UNIVERSITI PUTRA MALAYSIA

EFFECTS OF DRYING TECHNIQUES AND STORAGE ON RAW MATERIAL SAFETY AND STABILITY OF PHYTOCHEMICALS OF HEMPEDU BUMI (Andrographis paniculata (Burm.f.) Wall. Ex Nees)

NOR SHARIAH BINTI SALLEH

FP 2017 44

EFFECTS OF DRYING TECHNIQUES AND STORAGE ON RAW MATERIAL SAFETY AND STABILITY OF PHYTOCHEMICALS OF HEMPEDU BUMI (*Andrographis paniculata* (Burm.f.) Wall. Ex Nees)

By

NOR SHARIAH BINTI SALLEH

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

August 2017

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

EFFECTS OF DRYING TECHNIQUES AND STORAGE ON RAW MATERIAL SAFETY AND STABILITY OF PHYTOCHEMICALS OF HEMPEDU BUMI (*Andrographis paniculata* (Burm.f.) Wall. Ex Nees)

By

NOR SHARIAH BINTI SALLEH

August 2017

Chairman : Mahmud Tengku Muda Mohamed, PhD
Faculty : Agriculture

Controlling the quality of finished herbal products with regard to safety aspect begins with proper production, harvesting and postharvest handling systems. However, there is very limited information that gives an overview on the safety and quality of hempedu bumi or *Andrographis paniculata* focusing on drying techniques and storage duration. Therefore, the objective of this study was to ascertain the effects of drying and storage on safety and stability of phytochemicals of *A. paniculata*.

In terms of safety aspects, heavy metal contaminations showed that Al, As, Cr, Cu, Hg, Ni, Pb and Zn were detected in soil and only Al, Cr, Cu, Ni and Zn found in tissues. Sample collected from Jabatan Pertanian, Serdang, Selangor had less concentrations of Al, Zn, Cr and Cu than Taman Pertanian Universiti (TPU), Universiti Putra Malaysia, Serdang and Kg. Bukit Pulau, Melaka. On the other hand, microbial contaminations depended on the drying technique used and however, increased during storage. Total count of fungi, yeast and bacteria also specific bacteria, *Escherichia coli* and *Staphylococcus aureus* were found less in vacuum oven and freeze drying throughout storage. Fortunately, heavy metal and microbial contaminations of dried *A. paniculata* were within the permissible limits prescribed by WHO.

The quality of *A. paniculata* leaf colour was greatly affected by drying techniques. The leaf colour of freeze-dried samples was much better than other drying techniques, with bright and greenish colour leaves. In addition, the chemical markers of andrographolide (AG) and neoandrographolide (NAG) content of freeze-dried samples were found to be more stable during storage compared to 14-deoxy-11, 12-didehydroandrographolide (DDAG). Microbial contaminations had a significant negative correlation with AG content, which

indicating that the presence of microorganism may led to the decreased in AG. Apart of this, freeze-dried samples also showed highest content of TPC, TFC and antioxidant activities (DPPH and FRAP) throughout the storage duration. However, sun drying gave the highest content of DDAG and TFC throughout storage period as compared to vacuum and conventional oven drying techniques. This study also showed high correlation between TPC and TFC which demonstrated that antioxidant activities were contributed by phenolic and flavonoid compounds.

Therefore, sun and freeze dryings were selected for future optimization of their quality using proton nuclear magnetic resonance (^{1}H-NMR). Eight compounds were identified in both techniques. Result obtained in PCA revealed that freeze-dried samples had higher amounts of AG and NAG, and also with relatively high amount of chlorogenic acid and alanine. AG, NAG and alanine compounds in freeze-dried samples were optimum within 6 to 8 weeks of storage. Chlorogenic acid, a compound related to antioxidant activities was found increased with storage duration. However, sun-dried samples were rich in DAG and glucose compounds, where, the estimated optimum amount of these compounds was found within 5 to 6 weeks of storage. Conversely, the level of choline in sun-dried samples increased with storage period. Thus, freeze drying is considered to be an appropriate technique for drying *A. paniculata* commercially, because this technique can stabilize most of the phytochemicals, at the same time safe for consumption.

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

TAJUK TESIS PENGARUH TEKNIK PENGERINGAN DAN PENYIMPANAN TERHADAP KESELAMATAN BAHAN MENTAH DAN KESTABILAN FITOKIMIA HEMPEDU BUMI (*Andrographis paniculata* (Burm.f.) Wall. Ex Nees)

Oleh

NOR SHARIAH BINTI SALLEH

Ogos 2017

Pengerusi : Mahmud Tengku Muda Mohamed, PhD
Fakulti : Pertanian

Jaminan kualiti barangan herba terutama dari segi aspek keselamatan bermula di peringkat penghasilan produk, penuaian dan pengendalian lepas tuai dengan cara yang betul. Walau bagaimanapun, maklumat yang ada masih sedikit berkaitan dengan keselamatan dan kualiti hempedu bumi atau *Andrographis paniculata* dengan fokus kepada teknik pengeringan dan tempoh penyimpanan. Oleh itu, tujuan kajian ini adalah untuk menguji kesan pengeringan dan penyimpanan terhadap keselamatan dan kestabilan sebatian fitokimia *A. paniculata.*

Dari segi aspek keselamatan, pencemaran logam berat menunjukkan bahawa Al, As, Cr, Cu, Hg, Ni, Pb dan Zn telah berjaya dikenalpasti pada sampel tanah dan hanya Al, Cr, Cu, Ni dan Zn dijumpai di dalam sampel tisu. Sampel yang diambil dari Jabatan Pertanian, Serdang didapati kurang kandungan Al, Zn, Cr dan Cu berbanding TPU, Universiti Putra Malaysia, Serdang dan Kg. Bukit Pulau, Melaka. Selain itu, pencemaran mikrob dilihat bergantung kepada teknik pengeringan dan meningkat semasa tempoh penyimpanan. Jumlah kandungan kulat, yis dan bakteria dan juga bakteria spesifik seperti *Escherichia coli* dan *Staphylococcus aureus* didapati rendah kandungannya di dalam pengeringan ketuhar bervakum dan pengeringan sejuk beku sepanjang tempoh penyimpanan. Jumlah kiraan kulat, yis dan bakteria serta spesifik bakteria *Escherichia coli* dan *Staphylococcus aureus* didapati kurang dalam pengeringan ketuhar bervakum dan pengeringan sejuk beku semasa penyimpanan. Selain itu, pencemaran logam berat dan mikrob pada sampel kering *A. paniculata* masih di dalam had yang dibenarkan oleh WHO.

Kualiti warna daun *A. paniculata* sangat dipengaruhi oleh teknik pengeringan. Warna daun untuk pengeringan sejuk beku adalah lebih baik berbanding teknik pengeringan lain, yang mana menunjukkan warna daun yang cerah dan kehijauan. Tambahan pula, kandungan AG dan NAG daripada pengeringan sejuk beku didapati lebih stabil semasa penyimpanan berbanding DDAG. Pencemaran mikrob menunjukkan kolerasi negatif dengan kandungan AG, iaitu menunjukkan kehadiran mikroorganisma boleh menyebabkan pengurangan terhadap kandungan AG pada sampel kering *A. paniculata*.

Selain itu, pengeringan sejuk beku telah menunjukkan kandungan tertinggi untuk TPC, TFC dan aktiviti antioksidan (DPPH dan FRAP) sepanjang tempoh penyimpanan. Walau bagaimanapun, pengeringan matahari menunjukkan kandungan DDAG dan TFC yang tinggi sepanjang tempoh penyimpanan berbanding teknik pengeringan ketuhar bervakum dan ketuhar konvensional. Kajian ini juga menunjukkan korelasi yang tinggi di antara kandungan TPC dan TFC dengan aktiviti antioksidan dalam *A. paniculata*, membuktikan aktiviti antioksidan adalah berkait rapat dengan kandungan fenolik dan flavonoid.

Oleh itu, teknik pengeringan matahari dan sejuk beku telah dipilih untuk peroptimuman lanjut menggunakan proton-resonans magnetik nuklear (^{1}H-NMR). Lapan sebatian dikenalpasti daripada pengeringan matahari dan sejuk beku. Keputusan yang diperolehi melalui PCA telah menunjukkan bahawa sampel kering sejuk beku mempunyai jumlah AG dan NAG yang lebih tinggi dan juga jumlah asid klorogenik dan alanina yang agak tinggi. Sebatian AG, NAG dan alanina dalam sampel kering sejuk beku adalah optimum dalam tempoh penyimpanan antara 6 hingga 8 minggu. Asid klorogenik iaitu sebatian yang berkaitan dengan aktiviti antioksidan didapati meningkat dengan tempoh penyimpanan. Walau bagaimanapun, sampel kering matahari dikenalpasti tinggi dengan sebatian DAG dan glukosa, di mana jumlah optimum sebatian ini didapati dalam tempoh penyimpanan antara 5 hingga 6 minggu. Sebaliknya, tahap kolina pada sampel kering matahari meningkat apabila tempoh penyimpanan meningkat. Justeru, pengeringan sejuk beku dianggap sebagai teknik yang sesuai untuk pengeringan *A. paniculata* secara komersial, kerana teknik ini boleh menyebabkan sebatian fitokimia produk herba ini lebih stabil dan pada masa yang sama, selamat untuk digunakan.

ACKNOWLEDGEMENTS

Thanks to Almighty Allah for giving me strength and determination to learn, understand and complete this study. Alhamdulillah and insyaAllah, it will be successful.

I would like to express my deep gratitude to my supervisor, Prof. Dr. Mahmud Tengku Muda Mohamed for his advice, guidance and patience given to me. I also admire and grateful to Dr. Siti Hajar Ahmad, Prof. Dr. Khozirah Shaari and Dr. Wan Zaliha Wan Sembok for their valuable contribution and suggestions. My sincere gratitude to all the staff, who have helped me to achieve this study. I'm also thankful to my colleagues for their friendship and encouragement.

Finally, I wish specially thank to my beloved mother, father, husband, in-laws and siblings for their endless love, support, understandings, sacrifices, motivation, advice and encouragement.

I certify that a Thesis Examination Committee has met on 2 August 2017 to conduct the final examination of Nor Shariah binti Salleh on her thesis entitled "Effects of Drying Techniques and Storage on Raw Material Safety and Stability of Phytochemicals of Hempedu Bumi (*Andrographis paniculata* (Burm.f.) Wall. ex Nees)" in accordance with the Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U.(A) 106] 15 March 1998. The Committee recommends that the student be awarded the Doctor of Philosophy.

Members of the Thesis Examination Committee were as follows:

Yahya bin Awang, PhD
Associate Professor
Faculty of Agriculture
Universiti Putra Malaysia
(Chairman)

Siti Aishah binti Hassan, PhD
Associate Professor
Faculty of Agriculture
Universiti Putra Malaysia
(Internal Examiner)

Mohamad bin Osman, PhD
Associate Professor
Faculty of Agriculture
Universiti Putra Malaysia
(Internal Examiner)

Asgar Ali, PhD
Professor
University of Nottingham Malaysia Campus
Malaysia
(External Examiner)

NOR AINI AB. SHUKOR, PhD
Professor and Deputy Dean
School of Graduate Studies
Universiti Putra Malaysia

Date: 28 September 2017

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 the Supervisory Committee were as follows:

Mahmud Tengku Muda Mohamed, PhD
Professor
Faculty of Agriculture
Universiti Putra Malaysia
(Chairman)

Khozirah Shaari, PhD
Professor
Faculty of Science
Universiti Putra Malaysia
(Member)

Siti Hajar Binti Ahmad, PhD
Associate Professor
Faculty of Agriculture
Universiti Putra Malaysia
(Member)

Wan Zaliha Wan Sembok, PhD
Lecturer
School of Food Science and Technology
Universiti Malaysia Terengganu
(Member)

_____
ROBIAH BINTI YUNUS, 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: _____

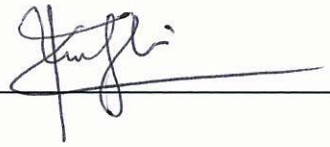
Name and Matric No.: Nor Shariah binti Salleh, GS31432

Declaration by Members of Supervisory Committee

This is to confirm that:

- the research conducted and the writing of this thesis was under our supervision;
- supervision responsibilities as stated in the Universiti Putra Malaysia (Graduate Studies) Rules 2003 (Revision 2012-2013) are adhered to.

