-assisted extraction of polyphenols from olive tree leaves: Antioxidant and antimicrobial properties. *Molecules*, *22*(7), 1056.

Sahraoui, N., Vian, M. A., Bornard, I., Boutekedjiret, C., & Chemat, F. (2008). Improved microwave steam distillation apparatus for isolation of essential oils: comparison with conventional steam distillation. *Journal of chromatography A, 1210*(2), 229-233.

Sawyer, L., Grubb, D. T., & Meyers, G. F. (2008). *Polymer microscopy*: Springer Science & Business Media.

Seedi, H. R., El-Said, A. M., Khalifa, S. A., Göransson, U., Bohlin, L., Borg-Karlson, A.-K., & Verpoorte, R. (2012). Biosynthesis, natural sources, dietary intake, pharmacokinetic properties, and biological activities of hydroxycinnamic acids. *Journal of Agricultural and Food Chemistry, 60*(44), 10877-10895.

Segarra, G., Jáuregui, O., Casanova, E., & Trillas, I. (2006). Simultaneous quantitative LC–ESI-MS/MS analyses of salicylic acid and jasmonic acid in crude extracts of Cucumis sativus under biotic stress. *Phytochemistry, 67*(4), 395-401.

Seixas, F. L., Fukuda, D. L., Turbiani, F. R., Garcia, P. S., Carmen, L. d. O., Jagadevan, S., & Gimenes, M. L. (2014). Extraction of pectin from passion fruit peel (Passiflora edulis f. flavicarpa) by microwave-induced heating. *Food Hydrocolloids, 38*, 186-192.

Seraglio, S. K. T., Valese, A. C., Daguer, H., Bergamo, G., Azevedo, M. S., Gonzaga, L. V., Fett, R., & Costa, A. C. O. (2016). Development and validation of a LC-ESI-MS/MS method for the determination of phenolic compounds in honeydew honeys with the diluted-and-shoot approach. *Food Research International, 87*, 60-67.

SGS KLG WI 013. (2017). Use of CCLAS for QC *Work Instruction* (Vol. 3, pp. 1-3): SGS(Malaysia).

SGS MINE-MG SOP 010. (2017). Analysis of solutions by ICP *In House Method* (pp. 1-15): SGS.

Shazman, A., Mizrahi, S., Cogan, U., & Shimoni, E. (2007). Examining for possible non-thermal effects during heating in a microwave oven. *Food chemistry, 103*(2), 444-453.

Siddhuraju, P., Mohan, P., & Becker, K. (2002). Studies on the antioxidant activity of Indian Laburnum (Cassia fistula L.): a preliminary assessment of crude extracts from stem bark, leaves, flowers and fruit pulp. *Food chemistry, 79*(1), 61-67.

Silva, V., Igrejas, G., Falco, V., Santos, T. P., Torres, C., Oliveira, A. M., Pereira, J. E., Amaral, J. S., & Poeta, P. (2018). Chemical composition, antioxidant and antimicrobial activity of phenolic compounds extracted from wine industry by-products. *Food Control, 92*, 516-522.

Simić, V. M., Rajković, K. M., Stojičević, S. S., Veličković, D. T., Nikolić, N. Č., Lazić, M. L., & Karabegović, I. T. (2016). Optimization of microwave-assisted extraction of total polyphenolic compounds from chokeberries by response surface methodology and artificial neural network. *Separation and Purification Technology*, *160*, 89-97.

Soomro, S. I., Memon, N., Bhanger, M. I., Memon, S., & Memon, A. A. (2016). Mineral content of Pakistani foods: An update of food composition database of Pakistan through indirect method. *Journal of Food Composition and Analysis, 51*, 45-54.

Sousa, A., Ferreira, I. C., Calhelha, R., Andrade, P. B., Valentão, P., Seabra, R., Estevinho, L., Bento, A., & Pereira, J. A. (2006). Phenolics and antimicrobial activity of traditional stoned table olives 'alcaparra'. *Bioorganic & medicinal chemistry, 14*(24), 8533-8538.

Souza, Bataglion, G. A., da Silva, F. M., de Almeida, R. A., Paz, W. H., Nobre, T. A., Marinho, J. V., Salvador, M. J., Fidelis, C. H., & Acho, L. D. (2016). Phenolic and aroma compositions of pitomba fruit (Talisia esculenta Radlk.) assessed by LC–MS/MS and HS-SPME/GC–MS. *Food Research International, 83*, 87-94.

Souza, S. O., Costa, S. S. L., Brum, B. C. T., Santos, S. H., Garcia, C. A. B., & Araujo, R. G. O. (2018). Determination of nutrients in sugarcane juice using slurry sampling and detection by ICP OES. *Food chemistry*.

Stintzing, F. C., & Carle, R. (2004). Functional properties of anthocyanins and betalains in plants, food, and in human nutrition. *Trends in Food Science & Technology, 15*(1), 19-38.

Stintzing, F. C., Schieber, A., & Carle, R. (2003). Evaluation of colour properties and chemical quality parameters of cactus juices. *European Food Research and Technology, 216*(4), 303-311.

Stojković, D. S., Živković, J., Soković, M., Glamočlija, J., Ferreira, I. C., Janković, T., & Maksimović, Z. (2013). Antibacterial activity of Veronica montana L. extract and of protocatechuic acid incorporated in a food system. *Food and Chemical Toxicology, 55*, 209-213.

Swinnen, I., Bernaerts, K., Dens, E. J., Geeraerd, A. H., & Van Impe, J. (2004). Predictive modelling of the microbial lag phase: a review. *International journal of food microbiology, 94*(2), 137-159.

Taguri, T., Tanaka, T., & Kouno, I. (2006). Antibacterial spectrum of plant polyphenols and extracts depending upon hydroxyphenyl structure. *Biological and Pharmaceutical Bulletin, 29*(11), 2226-2235.

Tan, S. N., Yong, J. W. H., Teo, C. C., Ge, L., Chan, Y. W., & Hew, C. S. (2011). Determination of metabolites in Uncaria sinensis by HPLC and GC–MS after green solvent microwave-assisted extraction. *Talanta, 83*(3), 891-898.

Tenore, G. C., Novellino, E., & Basile, A. (2012). Nutraceutical potential and antioxidant benefits of red pitaya (Hylocereus polyrhizus) extracts. *Journal of Functional Foods, 4*(1), 129-136.

Terrab, A., Hernanz, D., & Heredia, F. J. (2004). Inductively coupled plasma optical emission spectrometric determination of minerals in thyme honeys and their contribution to geographical discrimination. *Journal of Agricultural and Food Chemistry, 52*(11), 3441-3445.

Thirugnanasambandham, & Sivakumar. (2015). Microwave assisted extraction process of betalain from dragon fruit and its antioxidant activities. *Journal of the Saudi Society of Agricultural Sciences*.

Thirugnanasambandham, & Sivakumar. (2017). Microwave assisted extraction process of betalain from dragon fruit and its antioxidant activities. *Journal of the Saudi Society of Agricultural Sciences*, *16*(1), 41-48.

Thirugnanasambandham, Sivakumar, & Maran, P. (2014). Process optimization and analysis of microwave assisted extraction of pectin from dragon fruit peel. *Carbohydrate Polymers, 112,* 622-626.

Tian, F., Li, B., Ji, B., Zhang, G., & Luo, Y. (2009). Identification and structure–activity relationship of gallotannins separated from Galla chinensis. *LWT-Food Science and Technology, 42*(7), 1289-1295.

Tiberti, L. A., Yariwake, J. H., Ndjoko, K., & Hostettmann, K. (2007). Identification of flavonols in leaves of Maytenus ilicifolia and M. aquifolium (Celastraceae) by LC/UV/MS analysis. *Journal of Chromatography B, 846*(1), 378-384.

Tongkham, N., Juntasalay, B., Lasunon, P., & Sengkhamparn, N. (2017). Dragon fruit peel pectin: Microwave-assisted extraction and fuzzy assessment. *Agriculture and Natural Resources, 51*(4), 262-267.

Vagiri, M., Johansson, E., & Rumpunen, K. (2017). Phenolic compounds in black currant leaves–an interaction between the plant and foliar diseases? *Journal of Plant Interactions, 12*(1), 193-199.

Vallverdú, A., de Alvarenga, J. F. R., Estruch, R., & Lamuela-Raventos, R. M. (2013). Bioactive compounds present in the Mediterranean sofrito. *Food chemistry, 141*(4), 3365-3372.

Vargas, S., Millán-Chiu, B. E., Arvizu-Medrano, S. M., Loske, A. M., & Rodríguez, R. (2017). Dynamic light scattering: A fast and reliable method to analyze bacterial growth during the lag phase. *Journal of Microbiological Methods, 137*, 34-39.

Veggi, P. C., Martinez, J., & Meireles, M. A. A. (2012). Fundamentals of microwave extraction *Microwave-assisted Extraction for Bioactive Compounds* (pp. 15-52): Springer.

Vinardell, M., Ugartondo, V., & Mitjans, M. (2008). Potential applications of antioxidant lignins from different sources. *Industrial Crops and Products, 27*(2), 220-223.

Virot, M., Tomao, V., Colnagui, G., Visinoni, F., & Chemat, F. (2007). New microwave-integrated Soxhlet extraction: an advantageous tool for the extraction of lipids from food products. *Journal of chromatography A, 1174*(1), 138-144.

Virot, M., Tomao, V., Ginies, C., Visinoni, F., & Chemat, F. (2008). Microwave-integrated extraction of total fats and oils. *Journal of chromatography A, 1196*, 57-64.

Vuong, Q. V., Hirun, S., Roach, P. D., Bowyer, M. C., Phillips, P. A., & Scarlett, C. J. (2013). Effect of extraction conditions on total phenolic compounds and antioxidant activities of Carica papaya leaf aqueous extracts. *Journal of Herbal Medicine, 3*(3), 104-111.