Signature: _____
Name of Chairman of Supervisory Committee: Professor Dr. Mahmud Tengku Muda Mohamed

Signature: 
Name of Member of Supervisory Committee: Professor Dr. Khozirah Shaari

Signature: _____
Name of Member of Supervisory Committee: Associate Professor Dr. Siti Hajar Ahmad

Signature: 
Name of Member of Supervisory Committee: Dr. Wan Zaliha Wan Sembok

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

LIST OF ABBREVIATIONS

a_w	Water activity
v/v	Volume per volume
w/v	Weight per volume
Q^2	Predictive ability
%	Percent
µl	Microliter
^{1}H,13C-NMR	X-ray, Proton and Carbon-13 Nuclear Magnetic Resonance
^{1}H-NMR	^{1}H-Nuclear Magnetic Resonance
ABTS	2, 2'-azinobis (3- ethylbenzthiazoline)-6-sulphonic acid
AG	Andrographolide
Al	Aluminium
$AlCl_3$	Aluminum chloride
ANOVA	Analysis of variance
AOAC	Association of Official Analytical Chemists
As	Arsenic
ASCII	American Standard Code for Information Interchange
BW	Body weight
C^*	Chroma
Cd	Cadmium
CFS	Centre for Food Safety
CFU g^{-1}	Colony forming units per gram of sample
CH_2O_2	Formic acid
CH_3CN	Acetonitrile
CH_3OH-d4	Methanol-d4
cm	Centimeter
Co	Cobalt
Cr	Chromium
CRD	Completely randomized design
Cu	Copper
D	Drying
δ	Delta
D_2O	Deuterium oxide
DDAG	14-deoxy-11,12-didehydroandrographolide
DPPH	2,2-diphenyl-1-picrylhydrazyl
DW	Dry weight
ESI-MS	Electrospray Ionisation Mass Spectrometry
FD	Freeze drying
FDA	Food and Drug Administration
$FeCl_3.6H_2O$	Iron (III) Chloride Hexahydrate
FRAP	Ferric reducing antioxidant power
g	Gram
h	Hour
h^o	Hue angle
HCl	Hydrochloric acid
Hg	Mercury
HPLC	High Performance Liquid Chromatography

HSD	Tukey's Studentized Range
ICP-OES	Inductively coupled plasma optical emission spectrometry
K2S2O8	Potassium persulfate
kg	Kilogram
Kg.	Kampung
KH2PO4	Potassium dihydrogen phosphate
kPa	Kilopascal
L	Liter
L*	Lightness
LSD	Least significant difference
m	Meter
M	Molar
m2	Meter square
mbar	Millibars
MeOH	Methanol
mg	Milligram
mg g-1	Milligram per gram
mg kg-1	Milligram per kilogram
mg L-1	Milligram per liter
mg mL-1	Milligram per mililiter
mg N/ha	Milligram nitrogen per hectare
min	Minutes
mL	Mililiter
mL L-1	Mililiter per liter
mL/min	Mililiter per minutes
mm	Millimeter
mM	Millimolar
MSA	Mannitol Salt Agar
MVDA	Multivariate data analysis
NA	Nutrient agar
NAG	Neoandrographolide
NaOD	Sodium deuterium oxide
NaOH	Sodium hydroxide
ND	Not detected
Ni	Nickel
nm	Nanometer
NMR	Nuclear magnetic resonance-based
ns	No significant
O50	Oven drying at 50 ºC
O70	Oven drying at 70 ºC
ºC	Degree celcius
Pb	Lead
PCA	Principal component analysis
PDA	Potato dextrose agar
PLS	Partial least-squares analysis
ppm	Parts per million
QE	Quercetin equivalent
R^2	R square
rpm	Revolutions per minute
S	Storage
SD	Sun drying

SE	Standard error
TE	Trolox equivalent
TE/g	Trolox equivalent per gram
TFC	Total flavonoid content
TNTC	Too numerous to count
ton/ha	Ton / hectare
TPC	Total phenolic content
TPTZ	6-tripyridyl-striazine
TPU	Taman Pertanian Universiti
TSP	3-(trimethylsilyl) propionic-2,2,3,3-d4 acid sodium salt
UPM	Universiti Putra Malaysia
UV/VIS	Ultraviolet–visible
VD	vacuum oven drying
WHO	World Health Organization
Zn	Zinc
µm	Micrometer

CHAPTER 1

INTRODUCTION

Herbal remedies from medicinal plants have gained attention worldwide for having therapeutic effects which are the substitute medication of modern medicine. Together with the increasing demand for herbal products, quality and safety of medicinal plants and herbal products have become a major concern by the pharmaceutical industries, health authorities, and consumers (WHO, 2007). Thus, controlling the quality of finished herbal products should start with good field production, harvesting and postharvest handling practices.

In Malaysia, hempedu bumi or *Andrographis paniculata* was listed as a valuable herbs to be commercialized and was expected to generate the country's revenues. This plant has been effectively used as traditional medicines, in Asia as well as around the world, for centuries to treat various diseases. It is extensively used in the traditional Indian system of medicine, such as Ayurveda, Unani and Siddha, in home remedies for various diseases (Niranjan et al., 2010). Among many bioactive compounds in *A. paniculata*, andrographolide is considered to be the most active and valuable constituent which is responsible for the therapeutics activities (Parichatikanond et al., 2010).

Retention of bioactive compounds in harvested products is a major concern in the herbal industry. Bioactive compounds can be affected by postharvest handling, especially during drying process and storage. Drying treatments are important to descrese the moisture (Araújo and Bauab, 2012) in the herbs which would enable the extension of shelf life of the herbs. At the same time, drying will reduce the growth of microbes in medicinal plants but also can affect their phytochemical changes (Bernard et al., 2014). However, it can also give rise to other alterations that affect the stability of chemical markers.

Commonly, phytochemicals are unstable and vulnerable to degradation and decomposition. The stability of the phytochemicals is mostly influenced by various factors such as pH, oxygen, water activity, light, enzymes, concentration, structure, self-association, atmospheric composition, co-pigments, metallic ions, temperature and time of processing, the presence of antioxidants, and storage duration (Yang et al., 2013). Recently, various studies are reported in related to the factors that influence the stability of phytochemical in food products. The studies include the physical, chemical and/or biological changes that occur during processing or storage, such as loss of nutrients and loss of colour due to the degradation of pigments like carotenoids and anthocyanins (Nora et al., 2014). The author also reported that the DPPH scavenging activities in guabiju (*Myrcianthes pungens*) and red guava (*Psidium cattleyanum* Sabine) were reduced significantly through processing.

Changes in colour and essential oil contents of tarragon herb (*Artemisia dracunculus* L.) leaves at the storage depended on drying conditions and drying temperature in which 45 ^{o}C was suggested to maintain the quality nearest to the fresh material (Arabhosseini et al., 2007). However, storage temperature did not provide any significant impact on andrograholide which does not requires low temperature storage (Ibrahim and Chong, 2008). Nevertheless, Yang et al. (2013) have suggested that the loss phytochemicals could be reduced by minimizing the exposure to oxygen and light, as well as to select the appropriate temperature and pH during processing and storage of the food products.

The assessments of herbal quality are closely related to safety. Contamination can be defined as the undesired introduction of impurities of chemicals or foreign matters like heavy metals or microbiological nature into or onto a herbal products, at the production field, harvesting and postharvest handling including drying, packaging, storage and transport (WHO, 2007). Microbes are highly versatile and can entering the food chain at different steps, and adjust to the environment, then survive, growth and produce some toxic compounds in food (Havelaar et al., 2010).

Medicinal plants can be contaminated by enteric bacteria during growth in the farm and during harvest, pre-harvest and post-harvest activities as well as during transportation and further processing and handling (Havelaar et al., 2010). Ashiq et al. (2014) reported that various fungi contaminated medicinal plants during postharvest handling which could be held liable for damage and mycotoxin production. The contaminants found in medicinal herbs that caused a critical human health risk are pathogenic bacteria, such as *Escherichia coli, Shigella* spp. *Salmonella* spp., *Staphylococcus aureus* and other Gram positive and Gram negative strains of bacteria (Arias et al., 1999; Erich et al., 2001; Wolfgang et al., 2002; Adeleyea et al., 2003; Okunlola et al., 2007).

Many studies have shown that medicinal plants can accumulate heavy metals from contaminated soils and there is no exception with *A. paniculata.* Heavy metal uptake by *A. paniculata* is through metal transfer from sediments and water to food web (Mythili et al., 2011). All heavy metals can cause toxic effects to plants and, subsequently, to humans if consumed in high concentrations. There are three main mechanisms that need to be considered about heavy metal contaminations in herbal medicinal products: contamination during cultivation, cross contamination during processing and intentional introduction of heavy metals as a therapy (Rahimi et al., 2012).

Malaysia is well positioned to promote the growth and competitiveness of its herbal industry. Thus, all important factors related to maintenance of quality and safety of herbal products should be emphasized, especially in the area of postharvest handling practices, which is normally last to be considered. Until recently, the information on the effect of drying techniques and storage duration on the stability of phytochemicals of *A. paniculata* is still limited. A few reports of safety aspects have been studied for this plant (Mythili et al., 2011; Khandelwal

et al., 2013), yet did not cover heavy metals and microbial contamination during production or postharvest practices.

To fulfil the mission of improving the safety and stability of chemical markers of *A. paniculata*, it is pertinent to establish the scientific knowledge of its postharvest practices by focussing on drying techniques and storage. Therefore, the main objective of this study was to identify a suitable drying technique and storage duration so as to provide an optimum quality of *A. paniculata*, which ameliorate the stability of chemical markers and antioxidant properties.

The specific objectives were;

1. To identify heavy metals and microbial contaminants during production and drying of *A. paniculata*;
2. To determine the effect of drying techniques and storage durations on leaf colour and stability of three chemical markers (andrographolide, neoandrographolide and 14-deoxy-11, 12-didehydroandrographolide);
3. To evaluate the effect of drying techniques and storage durations on total phenolic content, total flavonoid content and antioxidant properties of *A. paniculata*; and
4. To distinguish the metabolic variations in dried samples of *A. paniculata* and to discriminate the changes of the metabolite compositions of dried samples stored at different storage duration using ^{1}H-Nuclear Magnetic Resonance (^{1}H-NMR) based metabolomics coupled with multivariate data analysis (MVDA).

REFERENCES

Abascal, K., Ganora, L. and Yarnell, E. (2005). The effect of freeze-drying and its implications for botanical medicine: a review. *Phytotherapy Research,* 19(6), 55-60.

Abba, D., Inabo, H. I., Yakubu, S. E. and Olonitola, O. S. (2009). Contamination of herbal medicinal products marketed in kaduna metropolis with selected pathogenic bacteria. *African Journal of Traditional, Complementary and Alternative Medicines,* 6(1), 70 - 77.

Abdel-Farid, I. B., Jahangir, M., van den Hondel, C. A. M. J. J., Kim, H. K., Choi, Y. H. and Verpoorte, R. (2009). Fungal infection-induced metabolites in *Brassica rapa. Plant Science,* 176, 608-615.

Abdul Razak, N., Shaari, A. R., Nat@ Simbas, A. F. and Abdullah, S. (2014). Effect of initial leaf moisture content on the herbal quality parameter of *Orthosiphon stamineus* dried leaf during storage. *International Journal of Agriculture Innovations and Research,* 2(6), 2319-1473.

Abu-Darwish, M. S., Abu-Dieyeh, Z. H., Mufeed, B., Al-Tawaha, A. R. M. and Al-Dalain, S. Y. A. (2009). Trace element contents and essential oil yields from wild thyme plants (*Thymus serpyllum* L.) grown at different natural variable environments, Jordan. *Journal of Food Agricultural Environment,* 7(4), 920-924.

Adekunle, A. A. and Ikumapayi, A. M. (2006). Antifungal property and phytochemical screening of the crude extracts of *Funtumia elastica* and *Mallotus oppositifolius*. *West Indian Medical Journal,* 55(6), 219-223.

Adeleyea, I. A., Ogunniyia, A. A. and Omonigbehin, E. A. (2003). Antimicrobial activity of some local herbs on common skin pathogens. *Bioscience Research Communications,* 15(3), 231-236.

Ah-Hen, K., Zambra, C., Aguëro, J., Vega-Gálvez, A. and Lemus-Mondaca, R. (2013). Moisture diffusivity coefficient and convective drying modelling of Murta (*Ugni molinae* Turcz): Influence of temperature and vacuum on drying kinetics. *Food and Bioprocess Technology,* 6, 919-930.

Ahmad, J. (2011). *Drying of vegetables: Principles and dryer design*. USA: Blackwell, John Wiley & Son Publishing.

Akbar, S. (2011). *Andrographis paniculata*: a review of pharmacological activities and clinical effects. *Alternative Medicine Review,* 16(1), 66-77.

Akowuah, G. A., Zhari, I., Mariam, A. and Yam, M. F. (2009). Absorption of andrographolides from *Andrographis paniculata* and its effect on CCl4-induced oxidative stress in rats. *Food and Chemical Toxicology,* 47(9), 2321-2326.

Alfaro, S., Mutis, A., Quiroz, A., Seguel, I. and Scheuermann, E. (2014). Effects of drying techniques on Murtilla fruit polyphenols and antioxidant activity. *Journal of Food Research,* 3(5), 73-82.

Al-Oud, S. S. (2008). Impact of municipal and industrial waste on the distribution and accumulation of some heavy metals in sandy soils of Al-Qassim region at central of Saudi Arabia. *Journal of Environmetntal Science and Technology,* 1, 135-142.

Al-Oud, S. S., Nadeem, M. E. A. and Al-Shbel, B. H. (2011). Distribution of heavy metals in soils and plants around a cement factory in Riyard City, Central of Saudi Arabia. *American-Eurasian Journal Agricultural and Environmental Science,* 11(2), 183-191.

Ali, K., Iqbal, M., Korthout, H. A. A. J., Maltese, F., Fortes, A. M., Pais, M. S. and Choi, Y. H. (2012). NMR spectroscopy and chemometrics as a tool for anti-TNFa activity screening in crude extracts of grapes and other berries. *Metabolomics,* 8, 1148-1161.

Aliyu, A. B., Musa, A. M., Sallau, M. S. and Oyewale, A. O. (2009). Proximate composition mineral elements and anti-nutritional factors of *Anisopus mannii* N.E. Br. (Asclepiadaceae). *Trends in Applied Sciences Research,* 4(1), 68-72.

Alwakeel, S. S. (2008). Microbial and heavy metals contamination of herbal medicines. *Research Journal of Microbiology,* 3(12), 683-691.

Al-Weshahy, A., El-Nokety, M., Bakhete, M. and Rao, V. (2013). Effect of storage on antioxidant activity of freeze-dried potato peels. *Food Research International,* 50(2), 507-512.

Amoo, S. O., Aremu, A. O., Moyo, M. and Van Staden, J. (2012). Antioxidant and acetylcholinesterase-inhibitory properties of long-term stored medicinal plants. *BMC Complementary and Alternative Medicine,* 12(87), 1-9.

Amroyan, E., Gabrielian, E., Panossian, A., Wikman, G. and Wagner, H. (1999). Inhibitory effect of andrographolide from *Andrographis paniculata* on PAF-induced platelet aggregation. *Phytomedicine,* 6, 27-31.

Aneesh, T. P., Hisham, M., Sonal, S. M., Manjusree, M. and Deepa, T. V. (2009). International market scenario of traditional Indian herbal drugs-India declining. *International Journal of Green Pharmacy,* 3(3), 184-190.

Anju, D., Jugnu, G., Kavita, S., Arun, N. and Sandeep, D. (2012). A review on medicinal prospectives of *Andrographis paniculata* nees. *Journal of Pharmaceutical and Scientific Innovation,* 1(1), 1-4.

Anand, M., Prabarakaran, P. and Pradeepa, V. (2011). A study on the phytochemicals characterization and antimicrobial potential of *Andrographis paniculata*. *Journal of Pharmacy Research,* 4, 530-531.

Annan, K., Dickson, R. A., Amponsah, I. K. and Nooni, I. K. (2013). The heavy metal contents of some selected medicinal plants sampled from different geographical locations. *Pharmacognosy Research,* 5(2), 103-108.

AOAC. (2002). AOAC Official Method 997.02-2000. *Yeast and mould counts in foods: dry rehydratable film method* (pp. 3). Maryland, USA: AOAC International.

Arabhosseini, A., Padhye, S., Huisman, W., van Boxtel, A. and Müller, J. (2011). Effect of drying on the color of tarragon (*Artemisia dracunculus* L.) leaves. *Food and Bioprocess Technology,* 4(7), 1281-1287.

Arabhosseini, A., Huisman, W., van Boxtel, A. and Muller, J. (2007). Long-term effects of drying conditions on the essential oil and color of tarragon leaves during storage. *Journal of Food Engineering,* 79, 561-566.

Araújo, M. G. d. F. and Bauab, T. M. (2012). Microbial quality of medicinal plant materials. *Latest Research into Quality Control*, 67-81. Retrieved from http://www.intechopen.com/books/latest-research-into-quality-control/micro-bial-quality-of-medicinal-plant-materials

Arendse, E., Fawole, O. A. and Opara, U. L. (2014). Effects of postharvest storage conditions on phytochemical and radical-scavenging activity of pomegranate fruit (cv. Wonderful). *Scientia Horticulturae,* 169, 125-129.

Arévalo-Pinedo, A., Murr, F., Arévalo, Z. and Giraldo-Zuniga, A. (2010). Modeling with shrink-age during the vacuum drying of carrot (*Daucus carota*). *Journal of Food Processing and Preservation,* 34, 611-621.

Argyropoulos, D. and Muller, J. (2014). Kinetics of change in colour and rosmarinic acid equivalents during convective drying of lemon balm (*Melissa officinalis* L.). *Journal of Applied Research on Medicinal and Aromatic Plants,* 1, 15-22.

Arias, P., Fernández-Moreno, M. A. and Malpartida, F. (1999). Characterization of the pathway-specific positive transcriptional regulator for actinorhodin biosynthesis in *Streptomyces coelicolor* A3(2) as a DNA-binding protein. *Journal of Bacteriology,* 181(22), 6958-6968.

Arık, F. and Yaldız, T. (2010). Heavy metal determination and pollution of the soil and plants of Southeast Tavsanlı (Kutahya, Turkey). *Soil, Air, Water* 38(11), 1017-1030.

Arifullah, M., Namsa, N. D., Mandal, M., Chiruvella, K. K., Vikrama, P. and Gopal, G. R. (2013). Evaluation of anti-bacterial and anti-oxidant potential of andrographolide and echiodinin isolated from callus culture of *Andrographis paniculata* Nees," *Asian Pacific Journal of Tropical Biomedicine*, 3(8), 604–610.

Arpadjan, A., Celik, G., Taskesen, S. and Gucer, S. (2008). Arsenic, cadmium and lead in medicinal herbs and their fractionation. *Food and Chemical Toxicology,* 46, 2871-2875.

Arrus, K. M., Holley, R. A., Ominski, K. H., Tenuta, M. and Blank, G. (2006). Influence of temperature on *Salmonella* survival in hog manure slurry and seasonal temperature profiles in farm manure storage reservoirs. *Livestock Science,* 102, 226-236.

Arslan, D. and Ozcan, M. M. (2011). Dehydration of red bell-pepper (*Capsicum annuum* L.): Change in drying behavior, colour and antioxidant content. *Food and Bioproducts Processing,* 89, 504-513.

Arslan, D. and Özcan, M. M. (2008). Evaluation of drying methods with respect to drying kinetics, mineral content and colour characteristics of rosemary leaves. *Energy Conversion and Management,* 49(5), 1258-1264.

Arslan, D., Ozcan, M. M. and Menges, H. O. (2010). Evaluation of drying methods with respect to drying parameters, some nutritional and colour characteristics of peppermint (*Mentha piperita* L.). *Energy Conversion,* 51, 2769-2775.

Arslan, D., & Özcan, M. M. (2011). Dehydration of red bell-pepper (*Capsicum annuum* L.): change in drying behaviour, colour and antioxidant content. *Food and Bioproducts Processing,* 89(4), 504- 513.

Artes, F., Villaescusa, R. and Tudela, J. A. (2000). Modified atmosphere packaging of pomegranate. *Journal of Food Science,* 65, 1112-1116.

Asami, D. K., Hong, Y. J., Barrett, D. M. and Mitchell, A. E. (2003). Comparison of the total phenolic and ascorbic acid content of freeze-dried and air-dried marionberry, strawberry, and corn grown using conventional, organic, and sustainable agricultural practices. *Journal of Agricultural and Food Chemistry,* 51(5), 1237-1241.

Ashiq, S., Hussain, M. and Ahmad, B. (2014). Natural occurrence of mycotoxins in medicinal plants: A review. *Fungal Genetics and Biology,* 66, 1-10.

Aziz, N. H., Youssef, Y. A., El -Fouly, M. Z. and Moussa, L. A. (1998). Contamination of some common medicinal plant samples and spices by fungi and their mycotoxins. *Botanical Bulletin of Academia Sinica,* 39, 279-285.

Bahloul, N., Boudhrioua, N., Kouhila, M. and Kechaou, N. (2009). Effect of convective solar drying on colour, total phenols and radical scavenging

activity of olive leaves (*Olea europaea* L.). *International Journal of Food Science and Technology,* 44, 2561-2567.

Bai, Y. J., Kong, M., Xu, J. D., Zhang, X. L., Zhou, S. S., Wang, X. N., Liu, L. F. and Li, S. L. (2014). Effect of different drying methods on the quality of *Angelicae Sinensis* Radix evaluated through simultaneously determining four types of major bioactive components by high performance liquid chromatography photodiode array detector and ultra-high performance liquid chromatography quadrupole time-of-flight mass spectrometry. *Journal of Pharmaceutical and Biomedical Analysis,* 94, 77-83.

Baylis, C., Uyttendaele, M., Joosten, H. and Davies, A. (2012). The enterobacteriaceae and their significance to the food industry. In I. L. S. Institute (Ed.), (Vol. ISBN 9789078637332). Belgium: ILSI Europe.

Beckles, D. M. and Roessner, U. (2012). Chapter 5: Plant metabolomics: Applications and opportunities for agricultural biotechnology. In Altman, A. and Hasegawa, P. M. (Eds.), *Plant Biotechnology and Agriculture: Prospects for the 21st century.* Elsevier Inc.

Behravesh, C. B., Ferraro, A., Deasy, M., Dato, V., Moll, M., Sandt, C., Rea, N. K., Rickert, R., Marriott, C, Warren, K., Urdaneta, V., Salehi, E., Villamil, E., Ayers, T., Hoekstra, R. M., Austin, J. L., Ostroff, S. and Williams, I. T. (2010). Human Salmonella infections linked to contaminated dry dog and cat food, 2006–2008. *Pediatrics,* 126, 477-483.

Bennett, L. E., Jegasothy, H., Konczak, I., Frank, D., Sudharmarajan, S. and Clingeleffer, P. R. (2011). Total polyphenolics and anti-oxidant properties of selected dried fruits and relationships to drying conditions. *Journal of Functional Foods,* 3, 115-124.

Benoy, G. K., Animesh, D. K., Aninda, M., Priyanka, D. K. and Sandip, H. (2012). An overview on *Andrographis paniculata* (BURM. F.) Nees. *International Journal of Research in Ayurveda and Pharmacy,* 3(6), 752-760.

Benzie, I. F. and Strain, J. (1996). The ferric reducing ability of plasma (FRAP) as a measure of "antioxidant power": the FRAP assay. *Analytical Biochemistry,* 239(1), 70-76.

Berins, M. L. (1991). Plastics Engineering Handbook of the Society of the Plastics Industry (5th Ed). United States of America: Kluwer Academic Publisher.

Bernard, D., Kwabena, A. I., Osei, O. D., Daniel, G. A., Elom, S. A. and Sandra, A. (2014). The effect of different drying methods on the phytochemicals and radical scavenging activity of Ceylon Cinnamon (*Cinnamomum zeylanicum*) plant parts. *European Journal of Medicinal Plants,* 4(11), 1324-1335.

Berregi, I., Santos, J. I., Campo, G. d., Miranda, J. I. and Aizpurua, J. M. (2003). Quantitation determination of chlorogenic acid in cider apple juices by ^{1}H NMR spectrometry. *Analytica Chimica Acta,* 486, 269-274.

Berrueta, L. A., Rosa, M., Alonso-Salces, R. M. and Héberger, K. (2007). Supervised pattern recognition in food analysis. *Journal of Chromatography A,* 1158, 196-214.

Beuchat, L. R., Komitopoulou, E., Beckers, H., Betts, R. P., Bourdichon, F., Fanning, S., Joosten, H. M., ter Kuile, B. H. (2013). Low-water activity foods: increased concern as vehicles of foodborne pathogens. *Journal of Food Protection,* 76(1), 150–172.

Bhan, M. K., Dhar, A. K., Khan, S., Lattoo, S. K., Gupta, K. K. and Choudhary, D. K. (2006). Screening and optimization of *Andrographis paniculata*

(Burm.f.) Nees for total andrographolide content, yield and its components. *Scientia Horticulturae,* 107, 386-391.

Bloem, E., Haneklaus, S. and Schnug, E. (2011). Storage life of field-grown garlic bulbs (*Allium sativum* L.) as influenced by nitrogen and sulfur fertilization. *Journal of Agricultural and Food Chemistry,* 59(9), 4442-4447.

Bloemen, M. L., Markert, B., and Lieth, H. (1995). The distribution of Cd, Cu, Pb and Zn in topsoils of Osnabruck in relation to land use. *Science of the Total Environment,* 166, 137-148.

Bohm, M., Bade, M. and Kunz, B. (2002). Quality stabilisation of fresh herbs using a combined vacuum-microwave drying process. *Advance Food Science,* 24(2), 55-61.

Bonjar, G.H., Nik, A. K. and Aghighi, S. (2004). Antibacterial and antifungal survey in plants used in indigenous herbal-medicine of south east regions of Iran. *Journal of Biological Science*, 4, 405–412.

Boopathi, C. (2000). *Andrographis* spp.: A source of bitter compounds for medicinal use. *Ancient Science of Life,* 19(3-4), 164-168.

Borhanuddin, M., Shamsuzzoha, M. and Hussain, A. H. (1994). Hypoglycaemic effects of *Andrographis paniculata* Nees on nondiabetic rabbits. *Bangladesh Medical Research Council Bulletin,* 20(1), 24-26.

Bugno, A., Almodovar, A. A. B., Pereira, T. C., Pinto, T. J. A. and Sabino, M. (2006). Occurrence of toxigenic fungi in herbal drugs. *Brazilian Journal of Microbiology,* 37, 47-51.

Bugno, A., Buzzo, A. A., Nakamura, C. T., Pereira, T. C., Matos, D. and Pinto, T. J. A. (2005). Avaliação da contaminação microbiana em drogas vegetais. *Revista Brasileira de Ciências Farmacêuticas,* 41(4), 491-497.

Cabrera, C., Lloris, F., Gimenez, R., d, O. a. and C. Lopez. (2003). Mineral content in legume and nuts: Contribution to the spanish dietary intake. *Science of the Total Environment,* 308, 1-14.

Cabrera, F., Clemente, L., Diaz Barrientos, E., Lopez, R. and Murillo, J. M. (1999). Heavy metal pollution of soils affected by the Guadiamar toxic flood. *The Science of the Total Environment,* 242, 117-129.

Cai, Y. Z., Sun, M. and Corke, H. (2003). Characterizationand application of betalain pigmentsfrom plants of the Amaranthaceae. *Trends in Food Science and Technology,* 16, 370-376.

Calabrese, C., Berman, S. H., Babish, J. G., Ma, X. H., Shinto, L., Dorr, M. and Standish, L. J. (2000). A phase I trial of andrographolide in HIV positive patients and normal volunteers. *Phytotherapy Research,* 14, 333-338.

Calín-Sánchez, A., Figiel, A., Hernández, F., Melgarejo, P., Lech, K. and Carbonell-Barrachina, A. A. (2013). Chemical composition, antioxidant capacity, and sensory quality of pomegranate (*Punica granatum* L.) arils and rind as affected by drying method. *Food Bioprocess Technology,* 6, 1644-1654.

Cebula, E. and Ciba, J. (2005). Effects of flooding in southern Poland on heavy metal concentrations in soils. *Soil Use and Management,* 21, 348-351.