Wang, Gao, X. D., Zhou, G. C., Cai, L., & Yao, W. B. (2008). In vitro and in vivo antioxidant activity of aqueous extract from Choerospondias axillaris fruit. *Food chemistry, 106*(3), 888-895.

Wang, & Weller, C. L. (2006). Recent advances in extraction of nutraceuticals from plants. *Trends in Food Science & Technology, 17*(6), 300-312.

Wang, F., Wei, F., Song, C., Jiang, B., Tian, S., Yi, J., Yu, C., Song, Z., Sun, L., Bao, Y., Wu, Y., Huang, Y., & Li, Y. (2017). Dodartia orientalis L. essential oil exerts antibacterial activity by mechanisms of disrupting cell structure and resisting biofilm. *Industrial Crops and Products, 109*, 358-366.

Wang, H., Ding, J., & Ren, N. (2016). Recent advances in microwave-assisted extraction of trace organic pollutants from food and environmental samples. *TrAC Trends in Analytical Chemistry, 75*, 197-208.

Wang, Y., & Buchanan, R. L. (2016). Develop mechanistic models of transition periods between lag/exponential and exponential/stationary phase. *Procedia Food Science, 7*, 163-167.

Weiss, J., Nerd, A., & Mizrahi, Y. (1994). Flowering behavior and pollination requirements in climbing cacti with fruit crop potential. *HortScience, 29*(12), 1487-1492.

Weon, J. B., Jung, Y. S., Ryu, G., Yang, W. S., & Ma, C. J. (2016). Simultaneous Determination of 11 Marker Compounds in Gumiganghwal-tang by HPLC-DAD and LC-MS. *Natural Product Sciences*, *22*(4), 238-245.

Wichienchot, S., Jatupornpipat, M., & Rastall, R. (2010). Oligosaccharides of pitaya (dragon fruit) flesh and their prebiotic properties. *Food chemistry, 120*(3), 850-857.

Wojdyło, A., Oszmiański, J., & Czemerys, R. (2007). Antioxidant activity and phenolic compounds in 32 selected herbs. *Food chemistry, 105*(3), 940-949.

World Health Organization. (2012). Guideline: Sodium intake for adults and children: World Health Organization.

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.

Xu, Y., Zhang, L., Bailina, Y., Ge, Z., Ding, T., Ye, X., & Liu, D. (2014). Effects of ultrasound and/or heating on the extraction of pectin from grapefruit peel. *Journal of Food Engineering, 126*, 72-81.

Yang, Landau, J. M., Huang, M.-T., & Newmark, H. L. (2001a). Inhibition of carcinogenesis by dietary polyphenolic compounds. *Annual review of nutrition, 21*(1), 381-406.

Yang, Landau, J. M., Huang, M. T., & Newmark, H. L. (2001b). Inhibition of carcinogenesis by dietary polyphenolic compounds. *Annu Rev Nutr*, *21*(1), 381-406.

Yang, L., Jiang, J. G., Li, W. F., Chen, J., Wang, D. Y., & Zhu, L. (2009). Optimum extraction process of polyphenols from the bark of Phyllanthus emblica L. based on the response surface methodology. *Journal of separation science, 32*(9), 1437-1444.

Yanık, D. K. (2017). Alternative to traditional olive pomace oil extraction systems: Microwave-assisted solvent extraction of oil from wet olive pomace. *LWT-Food Science and Technology, 77,* 45-51.

Yien, Y., Siang Tan, W., Rosfarizan, M., Chan, E. S., & Ti Tey, B. (2012). Isolation and identification of lactic acid bacteria from fermented red dragon fruit juices. *Journal of Food Science, 77*(10), M560-M564.

Zain, N. M., Stapley, A., & Shama, G. (2014). Green synthesis of silver and copper nanoparticles using ascorbic acid and chitosan for antimicrobial applications. *Carbohydrate Polymers, 112,* 195-202.

Zhang, H.-F., Yang, X.-H., & Wang, Y. (2011). Microwave assisted extraction of secondary metabolites from plants: current status and future directions. *Trends in Food Science & Technology, 22*(12), 672-688.

Zhang, L., Shamaladevi, N., Jayaprakasha, G. K., Patil, B. S., & Lokeshwar, B. L. (2015). Polyphenol-rich extract of Pimenta dioica berries (Allspice) kills breast cancer cells by autophagy and delays growth of triple negative breast cancer in athymic mice. *Oncotarget, 6*(18), 16379.

Zhang, M., Lin, J., Li, X., & Li, J. (2016). Quercetin ameliorates LPS-induced inflammation in human peripheral blood mononuclear cells by inhibition of the TLR2-NF-kappaB pathway. *Genet. Mol. Res, 15*(10.4238).

Zheng, X., Fangping, Y., Chenghai, L., & Xiangwen, X. (2011). Effect of process parameters of microwave assisted extraction (MAE) on polysaccharides yield from pumpkin. *Journal of Northeast Agricultural University (English Edition), 18*(2), 79-86.