Cevallos-Cevallos, J. M., Reyes-De-Corcuera, J. I., Etxeberria, E., Danyluk, M. D. and Rodrick, G. E. (2009). Metabolomic analysis in food science: A review. *Trends in Food Science and Technology,* 20(11-12), 557-566.

California Food Emergency Response Team (CFERT). (2007). Investigation of an *Escherichia coli* O157:H7 outbreak associated with Dole pre-

packaged spinach. Final Report, 21 March 2007. Retrieved from http://www.marlerclark.com/2006_Spinach_Report_Final_01.pdf.
CFS, Centre for Food Safety. (2014). *Microbiological guidelines for food: For ready-to-eat food in general and specific food items*. Hong Kong: Centre for Food Safety, Food and Environmental Hygiene Department.
Chan, E., Lim, Y. Y., Wong, S. K., Lim, K., Tan, S., Lianto, F. and Yong, M. (2009). Effects of different drying methods on the antioxidant properties of leaves and tea of ginger species. *Food Chemistry,* 113(1), 166-172.
Chao, W. W., Kuo, Y. H., Li, W. C. and Lin, B. F. (2009). The production of nitric oxide and prostaglandin E2 in peritoneal macrophages is inhibited by *Andrographis paniculata*, *Angelica sinensis* and *Morus alba* ethyl acetate fractions. *Journal of Ethnopharmacological,* 122, 68-75.
Chao, W. W. and Lin, B. F. (2010). IRsevoielwation and identification of bioactive compounds in *Andrographis paniculata* (Chuanxinlian). *Chinese Medicine,* 5(17), 1-15.
Chen, G. and Mujumdar, A. S. (2007). *Drying of herbal medicines and tea*. Boca Raton, FL: CRC Press.
Chen, L., Zhu, H., Wang, R., Zhou, K., Jing, Y. and Qiu, F. (2008). Ent-Labdane diterpenoid lactone stereoisomers from *Andrographis paniculata*. *Journal of Natural Products,* 71, 852-855.
Chen, X. D. and Mujumdar, A. S. (2009). *Drying technologies in food processing*. John Wiley & Sons.
Cheynier, V. (2005). Polyphenols in foods are more complex than often thought. *The American Journal of Clinical Nutrition,* 81, 223.
Chia, S. H. (2009). *Reproductive System and Genetic Diversity of Hempedu Bumi (Andrographis paniculata) Germplasm in Peninsular Malaysia.* Master thesis, Universiti Putra Malaysia, Malaysia.
Cho, S. H., Lee, C. H., Jang, M. R., Son, Y. W. and Lee, S. M. (2008). Aflatoxins contamination in spices and processed spice products commercialized in Korea. *Food Chemistry,* 107, 1283-1288.
Choi, M. Y., Chai, C., Park, J. H., Lim, J., Lee, J. and Kwon, S. W. (2011). Effects of storage period and heat treatment on phenolic compound composition in dried Citrus peels (Chenpi) and discrimination of Chenpi with different storage periods through targeted metabolomic study using HPLC-DAD analysis. *Journal of Pharmaceutical and Biomedical Analysis,* 54, 638-645.
Colquhoun, I. J. (2007). Use of NMR for metabolic profiling in plant systems. *Journal of Pesticide Science,* 32, 200-212.
Cosano, I., Pintado, C., Acevedo, O., Novella, J. L., Alonso, G. L., Carmona, M. and Rotger, R. (2009). Microbiological quality of saffron from the main producer countries. *Journal of Food Protection,* 72, 2217-2220.
Cronin, G., Lindquist, N., Hay, M. E. and Fenical, W. (1995). Effects of storage and extraction procedures on yields of lipophilic metabolites from the brown seaweeds *Dictyota ciliolata* and *D. menstrualis*. *Marine Ecology Progress Series,* 119, 265-273.
Cubero-Leon, E., Peñalver, R. and Maquet, A. (2014). Review on metabolomics for food authentication. *Food Research International,* 60, 95-107.
Cui, L., Qiu, F. and Yao, X. (2005). Isolation and identification of seven glucuronide conjugates of andrographolide in human urine. *Drug Metabolism and Disposition,* 33(4), 555-562.

Cui, Y., Zhu, Y.G., Zhai, R., Huang, Y., Qiu, Y. and Liang, J. (2005). Exposure to metal mixtures and human health impacts in a contaminated area in Nanning, China. *Environment International,* 31, 784-790.

Czech, E., Kneifel, W. and Kopp, B. (2001). Microbiological status of commercially available medicinal herbal drugs - A screening study. *Planta Medica,* 67, 263-269.

Dabonne, S., Koffi, B. P. K., Kouadio, E. J. P., Koffi, A. G., Due , E. A. and Kouame, L. P. (2010). Traditional utensils: potential sources of poisoning by heavy metals. *British Journal of Pharmacology and Toxicology,* 1(2), 90-92.

Da-Costa-Rocha, I., Edwards, S., Lawrence, M. J., Cable, C. and Heinrich, M. (2012). Quality and safety of herbal products: Part 1 - new legislation and production. 288, p685. Retrieved from Website http://www.pharmaceutical-journal.com/opinion/comment/quality-and-safety-of-herbal-products-part-1-new-legislation-and-production/11102232.article

Dai, J. and Mumper, R. J. (2010). Plant Phenolics: Extraction, Analysis and Their Antioxidant and Anticancer Properties. *Molecules,* 15, 7313-7352.

Das, P. and Srivastav, A. K. (2014). Phytochemical extraction and characterization of the leaves of *Andrographis paniculata* for its anti-bacterial, anti-oxidant, anti-pyretic and anti-diabetic activity. *International Journal of Innovative Research in Science, Engineering and Technology,* 3(8), 15276-15184.

Davey, M. W., Montagu, M. v., Inzé, D., Sanmartin, M., Kanellis, A., Smirnoff, N. and Fletcher, J. (2000). Plant L-ascorbic acid: chemistry, function, metabolism, bioavailability and effects of processing. *Journal of the Science of Food and Agriculture,* 80(7), 825-860.

De Ancos, B., Ibañez, E., Reglero, G. and Cano, M. P. (2000). Frozen storage effects on anthocyanins and volatile compounds of raspberry fruit. *Journal of Agricultural and Food Chemistry,* 48, 873-879.

De Pasquale, A., Paino, F., De Pasquale, R. and Germano, M. P. (1993). Contamination by heavy metals in drugs from different commercial sources. *Pharmacological Research,* 27(1), 9-10.

Deepak, S., Pawar, A. and Shinde, P. (2014). Study of antioxidant and antimicrobial activities of *Andrographis paniculata*. *Asian Journal of Plant Science and Research,* 4(2), 31-41.

Dennison, D. K. and Kirk, J. R. (1982). Effect of trace metal fortification on the storage stability of ascorbic acid in a dehydrated model food system. *Journal of Food Science,* 47, 1199.

Dettmer, K., Aronov, P. A. and Hammock, B. D. (2007). Mass spectrometry-based metabolomics. *Mass Spectrometry Reviews,* 26(1), 51-78.

Devic, E., Guyot, S., Daudin, J. D. and Bonazzi, C. (2010). Kinetics of polyphenol losses during soaking and drying of cider apples. *Food and Bioprocess Technology,* 3(6), 867-877.

Dewanto, V., Wu, X., Adom, K. K. and Liu, R. H. (2002). Thermal processing enhances the nutritional values of tomatoes by increasing total antioxidant activity. *Journal of Agricultural and Food Chemistry,* 50, 3010-3014.

Di Cesare, L. F., Forni, E., Viscardi, D. and Nani, R. C. (2003). Changes in the chemical composition of basil caused by different drying procedures. *Journal of Agricultural and Food Chemistry,* 51(12), 3575-3581.

Díaz-Maroto, M. C., Palomo, E. S., Castro, L., Gonzaléz Vinas, M. A. and Pérez-Coello, M. S. (2004). Changes produced in the aroma compounds and structural integrity of basil (*Ocimum basilicum* L) during drying. *Journal of the Science of Food and Agriculture,* 84, 2070-2076.

Díaz-Maroto, M. C., Pérez-Coello, M. S., Gonzaléz Vinas, M. A. and Dolores Cabezudo, M. (2003). Influence of drying on the flavor quality of spearmint (*Mentha spicata* L.). *Journal of Agricultural and Food Chemistry,* 51, 1265-1269.

Diaz, M. N., Frei, B., Vita, J. E. and Keaney, J. F. (1997). Antioxidants and atherosclerotic heart disease. *Journal of Medicine and Nutrition England,* 337, 408-416.

Dong, J. E., Fu, Z. R., Ma, X. H., Mo, K. L. and Xia, G. D. (2011). Effects of different drying methods on quality of eucommia ulmoides male flower tea. *Transactions of the Chinese Society for Agriculture Machinery,* 42, 131-137.

Dorta, E., Lobo, M. G. and Gonzalez, M. (2012b). Reutilization of mango byproducts: study of the effect of extraction solvent and temperature on their antioxidant properties. *Journal of Food Science,* 71, 80-88.

Dorta, E., Lobo, M. G. and González, M. (2012a). Using drying treatments to stabilise mango peel and seed: Effect on antioxidant activity. *LWT-Food Science and Technology,* 45(2), 261-268.

Doymaz, I. (2004). Convective air drying characteristics of thin layer carrots. *Journal of Food Engineering,* 61(3), 359-364.

Doymaz, I. and Pala, M. (2002). Hot-air drying characteristics of red. *Journal of Food Engineering,* 55, 331-335.

Du, Q., Jerz, G. and Winterhalter, P. (2003). Separation of andrographolide and neoandrographolide from the leaves of *Andrographis paniculata* using high-speed counter-current chromatography. *Journal of Chromatography A,* 984(1), 147-151.

Dua, V. K., Ojha, V. P., Roy, R., Joshi, B. C., Valecha, N., Devi, C. U. and Subbarao, S. K. (2004). Anti-malarial activity of some xanthones isolated from the roots of *Andrographis paniculata*. *Journal of Ethnopharmacology,* 95(2-3), 247-251.

Duthie, G. G., Gardner, P. T. and Kyle, J. A. (2003). Plant polyphenols: are they the new magic bullet? *Proceedings of the Nutrition Society*, 62, 599-603.

Echavarrı´a. A. P., Paga´n, J. and Ibarz, A. (2012). Melanoidins formed by Maillard reaction in food and their biological activity. *Food Engineering Review*, 4, 203 – 223.

EMA, European Medicines Agency. (2015). *Reflection paper on microbiological aspects of herbal medicinal products and traditional herbal medicinal products*. United Kingdom.

Eison-Perchonok, M. H. and Down, T. W. (1982). Kinetics of ascorbic acid oxidation as a function of dissolved oxygen and temperature. *Journal of Food Science,* 47, 765.

Erich, C., Wolfgang, K. and Brigitte, K. (2001). Microbiological status of commercially available medicinal herbal drugs-a screenings study. *Planta Medica,* 67, 263-269.

Eriksson, L., Johansson, E., Kettaneh-Wold, N., Trygg, J., Wikstrom, C. and Wold, S. (2006). *Multi- and megavariate data anaysis. Part 1: Basic principles and applications*. Umea, Sweeden: Umetrics Academy.

Ertekin, C. and Heybeli, N. (2014). Thin-layer infrared drying of mint leaves. *Journal of Food Processing and Preservation,* 38(4), 1480–1490.
Fasola, T., Ayodele, A., Odetola, A. and Umotok, N. (2010). Foliar Epidermal Morphology and Anti-diabetic Property of *Andrographis paniculata* (Burm. f.) Wall ex. Nees. *Ethnobotanical Leaflets,* 2010(5), 1-5.
FDA, Food and Drug Adminitration. (2001). Bacteriological analytical manual *Aerobic plate count*. Maryland: U.S. Food and Drug Adminitration (FDA).
Fei Meng, L. I., Tong, L. I., Wei, L. I. and Yang, L. D. (2015). Changes in antioxidant capacity, levels of soluble sugar, total polyphenol, organosulfur compound and constituents in garlic clove during storage. *Industrial Crops and Products,* 69, 137-142.
Fennell, C. W., Light, M. E., Sparg, S. G., Stafford, G. I. and van Staden, J. (2004). Assessing African medicinal plants for efficacy and safety: Agricultural and storage practices. *Journal of Ethnopharmacology,* 95(2-3), 113-121.
Food Act. (1983). Law of Malaysia – Act 281. The commissioner of law Revision, Malaysia.
Fraga, C. G., Galleano, M., Verstraeten, S. V. and Oteiza, P. I. (2010). Basic biochemical mechanisms behind the health benefits of polyphenols. *Molecular Aspects of Medicine,* 31, 435-445.
Friberg, L., Nordberg, G. F. and Vouk, V. B. (1986). *Handbook on the toxicology of metals* (Vol. 2). Amsterdam, Oxford: Elsevier Science Publishers BV.
Fujita, T., Fujitani, R., Takeda, Y., Yamada, T., M., K. and Miura. (1984). On the ditrpenoids of *Andrographis paniculata*: X-ray crystallographic analysis of andrographolide and structure determination of new minor diterpenoids. *Chemical and Pharmaceutical Bulletin,* 32(6), 2117-2125.
Gahler, S., Otto, K. and Böhm, V. (2003). Alterations of vitamin C, total phenolics, and antioxidant capacity as affected by processing tomatoes to different products. *Journal of Agriculture and Food Chemistry,* 51, 7962-7968.
Galfati, I., Bilal, E., Beji Sassi, A., Abdallah, H. and Zaier, A. (2011). Accumulation of heavy metals in native plants growing near the phosphate treatment industry, Tunisia. *Carpathian Journal of Earth and Environmental Sciences,* 6(2), 85-100.
Gallegos-Robles, M. A., Morales-Loredo, A., Alvarez-Ojeda, G., Vega, P. A., Chew, M. Y., Velarde, S. and Fratamico, P. (2008). Identification of *Salmonella* serotypes isolated from cantaloupe and chile pepper production systems in Mexico by PCR-restriction fragment length polymorphism. *Journal of Food Protection,* 71, 2217-2222.
Gao, Q. H., Wu, C. S., Wang, M., Xu, B. N. and Du, L. J. (2012). Effect of drying of jujubes (*Ziziphus jujuba* Mill.) on the content of sugars, organic acids, α-tocopherol, β-carotene and phenolic compounds. *Journal of Agricultural and Food Chemistry,* 60, 9642-9648.
Garau, M. C., Simal, S., Rossello, C. and Femenia, A. (2007). Effect of air-drying temperature on physico-chemical properties of dietary fibre and antioxidant capacity of orange (*Citrus aurantium* v. Canoneta) by-products. *Food Chemistry,* 104(3), 1014-1024.
Garcia, R., Baelum, J., Fredslund, L., Santorum, P. and Jacobsen, C. S. (2010). Influence of temperature and predation on survival of *Salmonella enterica* serovar Typhimurium and expression of *inv*A in soil and

manure-amended soil. *Applied and Environmental Microbiology,* 76(15), 5025-5031.
Gaur, A. and Adholeya, A. (2004). Prospects of arbuscular mycorrhizal fungi in phytoremediation of heavy metal contaminated soils. *Current Science,* 86, 528-534.
Gaw, S. K., Wilkins, A. L., Kim, N. D., Palmer, G. T. and Robinson, P. (2006). Trace element and ΣDDT concentrations in horticultural soils from the Tasman, Waikato and Auckland regions of New Zealand. *Science of the Total Environment,* 355, 31-47.
Ge, C., Lee, C. and Lee, J. (2012). The impact of extreme weather events on *Salmonella* internalization in lettuce and green onion. *Food Research International,* 45, 1118-1122.
Georgiev, M. I., Ali, K., Alipieva, K., Verpoorte, R. and Choi, Y. H. (2011). Metabolic differentiations and classification of *Verbascum* species by NMR-based metabolomics. *Phytochemistry,* 72 2045-2051.
Gerba, C. P. and Smith, J. E. J. (2005). Sources of pathogenic microorganisms and their fate during land application of wastes. *Journal of Environmental Quality,* 34(1), 42-48.
Giard, J. C., Laplace, J. M., Rince, A., Pichereau, V., Benachour, A., Leboeuf, C. and Hartke, A. (2001). The stress proteome of *Enterococcus faecalis*. *Electrophoresis,* 22, 2947-2954.
Govender, S., Du Plessis-Stoman, D., Downing, T. G. and Van de Venter, M. (2006). Traditional herbal medicines: microbial contamination, consumer safety and the need for standards. *South African Journal of Science,* 102, 253-255.
Govindaraghavan, S., Hennell, J. R. and Sucher, N. J. (2012). From classical taxonomy to genome and metabolome: Towards comprehensive quality standards for medicinal herb raw materials and extracts. *Fitoterapia,* 83, 979-988.
Guan, T. Y. and Holley, R. A. (2003). Pathogen survival in swine manure environments and transmission of human enteric illness: A review. *Journal of Environmental Quality,* 32, 383-392.
Gutzeit, H. O. and Muller, J. L. (2014). *Plant natural product: synthesis, biological functions and practical application*. Weinheim, Germany: Wiley-Blackwell.
Hall, R. D. (2006). Plant metabolomics: From holistic hope, to hype, to hot topic. *New Phytologist,* 169(3), 453-468.
Halt, M. (1998). Moulds and mycotoxins in herb tea and medicinal plants. *European Journal of Epidemiology,* 14, 269-274.
Hammami, C. and Rene, F. (1997). Determination of freeze-drying process variables for strawberries. *Journal of Food Engineering,* 32(2), 133-154.
Handa, S. S. and Sharma, A. (1990a). Hepatoprotective activity of andrographolide from *Andrographis paniculata* against carbontetrachloride. *The Indian Journal of Medical Research,* 92, 276-283.
Handa, S. S. and Sharma, A. (1990b). Hepatoprotective activity of andrographolide against galactosamine and paracetamol intoxication in rats. *Indian Journal of Medical Research,* 92, 284-292.
Harborne, J. B. (1964). *Biochemistry of phenolic compounds.* London: Academic Press.

Harbourne, N., Marete, E., Jacquier, J. C. and O'Riordan, D. (2009). Effect of drying methods on the phenolic constituents of meadowsweet (*Filipendula ulmaria*) and willow (*Salix alba*). *LWT-Food Science and Technology,* 42, 1468-1473.

Havelaar, A. H., Stanley Brul, S., Jong, A., Jonge, R., Zwietering, M. H. and Kuile, B. H. (2010). Future challenges to microbial food safety. *International Journal of Food Microbiology,* 139, 79-94.

Hay, M. E., Duffy, J. E., Fenical, W. and Gustafson, K. (1988). Chemical defense in the seaweed *Dictyoptens delicatula*: differential effects against reef fishes and amphipods. *Marine Ecology Progress Series*, 48, 185-192

Haynes, R. J. and Williams, P. H. (1993). Nutrient cycling and soil fertility in the grazed pasture ecosystem. *Advances in Agronomy,* 49, 120-199.

He, H. J. and Sun, D. W. (2015). Microbial evaluation of raw and processed food products by Visible /Infrared , Raman and Fluroescence spectroscopy. *Trends in Food Science and Technology*, 1-12.

Hee, Y. Y. and Chong, G. H. (2015). Drying behaviour of *Andrographis paniculata* in vacuum drying. *International Food Research Journal,* 22(1), 393-397.

Heindl, A. and Müller, J. (2007). Microwave drying of medicinal and aromatic plants. *Stewart Postharvest Review,* 4, 1-6.

Hell, K. and Mutegi, C. (2011). Aflatoxin control and prevention strategies in key crops of Sub-Saharan Africa. *African Journal of Microbiology Research,* 5, 459-466.

Herbach, K. M., Stintzing, F. C. and Carle, R. (2006). Betalain stability and degradation-structural and chromatic aspects. *Journal of Food Science,* 71, 41-50.

Higdon, J. V. and Frei, B. (2003). Tea catechins and polyphenols: Health effects, metabolism, and antioxidant functions.

Hina, K., Muhammad, A. and Mansoor, H. (2013). Water relations and onic omposition in the seedlings of some newly developed and candidate cultivars of wheat (*Triticumaestivum* L.) under saline conditions. *Pakistan Journal of Botany,* 45(4), 1221-1227.

Hirsch, A. R., Förch, K., Neidhart, S., Wolf, G. and Carle, R. (2008). Effects of thermal treatments and storage on pectin methylesterase and peroxidase activity in freshly squeezed orange juice. *Journal of Agricultural and Food Chemistry,* 56(14), 5691-5699.

Höhler, D. (2000). A brief survey on important mycotoxins and possible detoxification methods. *Feed Technology,* 4(5), 44-46.

Holley, R. A., Arrus, K. M., Ominski, K. H., Tenuta, M. and Blank, G. (2006). *Salmonella* survival in manure-treated soils during simulated seasonal temperature exposure. *Journal of Environmental Quality,* 35, 1170-1180.

Holmes, E., Tang, H., Wang, Y. and Seger, C. (2006). The assessment of plant metabolite profiles by NMR-based methodologies. *Planta Medica,* 72, 771-785.

Holt, S. and Comac, L. (1998). *Miracle Herbs: How herbs combine with modern medicine to treat cancer, heart disease, AIDS, and more*. Michigan, USA: Caro Publishing Group.

Hossain, M., Barry-Ryan, C., Martin-Diana, A. B. and Brunton, N. (2010). Effect of drying method on the antioxidant capacity of six Lamiaceae herbs. *Food Chemistry,* 123(1), 85-91.

Hossain, M. S., Urbi, Z., Sule, A. and Hafizur Rahman, K. M. (2014). *Andrographis paniculata* (Burm. f.) Wall. ex Nees: A Review of Ethnobotany, Phytochemistry, and Pharmacology. *The Scientific World Journal,* 2014, 1-28.

Huang, C. J. and Wu, M. C. (2002). Differential effects of foods traditionally regarded as 'heating' and 'cooling' on prostaglandin E2 production by a macrophage cell line. *Journal of Biomedical Science,* 9, 596-606.

Hug, S. J., Gaertner, D., Roberts, L. C., Schirmer, M., Ruettimann, T., Rosenberg, T. M., Badruzzaman, A. B. M. and Ali, M. A. (2011). Avoiding high concentrations of arsenic, manganese and salinity in deep tubewells in Munshiganj District, Bangladesh. *Applied Geochemistry,* 26, 1077-1085.

Ibnu Hajar, E. W., Sulaiman, A. Z. and Mimi Sakinah, A. M. (2014). Assessment of heavy metals tolerance in leaves, stems and flowers of *Stevia rebaudiana* plant. *Procedia Environmental Sciences,* 20, 386-393.

Ibrahim, M. N. and Chong, G. H. (2008). Stability of andrographolide in *Andrographis paniculata* under selected storage conditions. *International Journal of Engineering and Technology,* 5(1), 69-73.

Idu, M., Erhabor, J. O. and Idele, S. O. (2011). Microbial load of some medicinal plants sold in local markets of Benin City, Nigeria. *International Journal of Medicinal and Aromatic Plants,* 1(3), 272-277.

Idu, M. D., Solomon, E. O., Joseph, O. E. and Harret, M. E. (2010). Microbial load of some medicinal plants sold in some local markets in Abeokuta, Nigeria. *Tropical Journal of Pharmaceutical Research,* 9(3), 251-256.

Iruretagoyena, M. I., Tobar, J. A., González, P. A., Sepúlveda, S. E., Figueroa, C. A., Burgos, R. A., Hancke, J. L. and Kalergis, A. M. (2005). Andrographolide interferes with T-cell activation and reduces experimental autoimmune encephalomyelitis in the mouse. *Journal of Pharmacology and Experimental Therapeutics,* 312(1), 366-372.

Islam, M., Morgan, J., Doyle, M. P. and Jiang, X. P. (2004). Fate of *Escherichia coli* O157:H7 in manure compost-amended soil and on carrots and onions grown in an environmentally controlled growth chamber. *Journal of Food Protection,* 67, 574-578.

Islam, M. S., Ahmed, M. K., Al-Mamun, M. H. and Raknuzzaman, M. (2015). The concentration, source and potential human health risk of heavy metals in the commonly consumed foods in Bangladesh. *Ecotoxicology and Environmental Safety,* 122, 462-469.

Islam, M. S., Ahmed, M. K., Habibullah-Al-Mamun, M. and Masunaga, S. (2014). Trace metals in soil and vegetables and associated health risk assessment. *Environmental Monitoring and Assessment* 186, 8727-8739.

Itanna, F. (2002). Metals in leafy vegetables grown in Addis Ababa and toxicological implications. *Ethiopian Journal of Health Development,* 16(3), 295-302.

Jacobsen, C. S. and Bech, T. B. (2012). Soil survival of *Salmonella* and transfer to freshwater and fresh produce. *Food Research International,* 45, 557-566.

Jahangir, M., Abdel-Farid, I. B., Choi, Y. H. and Verpoorte, R. (2008). Metal ion-inducing metabolite accumulation in *Brassica rapa*. *Journal of Plant Physiology,* 165, 1429-1437.

Jarukamjorn, K. and Nemoto, N. (2008). Pharmacological aspects of *Andrographis paniculata* on health and its major diterpenoid constituent andrographolide. *Journal of Health Science,* 54(4), 370-381.

Jayakumar, T., Hsieh, C. Y., Lee, J. J. and Sheu, J. R. (2013). Experimental and clinical pharmacology of *Andrographis paniculata* and its major bioactive phytoconstituent andrographolide. *Evidence-Based Complementary and Alternative Medicine*. doi:http://dx.doi.org/10.1155/2013/846740

Jayaprakasha, G. K. and Patil, B. S. (2016). A metabolomics approach to identify and quantify the phytochemicals in watermelons by quantitative 1H-NMR. *Talanta,* 153, 268-277.

Jebril, A. A. (2005). *Genetic variation and anticancer activity of Andrographis paniculata germplasm from Malaysia.* Master Thesis. Universiti Putra Malaysia, Malaysia.

Jéssica, L., Vega-Gálvez, A., Torres, M. J., Lemus-Mondaca, R., Quispe-Fuentes, I. and Di Scala, K. (2013). Effect of dehydration temperature on physico-chemical properties and antioxidant capacity of goldenberry (*Physalis peruviana* L.). *Chilean Journal Of Agricultural Research,* 73(3), 293-300.

Jiang, H. L., Xie, Z. Z., Koo, H. J., McLaughlin, S. P., Timmermann, B. N. and Gang, D. R. (2006). Metabolic profiling and phylogenetic analysis of medicinal Zingiber species: Tools for authentication of ginger (*Zingiber officinale* Rosc.). *Phytochemistry Reviews,* 67, 1673-1685.

Jimenez-Monreal, A. M., Garcia-Diz, L., Martinez-Tome, M., Mariscal, M., and Murcia, M. A. (2009). Influence of cooking methods on antioxidant activity of vegetables. *Journal of Food Science,* 74, 97–103.

Jing, Y., Jin-Feng, C., Yu-Ying, Z. and Lin-Chun, M. (2010). Effects of drying processes on the antioxidant properties in sweet potatoes. *Agricultural Sciences in China,* 9, 1522-1529.

Johnson, I. T. (2013). *Phytochemicals and Health*. Iowa, USA: Wiley-Blackwell, John Wiley & Son.

Jordan, S. A., Cunningham, D. G. and Marles, R. J. (2010). Assessment of herbal medicinal products: challenges, and opportunities to increase the knowledge base for safety assessment. *Toxicology and Applied Pharmacology,* 243, 198-216.

Kabir, M. H., Hasan, N., Rahman, M. M., Rahman, M. A., Khan, J. A., Hoque, N. T. and Mohammed, R. (2014). A survey of medicinal plants used by the Deb barma clan of the Tripura tribe of Moulvibazar district, Bangladesh. *Journal of Ethnobiology and Ethnomedicine,* 10(1), 1-28.

Kamdem, R. E., Sang, S. and Ho, C. T. (2002). Mechanism of the superoxide scavenging activity of neoandrographolide - A natural product from *Andrographis paniculata* Nees. *Journal of Agricultural and Food Chemistry,* 50, 4662-4665.

Kapil, A., Koul, I. B., Banerjee, S. K. and Gupta, B. D. (1993). Antihepatoxic effects of major diterpenoid constituents of *Andrographis paniculata*. *Biochemical Pharmacology,* 46(1), 182-185.

Karim, M. A. and Hawlader, M. N. A. (2005). Mathematical modelling and experimental investigation of tropical fruits drying. *International Journal of Heat and Mass Transfer,* 48, 4914-4925.

Karimi, E. (2011). *Phytochemical analyses and biological activities of defferent parts of three varieties of Labisia pumila Benth.* PhD Thesis, Universiti Putra Malaysia, Malaysia.

Katerere, D. R., Stockenström, S., Thembo, K. M., Rheeder, J. P., Shephard, G.S. and Vismer, H.F. (2008). A preliminary survey of mycological and fumonisin and aflatoxin contamination of African traditional herbal medicines sold in South Africa. *Human and Experimental Toxicology,* 27, 793-798.

Kaume, L., Foote, J. C. and Gbur, E. E. (2012). Microbial contamination of herbs marketed to HIV infected people in Nairobi (Kenya). *South African Journal of Science,* 108, 9-10.

Keinanen, M. and Julkunen-Tiitto, R. (1996). Effect of sample preparation method on birch (*Betulapendula* Roth) leaf phenolics. *Journal of Agricultural and Food Chemistry,* 44, 2724-2727.

Khan, I. A., Allgood, J., Walker, L. A., Abourashed, E. A., Schlenk, D. and Benson, W. H. (2001). Determination of heavy metals and pesticides in ginseng products. *Journal of AOAC International,* 84(3), 936-939.

Khandelwal, G., Gupta, A., Dwivedi, D., Prasad, G. and Maheshwari, D. K. (2013). Evaluation of relationship between microbial load and drug efficacy of *Andrographis paniculata* during storage. *Journal of Applied and Natural Science,* 5(1), 142-147.

Khanzadi, F. K. (2012). Microbiological quality assessment of commercially available medicinal plants in Peshawar city, Pakistan. *Pakistan Journal of Botany,* 44(4), 1203-1208.

Khurana, N., Sharma, R. K. and Bhaduria, S. (2011). Microbiological quality assessment of some commericial herbal drugs. *International Journal of Pharmaceutical Quality Assurance,* 3(4), 15-17.

Kim, H. K., Choi, Y. H. and Verpoorte, R. (2010). NMR-based metabolomic analysis of plants: protocol. *Nature Protocols,* 5(3), 536-549.

Kim, H. K. and Verpoorte, R. (2010). Sample Preparation for plant metabolomics. *Phytochemical Analysis,* 21, 4-13.

Kim, J. S., He, L. and Lemasters, J. J. (2003). Mitochondrial permeability transition: A common pathway to necrosis and apoptosis. *Biochemical and Biophysical Research Communications,* 304, 463-470.

Kim, T. G., Hwi, K. K. and Hung, C. S. (2005). Morphological and biochemical changes of andrographolide-induced cell death in human prostatic adenocarcinoma PC-3 cells. *In Vivo,* 19(3), 551-557.

Kim, W. W., Amal, K. G., Wu, J. C., Eom, S. H., Lee, B. G., Kang, W. S. and Cho, D. H. (2012). Effectof far infrared drying on antioxidant property, anti-inflammatory activity, and inhibitory activity in A549 cells of Gamguk (*Chrysanthemum indicum* L.) flower. *Food Science and Biotechnology,* 21, 261-265.

Kosalec, I., Cvek, J. and Tomic, S. (2009). Contaminants of medicinal herbs and herbal products. *Archives of Industrial Hygiene and Toxicology,* 60, 485-501.

Koteswara, R. Y., Vimalamma, G., Venkata, R. C. and Tzeng, Y.-M. (2004). Flavonoids and andrographolides from *Andrographis paniculata Phytochemistry,* 65(16), 2317-2321.

Krokida, M. and Philippopoulos, C. (2006). Volatility of apples during air and freeze drying. *Journal of Food Engineering,* 73(2), 135-141.

Kroupitski, Y., Golberg, D., Belausov, E., Pinto, R., Swartzberg, D., Granot, D. and Sela, S. (2009). Internalization of *Salmonella enterica* in leaves is induced by light and involves chemotaxis and penetration through open stomata. *Applied and Environmental Microbiology,* 75, 6076-6086

Kulshrestha, R., Gupta, C. P., Shukla, G., Kundu, M. G., Bhatnagar, S. P. and Katiyar, C. K. (2008). The effect of water activity and storage temperature on the growth of *Aspergillus flavus* in medicinal herbs. *Planta Medica,* 74, 1308-1315.

Kumar, A., Dora, J., Singh, A. and Tripathi, R. (2012). A review on king of bitter (Kalmegh). *International Journal of Research in Pharmacy and Chemistry,* 2(1), 116-124.

Kumar, A., Shukla, R., Singh, P. and Dubey, N. K. (2009). Biodeterioration of some herbal raw materials by storage fungi and aflatoxin and assessment of *Cymbopogon flexuosus* essential oil and its components as antifungal. *International Biodeterioration & Biodegradation,* 63, 712-716.

Kunene, N. F., Hastings, J. W. and von Holy, A. (1999). Bacterial populations associated with a sorghum-based fermented weaning cereal. *International Journal of Food Microbiology,* 49, 75-83.

Kunle, O. F., Egharevba, H. O. and Ahmadu, P. O. (2012). Standardization of herbal medicines - A review. *International Journal of Biodiversity and Conservation,* 4(3), 101-112.

Kwon, D. J., Jeong, H. J., Moon, H., Kimb, H. N., Cho, J. H., Lee, J. E., Hong, K. S. and Hong, Y. S. (2015). Assessment of green coffee bean metabolites dependent on coffee quality using a 1H-NMR-based metabolomics approach. *Food Research International,* 67, 175-182.

Kwok, B. H. L., Hu, C., Durance, T. and Kitts, D. D. (2004). Dehydration techniques affect phytochemical contents and free radical scavenging activities of Saskatoon berries (*Amelanchier alnifolia* Nutt.). *Journal of Food Science,* 69(3), 122-126.

Laher, F., Aremu, A. O., Van Staden, J. and Finnie, J. F. (2013). Evaluating the effect of storage on the biological activity and chemical composition of three South African medicinal plants. *South African Journal of Botany,* 88, 414-418.

Lasisi, A. A., Ejelonu, B. C., Nwosu, F. O., Olayiwola, M. A. and Yusuff, A. A. (2006). Heavy metals and macronutrients contents in selected herbal plants of south-western Nigeria. *Hamdard Medicus,* XLIX(4), 71-76.

Lawley, R. (2013). Afflatoxin: The science of safe food. Retrieved from http://www.foodsafetywatch.org/factsheets/aflatoxins/

Lee, M. J., Rao, Y. K., Chen, K., Lee, Y. C., Chung, Y. S. and Tzeng, Y. M. (2010). Andrographolide and 14-deoxy-11,12-didehydroandrographolide from *Andrographis paniculata* attenuate high glucose-induced fibrosis and apoptosis in murine renal mesangeal cell lines. *Journal of Ethnopharmacology,* 132(2), 497-505.

Lee, S. K. and Kader, A. A. (2000). Preharvest and postharvest factors influencing vitamin C content of horticultural crops. *Postharvest biology and Technology,* 20, 207-220.

Le Gall, G., Colquhoun, I. J., Davis, A. L., Collins, G. J. and Verhoeyen, M. E. (2003). Metabolite profiling of tomato (*Lycopersicon esculentum*) using 1H NMR spectroscopy as a tool to detect potential unintended effects following a genetic modification. *Journal of Agricultural and Food Chemistry* , 51, 2447-2456.

Le Gall, G., Colquhoun, I. J. and Defernez, M. (2004). Metabolite profiling using 1H NMR spectroscopy for quality assessment of green tea, *Camellia sinensis* (L.). *Journal of Agricultural and Food Chemistry,* 52, 692-700.

Leong, S. Y. and Oey, I. (2012). Effects of processing on anthocyanins, carotenoids and vitamin C in summer fruits and vegetables. *Food Chemistry,* 133, 1577-1587.

Li, W., Xu, X., Zhang, H., Ma, C., Fong, H., van Breemen, R. and Fitzloff, J. (2007). Secondary metabolites from *Andrographis paniculata*. *Chemical and Pharmaceutical Bulletin (Tokyo),* 55(3), 455-458.

Lim, Y. and Murtijaya, J. (2007). Antioxidant properties of Phyllanthus amarus extracts as affected by different drying methods. *LWT-Food Science and Technology,* 40(9), 1664-1669.

Lin, S. D., Sung, J. M. and Chen, C. L. (2011). Effect of drying and storage conditions on caffeic acid derivatives and total phenolics of *Echinacea Purpurea* grown in Taiwan. *Food Chemistry,* 125, 226-231.

Lomlim, L., Jirayupong, N. and Plubrukarn, A. (2003). Heat-accelerated degradation of solid-state andrographolide. *Chemical and Pharmaceutical Bulletin,* 51, 24-26.

López, J., Vega-Gálvez, A., Torres, M., Lemus-Mondaca, R., Quispe-Fuentes, I. and Di Scala, K. (2013). Effect of dehydration temperature on physico-chemical properties and antioxidant capacity of goldenberry (*Physalis peruviana* L.). *Chilean Journal of Agricultural Research,* 73, 293-299.

Lopez-Nicolas, M. J. and Garcia-Carmona, F. (2010). Enzymatic and nonenzymatic degradation of polyphenols. In L. de la Rosa, E. Alvarez-Parrilla, G. Go´ nzalez-Aguilar, and M. R. (Eds.), *Fruit and Vegetable Phytochemicals* (pp. 101-103). Wiley-Blackwell Publishing: Iowa, USA.

Lubbe, A., Pomahacová, B., Choi, Y. H. and Verpoorte, R. (2010). Analysis of metabolic variation and galanthamine content in *Narcissus* bulbs by 1H NMR. *Phytochemistry Analysis,* 21, 66-72.

Mahanom, H., Azizah, A. H. and Dzulkifly, M. H. (1999). Effect of different drying methods on concentrations of several phytochemicals in herbal preparation of 8 medicinal plants leaves. *Malaysian Journal of Nutrition,* 5, 47-54.

Mahendran, T. (2010). Physico-chemical properties and sensory characteristics of dehydrated guava concentrate: effect of drying method and maltodextrin concentration. *Tropical Agricultural Research and Extension,* 13(2), 48-54.

Maimoona, A., Naeem, I., Saddiqe, Z. and Ali, N. (2011). Analysis of total flavonoids and phenolics in different fractions of bark and needle extracts of Pinus roxburghii and Pinus wallichiana. *Journal of Medicinal Plants Research,* 5(21), 5216-5220.

Mandal, S. C., Dhara, A. K. and Maiti, B. C. (2001). Studies on Psychopharmacological Activity of *Andrographis paniculata* Extract. *Phytotherapy Research* , 15, 253-256.

Mandeel, Q. A. (2005). Fungal contamination of some imported spices. *Mycopathologia,* 159, 291-298.

Mangels, A. R., Holden, J. M., Beecher, G. R., Forman, M. R. and Lanza, E. (1993). Carotenoid content of fruits and vegetables: an evaluation of analytic data. *Journal of the American Dietetic Association,* 93(3), 284-296.

Mao, L.-C., Pan, X., Que, F. and Fang, X.-H. (2006). Antioxidant properties of water and ethanol extracts from hot air-dried and freeze-dried daylily flowers. *European Food Research and Technology,* 222(3-4), 236-241.

Martin, S. A. (2014). Disorders of primary metabolites in response to drought may increase the synthesis of natural products for medicinal purposes: South American herbs — a case study. *Recent Patents in Biotechnology.,* 8, 36-46.

McGuiere, R. G. (1992). Reporting of objective colour measurements. *HortScience,* 27(12), 1254-1255.

McLaughlin, M. J., Parker, D. R. and Clark, J. M. (1999). Metals and micronutrients-food safety issues. *Field Crops Research,* 60, 143-163.

MdNor, C. R., Ibrahim, M. N. and Song, S. T. (2009). *Preliminary studies on vacuum drying of hempedu bumi (Andrographis paniculata).* Paper presented at the Proceedings of the Regional Engineering: Postgraduate Conference, Universiti Putra Malaysia.

Medforth, C. J., Chang, R. S., Chen, G. Q., Olmstead, M. M. and Smith, K. M. (1990). A conformational study of diterpenoid lactones isolated from the Chinese medicinal herb *Andrographis paniculata*. *Journal of the Chemical Society, Perkin Transactions,* 2(6), 1011-1016.

Mediani, A., Abas, F., Khatib, A., Maulidiani, H., Shaari, K., Choi, Y. H. and Lajis, N. H. (2012). H-NMR-based metabolomics approach to understanding the drying effects on the phytochemicals in *Cosmos caudatus*. *Food Research International,* 49, 763-770.

Mediani, A., Abas, F., Khatib, A., Tan, C. P., Ismail, I. S., Shaari, K. and Lajis, N. H. (2015). Phytochemical and biological features of *Phyllanthus niruri* and *Phyllanthus urinaria* harvested at different growth stages revealed by 1H NMR-based metabolomics. *Industrial Crops and Products,* 77, 602-613.

Michalczyk, M., Macura, R. and Matuszak, I. (2009). The effect of air-drying, freeze-drying and storage on the quality and antioxidant activity of some selected berries. *Journal of Food Processing and Preservation,* 33(1), 11-21.

Minguez-Mosquera, M. I., Pérez-Gálvez, A. and Garrido-Fernández, J. (2000). Carotenoid Content of the varieties Jaranda and Jariza (Capsicum a nnuum L.) and response during the industrial slow drying and grinding steps in paprika Processing. *Journal of Agricultural and Food Chemistry,* 48(7), 2972-2976.

Miliauskas, G., Venskutonis, P. and Van Beek, T. (2004). Screening of radical scavenging activity of some medicinal and aromatic plant extracts. *Food chemistry,* 85(2), 231-237.

Ministry of Natural Resourses and Environment. (2009). Contaminated land management and control guidelines no. 1 *Malaysian Recommended Site Screening Levels for Contaminated Land* (pp. 1-58). Malaysia.

Mishra, S., Sangwan, N. and Sangwan, R. (2007). *Andrographis paniculata* (Kalmegh): A review. *Pharmacognosy Reviews,* 1(2), 283-298.

Moir, J. L., and Moot, J. (2010). *Soil pH, exchangeable aluminium and lucerne yield responses to lime in a South Island high country soil.* Paper presented at the Proceedings of the New Zealand Grassland Association.

Modarai, M., Yang, M., Suter, A., Kortenkamp, A. and Heinrich, M. (2010). Metabolomic profiling of liquid *Echinacea* medicinal products with in vitro inhibitory effects on cytochrome P450 3A4 (CYP3A4). *Planta Medica,* 76, 378-385.

Moir, J. L., Scotter, D. R., Hedley, M. J. and Mackay, A. D. (2000). A climate-driven, soil fertility dependent, pasture production model. *New Zealand Journal of Agricultural Research* 43, 491-500.

Montgomery, S., Goldschmidt, V. and Franchek, M. (1998). Vacuum assisted drying of hydrophilic plates: static drying experiments. *International journal of heat and mass transfer,* 41(4), 735-744.

Morgan, J. N. (1999). *Impact of Processing on Food Safety: Effects of Processing on Heavy Metal Content of Foods* (L. S. Jackson, M. G. Knize, and J. N. Morgan Eds.): Springer US.

Mphahlele, R. R., Fawole, O. A., Stander, M. A. and Opara, U. L. (2014). Preharvest and postharvest factors influencing bioactive compounds in pomegranate (*Punica granatum* L.) - A review. *Scientia Horticulturae 178,* 178, 114-123.

Mrad, N. D., Boudhrioua, N., Kechaou, N., Courtois, F. and Bonazzi, C. (2012). Influence of air drying temperature on kinetics, physicochemical properties, total phenolic content and ascorbic acid of pears. *Food and Bioproducts Processing,* 90(3), 433-441.

Mujumdar, A. S. and Law, C. L. (2010). Drying technology: Trends and applications in postharvest processing. *Food and Bioprocess Technology,* 3, 843-852.

Murugan, T., Wins, J. A. and Murugan, M. (2013). Antimicrobial Activity and Phytochemical Constituents of Leaf Extracts of *Cassia auriculata.* *Indian Journal of Pharmaceutical Science*, 75(1), 122–125.

Mythili, S., V., S. and Sathia Velu, A. (2011). Analysis Of Heavy Metal Content in *Andrographis Paniculata*. *International Journal of Pharmaceutical Sciences Review and Research. ,* 10, 165-166.

Nanda, S., Rao, D. V. S. and Krishnamurthy, S. (2001). Effects of shrink film wrapping and storage temperature on the shelf life and quality of pomegranate fruits cv. Ganesh. *Postharvest biology and Technology,* 22, 61-69.

Natvig, E. E., Ingham, S. C., Ingham, B. H., Cooperbrand, L. R. and Roper, T. R. (2002). *Salmonella enterica* serovar Typhimurium and *Escherichia coli* contamination of root and leaf vegetables grown in soils with incorporated bovine manure. *Applied and Environmental Microbiology,* 68, 2737-2744.

Naveedullah, Hashmi, M. Z., Yu, C., Shen, H., Duan, D., Shen, C., Lou, L. and Chen, Y. (2013). Risk Assessment of heavy metals pollution in agricultural soils of Siling Reservoir Watershed in Zhejiang Province, China. *BioMed Research International,* 2013, 1-10.

Negi, P. S. (2013). *Stability of phytochemicals at the point of sale*. Iowa, USA: Wiley-Blackwell, John Wiley & Son

Nerantzaki, A. A., Tsiafoulis, C. G., Charisiadis, P., Kontogianni, V. G. and Gerothanassis, I. P. (2011). Novel determination of the total phenolic content in crude plant extracts by the use of ^{1}H NMR of the –OH spectral region. *Analytica Chimica Acta,* 688, 54-60.

Neumann, R. B., Ashfaque, K. N., Badruzzaman, A. B. M., Ali, M. A., Shoemaker, J. K. and Harvey, C. F. (2011). Rice field geochemistry and hydrology: an explanation for why groundwater irrigated fields in Bangladesh are net sinks of arsenic from groundwater. *Environmental Science and Technology,* 45, 2072-2078.

Ning, W., Peng, X., Ma, L., Cui, L., Lu, X., Wang, J., Tian, J., Li, X., Wang, W. and Zhang, L. (2012). Enhanced secondary metabolites production and antioxidant activity in postharvest *Lonicera japonica* Thumb. in response to UV radiation. Innovative Food Science and Emerging Technologies, 13, 231–243.

Niranjan, A., Tewari, S. K. and Lehri, A. (2010). Biological activities of Kalmegh (*Andrographis paniculata* Nees) and its active principles - A review. *Indian Journal of Natural Products aand Resources,* 1(2), 125-135.

Nora, C. D., Muller, C. l. D.-R., De Bona, G. S., Rios, A. d. O., Hertz, P. F., Jablonski, A., de Jong, E. V. and Flores, S. H. (2014). Effect of processing on the stability of bioactive compounds from red guava (*Psidium cattleyanum* Sabine) and guabiju (*Myrcianthes pungens*). *Journal of Food Composition and Analysis,* 34, 18-25.

Nunes, J. C., Lago, M. G., Castelo-Branco, V. N., Oliveira, F. R., Torres, A. G., Perrone, D. and Monteiro, M. (2016). Effect of drying method on volatile compounds, phenolic profile and antioxidant capacity of guava powders. *Food Chemistry,* 197, 881-890.

Obi, E., Akunyili, D. N., Ekpo, B. and Orisakwe, O. E. (2006). Heavy metal hazards of Nigerian herbal remedies. *Science of the Total Environment Journal,* 369(1-3), 35-41.

Offei-Oknye, R., Patterson, J., Walker, L. and Verghese, M. (2015). Processing effects on phytochemical content and antioxidative potential of ginger *Zingiber officale*. *Food and Nutrition Sciences,* 6(5), 445-451.

Ojha, S. and Kostrzynska, M. (2007). Approaches for reducing *Salmonella* in pork production. *Journal of Food Protection,* 70, 2676-2694.

Okhuarobo, A., Ehizogie Falodun, J., Erharuyi, O., Imieje, V., Falodun, A. and Langer, P. (2014). Harnessing the medicinal properties of *Andrographis paniculata* for diseases and beyond: a review of its phytochemistry and pharmacology. *Asian Pacific Journal of Tropical Disease,* 4(3), 213-222.

Okos, M. R., Narsimhan, G., Singh, R. K. and Witnauer, A. C. (1992). *Food dehydration* (D. R. Heldman and D. B. Lund Eds.). New York: Marcel Dekker.

Okunlola, A., Adewoyin, B. A. and Odeku, O. A. (2007). Evaluation of pharmaceutical and microbial qualities of some herbal medicinal products in South Western Nigeria. *Tropical Journal of Pharmaceutical Research,* 6(1), 661-670.

Oliver, D. M., Clegg, C. D., Haygarth, P. M. and Heathwaite, A. L. (2005). Assessing the potential for pathogen transfer from grassland soils to surface waters. *Advances in Agronomy,* 85, 125-180.

Oluyege, J. O. and Adelabu, D. M. (2010). Microbial contamination of some hawked herbal products in Ado-Ekiti, Nigeria. *Continental Journal of Microbiology,* 4(8), 8-14.

Ongeng, D., Muyanja, C., Geeraerd, A. H., Springael, D. and Ryckeboer, J. (2011). Survival of Escherichia coli O157:H7 and *Salmonella enterica* serovar Typhimurium in manure and manure-amended soil under tropical climatic conditions in Sub-Saharan Africa. *Journal of Applied Microbiology,* 110, 1007–1022.

Opaluwa, O. D., Aremu, M. O., Ogbo, L. O., Abiola, K. A., Odiba, I. E., Abubakar, M. M. and Nweze, N. O. (2012). Heavy metal concentrations in soils, plant leaves and crops grown around dump sites in Lafia Metropolis,

Nasarawa State, Nigeria. *Advances in Applied Science Research,* 3(2), 780-784.
Orphanides, A., Goulas, V. and Gekas, V. (2013). Effect of drying method on the phenolic content and antioxidant capacity of spearmint. *Czech Journal of Food Sciences,* 31(5), 509–513.
Otake, T., Mori, H., Morimoto, M., Ueba, N., Sutardjo, S., Kusumoto, I. T., Hattori, M. and Namba, T. (1995). Screening of Indonesian plant extracts for anti-human immunodeficiency virus—type 1 (HIV-1) activity. *Phytotherapy Research,* 9(1), 6-10.
Parichatikanond, W., Suthisisang, C., Dhepakson, P. and Angkana Herunsalee, A. (2010). Study of anti-inflammatory activities of the pure compounds from *Andrographis paniculata* (burm.f.) Nees and their effects on gene expression. *International Immunopharmacology* 10, 1361-1373.
Payne, J. B., Osborne, J. A., Jenkins, P. K. and Sheldon, B. W. (2007). Modeling the growth and death kinetics of *Salmonella* in poultry litter as a function of pH and water activity. *Poultry Science,* 86, 191-201.
Pham, H. N. T., Nguyen, V. T., Vuong, Q. V., Bowyer, M. C. and Scarlett, C. J. (2015). Effect of extraction solvents and drying methods on the physicochemical and antioxidant properties of *Helicteres hirsuta* Lour. leaves. *Technologies, 3(4), ,* 3(4), 285-301.
Pholphana, N., Rangkadilok, N., Thongnest, S., Ruchirawat, S., Ruchirawat, M. and Satayavivad, J. (2004). Determination and variation of three active diterpenoids in *Andrographis paniculata* (Burm.f.) Nees. *Phytochemical Analysis* 15, 365-371.
Piluzza, G. and S., B. (2011). Correlations between phenolic content and antioxidant properties in twenty-four plant species of traditional ethnoveterinary use in the Mediterranean area. *Pharmaceutical Biology,* 49(3), 240-247.
Pinela, J., Barros, L., Dueñas, M., Carvalho, A. M., C., S.-B. and Ferreira, C. F. R. I. (2012). Antioxidant activity, ascorbic acid, phenolic compounds and sugars of wild and commercial *Tuberaria lignosa* samples: Effects of drying and oral preparation methods. *Food Chemistry,* 135, 1028-1035.
Podolak, R., Enache, E., Stone, W., Black, D. G. and Elliott, P. H. (2010). Sources and risk factors for contamination, survival, persistence, and heat resistance of Salmonella in low-moisture foods. *Journal of Food Protection,* 73(10), 1919-1936.
Prasad, G., Sharma, P., Gupta, K. K. and Chopra, A. K. (2007). Effect of microbial contaminants on Triphala drug efficacy during storage and enhancement of therapeutic spectrum of the drug In Vitro. *Hamdard Medicus Journal,* 50(1), 55-62.
Price, M. L., Van Scoyoc, S. and Butler, L. G. (1978). A critical evaluation of the vanillin reaction as an assay for tannin in sorghum grain. *Journal of Agricultural and Food Chemistry,* 26(5), 1214-1218.
Pérez, M. G. F., Guzmán, N. E. R., Silva, E. M., Piña, G. L. and Camacho, R. R. (2014). Effect of chemical elicitors on peppermint (*Mentha piperita*) plants and their impact on the metabolite profile and antioxidant capacity of resulting infusions. *Food Chemistry,* 156, 273-278.
Peter, K. and Babu, K. (2012). Introduction to herbs and spices: medicinal uses and sustainable production. *Handbook of herbs and spices* (Vol. 2, pp. 1-16). United Kingdom: Woodhead Publishing Limited Cambridge.

Ponce, A. G., Fritz, R., del Valle, C. E. and Roura, S. I. (2003). Antimicrobial activity of essential oils on the native microflora of organic Swiss chard. *Lebensmittel-Wissenschaft and Technologie,* 36, 679-684.

Puranik, V., Chauhan, D. K., Mishra, V. and Rai, G. K. (2012). Effect of drying techniques on the physicochemical andbioactive components of selected medicinal herbs. *Annals of Phytomedicine,* 1(2), 23-29.

Qader, S. W., Abdulla, M. A., Lee, S. C., Najim, N., Mat Zain, M. and Hamdan, S. (2011). Antioxidant, total phenolic content and cytotoxicity evaluation of selected malaysian plants. *Molecules,* 16, 3433-3443.

Quispe Candori, S., Foglio, M. A., Rosa, P. T. V. and Meireles, M. A. A. (2008). Obtaining b-caryophyllene from Cordia verbenacea de Candolle by super crtitical fluid extraction *Journal of Supercritical Fluids,* 46, 27-32.

Raberta, M. and Lin, S. (2015). Effects of Different Drying Methods on the Antioxidant Activities of Leaves and Berries of *Cayratia trifolia*. *Sains Malaysiana,* 44(2), 275-280.

Rahimi, M., Farhadi, R. and Salehi Balashahri, M. (2012). Effects of heavy metals on the medicinal plant. *International Journal of Agronomy and Plant Production,* 3(4), 154-158.

Rahimmalek, M. and Goli, S. A. H. (2013). Evaluation of six drying treatments with respect to essential oil yield, composition and colour characteristics of *Thymus daenensis* subsp. *daenensis*. Celak leaves. *Industrial Crops and Products,* 42, 613-619.

Rahman, M. A., Rahman, M. M., Reichman, S. M., Lim, R. P. and Naidu, R. (2014). Heavy metals in Australian grown and imported rice and vegetables on sale in Australia: Health hazard. *Ecotoxicology and Environmental Safety,* 100, 53-60.

Rajani, M., Shrivastava, N. and Ravishankara, M. N. (2000). A rapid method for isolation of andrographolide from *Andrographis paniculata* Nees (Kalmegh). *Pharmaceutical Biology,* 38(3), 204-209.

Rajic, A., Waddell, L. A., Sargeant, J. M., Read, S., Farber, J., Firth, M. J. and Chambers, A. (2007). An overview of microbial food safety programs in beef, pork, and poultry: from farm to processing in Canada. *Journal of Food Protection,* 70, 1286-1294.

Randle, W. M. and Lancaster, J. E. (2002). *Sulphur compounds in Alliums in relation to flavour quality*. Wallingford: CAB International.

Rasmussen, B., Cloarec, O., Tang, H., Staerk, D. and Jaroszewski, J. W. (2006). Multivariate analysis of integrated and full resolution 1H NMR spectral data from complex pharmaceutical preparations: St. John's wort. *Planta Medica,* 72, 556-563.

Rastogi, K. B., Mehrotra, B. N. and Pastogi, R. P. (2001). *Compendium of Indian Medicinal Plants* (Vol. 3). New Delhi: Council of Scientific & Industrial Research.

Ratti , C. (2001). Hot air and freeze-drying of high-value foods: A review. *Journal of Food Engineering,* 49, 311-319.

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

Reddy, V. L. N., Reddy, S. M., Ravikanth, V., Krishnaiah, P., Goud, T. V., Rao, T. P., Ram, T. S., Gonnade, R. G., Bhadbhade, M. and Venkateswarlu, Y. (2005). A new bisandrographolide ether from Andrographis

paniculata nees and evaluation of anti-HIV activity. *Natural Product Research,* 19(3), 223-230.
Refai, K. (1988). Aflatoxins and Aflatoxicosis. *Journal of the Egyptian Veterinary Medical Association,* 48(1), 1-19.
Renaud, S. C., Gueguen, R., Schenker, J. and d'Houtaud, A. (1998). Alcohol and mortality in middle-aged men from eastern France. *Epidemiology,* 9, 184-188.
Renner, R. (2004). Arsenic and lead leach out of popular fertilizer. *Environmental Science & Technology,* 38(20), 382-383.
Rice-Evans, C. A., Miller, J. and Paganga, G. (1997). Review: Antioxidant properties of phenolic compounds. *Trends Plant Science,* 2(4), 152.
Ristori, C. A., Santos Pereira, M. A. and Gelli, D. S. (2007). Behavior of Salmonella Rubislaw on ground black pepper (*Piper nigrum* L.). *Food Control 18,* 18, 268-272.
Roos, G., Röseler, C., Büter, K. B. and Simmen, U. (2004). Classification and correction of St. John's wort extracts by nuclear magnetic resonance spectroscopy, multivariate data analysis and pharmacological activity. *Planta Medica.,* 70, 771-777.
Roshanak, S., Rahimmalek, M. and Goli, S. A. H. (2016). Evaluation of seven different drying treatments in respect to total flavonoid, phenolic, vitamin C content, chlorophyll, antioxidant activity and color of green tea (Camellia sinensis or C. assamica) leaves. *Journal of food science and technology,* 53(1), 721-729.
Roy, D. N., Mandal, S., Sen, G., Mukhopadhyay, S. and Biswas, T. (2010). 14-Deoxyandrographolide desensitizes hepatocytes to tumour necrosis factor-alpha-induced apoptosis through calcium dependent tumour necrosis factor receptor superfamily member 1A release via the NO/cGMP pathway. *British Journal of Pharmacology,* 160(7), 1823-1843.
Rudra, S. G., Singh, H., Basu, S. and Shivhare, U. (2008). Enthalpy entropy compensation during thermal degradation of chlorophyll in mint and coriander puree. *Journal of food engineering,* 86(3), 379-387.
Sablani, S. S., Andrews, P. K., Davies, N. M., Walters, T., Saez, H. and Bastarrachea, L. (2011). Effects of air and freeze drying on phytochemical content of conventional and organic Berries. *Drying Technology,* 29, 205-216.
Sabu, K. K., Padmesh, P. and Seeni, S. (2001). Intraspesific variation in active principle content and isozymes of *Andrographis paniculata* Nees (Kalmegh): A tradisional hepatoprpyive medicinal herb of India. *Journal of Medicinal and Aromatic Plant Science* 23, 637-647.
Sajur, S. A., Saguir, F. M. and de Nadra, M. C. M. (2007). Effect of dominant specie of lactic acid bacteria from tomato on natural microflora development in tomato puree. *Food Control,* 18, 594-600.
Salido, A. L., Hasty, K. L., Lim, J. M. and Butcher, D. J. (2003). Phytoremediation of arsenic and lead in contaminated soil using Chinese Brake ferns (*Pterisvittata*) and Indian mustard (*Brassica juncea*). *International Journal of Phytoremediation,* 5(2), 89-103.
Salleh, L. M., Hartati, Jamaludin, R., Yunus, M. A. C., Yakub, H. and Aziz, A. A. (2014). Antioxidant activity and total phenolic contents in methanol extracts from *Swietenia mahagoni* and *Andrographis paniculata*. *Jurnal Teknologi (Sciences & Engineering),* 69(4), 51-53.

Sani, Y. N., Danladi, S., Wan-Azemin, A., Rao, M., Mohd, K. S. and Dharmaraj, S. (2015). Effects of extracting solvents on total phenolic content, total flavonoid Ccontent and anti-oxidant activity of *Andrographis paniculata* from Kemaman, Malaysia. *Research Journal of Pharmaceutical, Biological and Chemical Sciences,* 6(3), 1397-1404.

Sani, Y. N. and Raj, S. D. (2016). *Andrographis paniculata* Ness, An ancient herb to explore for its therapeutic benefit in Malaysia. *Journal of Natural Sciences Research,* 6(13), 45-54.

Saohin, W., Boonchoong, P., Iamlikitkuakoon, S., Jamnoiprom, I. and Mungdee, W. (2007). Effects of drying temperature and residual moisture content of Fa-Tha-Li (*Andrographis paniculata* (Burm.f.) Nees) crude powder for capsule preparation. *Thai Journal of Pharmaceutical Sciences,* 31, 28-35.

Saraswathy, S., Preethi, T. L., Balasubramaniam, S., Suresh, J., Revathy, N. and Natarajan, S. (2008). *Postharvest management of horticaltural crops*. India: Agrobios.

Sareer, O., Ahad, A. and Umar, S. (2012). Prophylactic and lenitive effects of *Andrographis paniculata* against common human ailments: an exhaustive and comprehensive reappraisal. *Journal of Pharmaceutical Research and Opinion,* 2(10), 138-162.

Sarker, S. D. and Nahar, L. (2007). *Chemistry for Pharmacy Students General, Organic and Natural Product Chemistry*. England: John Wiley and Sons.

Sayyari, M., Valero, D., Babalar, M., Kalantari, S., Zapata, P. J. and Serrano, M. (2010). Prestorage oxalic acid treatment maintained visual quality, bioactive com-pounds, and antioxidant potential of pomegranate after long-term storage at 2 ◦C. *Journal of Agricultural and Food Chemistry,* 58, 6804-6808.

Scimeca, J. A. (1995). *Naturally occurring orally active dietary carcinogens: In: Handbook of human toxicology.* : CRC Press.

See, D., Mason, S. and Roshan, R. (2002). Increased tumor necrosis factor alpha (TNF-alpha) and natural killer cell (NK) function using an integrative approach in late stage cancers. *Immunological Investigations,* 31, 137-153.

Semenov, A. M., Kuprianov, A. A. and van Bruggen, A. H. (2010). Transfer of enteric pathogens to successive habitats as part of microbial cycles. *Microbial Ecology,* 60(1), 239-249.

Shalini, V. B. and Narayanan, J. S. (2015). Characterization studies on medicinal plant of *Andrographis paniculata* (NEES). *Journal of Medicinal Plants Studies,* 3(5), 96-102.

Shanker, A. K., Ravichandran, V. and Pathmanabhan, G. (2005). Phytoaccumulation of chromium by some multipurpose-tree seedlings. *Agroforestry Systems,* 64, 83-87.

Sharma, G. P. and Prasad, S. (2001). Drying of garlic (*Allium sativum*) cloves by microwave–hot air combination. *Journal of Food Engineering,* 50, 99-105.

Sharma, M. and Joshi, S. (2011). Comparison of anti-oxidant activity of *Andrographis paniculata* and *Tinospora cordifolia* leaves. *Journal of Current Chemical and Pharmaceutical Sciences,* 1(1), 1-8.

Sharma, M. and Sharma, R. (2013). Identification, purification and quantification of andrographolide from Andrographis paniculata (burm. F.) Nees by

HPTLC at different stages of life cycle of crop. *Journal of Current Chemical and Pharmaceutical Sciences,* 3(1), 23-32.

Sharma, S. N., Sinha, R. K., Sharma, D. K. and Jha, Z. (2009). Assessment of intra-specific variability at morphological, molecular and biochemical level of *Andrographis paniculata* (Kalmegh). *Current Science,* 96(3), 402-408.

Sheeja, K., Guruvayoorappan, C. and Kuttan, G. (2007). Antiangiogenic activity of *Andrographis paniculata* extract and andrographolide. *International Immunopharmacology,* 7, 211-221.

Shen, Y. C., Chen, C. F., and Chiou, W. F. (2002). Andrographolide prevents oxygen radical production by human neutrophils: possible mechanism (s) involved in its anti-inflammatory effect. *British Journal of Pharmacology,* 135(2), 399-406.

Shen, Y. H., Li, R. T., Xiao, W. L., Xu, G., Lin, Z. W., Zhao, Q. S. and Sun, H. D. (2006). ent-Labdane diterpenoids from *Andrographis paniculata Journal of Natural Products,* 69(3), 319-322.

Shi, M. D., Lin, H. H., Lee, Y. C., Chao, J. K., Lin, R. A. and Chen, J. H. (2008). Inhibition of cell-cycle progression in human colorectal carcinoma Lovo cells by andrographolide. *Chemico-Biological Interactions,* 174, 201-210.

Shirisha, K. and Mastan, M. (2013). *Andrographis paniculata* and its bioactive phytochemicals constituent for oxidative damage: a systemic review. *Pharmacophore,* 4(6), 212-229.

Shuib, N. H., Shaari, K., Khatib, A., Maulidiani, Kneer, R., Zareen, S., Raof, S.M., Lajis, N.H. and Neto, V. (2011). Discrimination of young and mature leaves of Melicope ptelefolia using 1H NMR and multivariate data analysis. Food Chemistry, 126(2), 640-645.

Silva, D. I. S. d., Nogueir, G. D. R., Duzzioni, A. G. and Barrozo, M. A. S. (2013). Changes of antioxidant constituents in pineapple (*Ananas comosus*)residue during drying process. *Industrial Crops and Products,* 50, 557- 562.

Singh, R. P., Banerjee, S. and Rao, A. R. (2001). Modulatory influence of *Andrographis paniculata* on mouse hepatic and extrahepatic carcinogen metabolizing enzymes and antioxidant status. *Phytotherapy Research,* 15, 382-390.

Singh, U. and Sagar, V. R. (2010). Quality characteristics of dehydrated leafy vegetables influenced by packaging materials and storage temperature. *Journal of Scientific and Industrial Research,* 69, 785-789.

Singh, V. and Garg, A. N. (2006). Availability of essential trace elements in Indian cereals, vegetables, and spices using INAA and the contribution of spices to daily dietary intake. *Food Chemistry,* 94(1), 81-89.

Sinha, R. K., Herat, S. and Tandon, P. K. (2004). *Book of Environmental Bioremediation Technologies*. Berlin, Germany: Springer.

Škerget, M., Kotnik, P., Hadolin, M., Hraš, A. R., Simonič, M. and Knez, Ž. (2005). Phenols, proanthocyanidins, flavones and flavonols in some plant materials and their antioxidant activities. *Food chemistry,* 89(2), 191-198.

Sledz, M., Nowacka, M., Wiktor, A. and Rajchert, D. W. (2013). Selected chemical and physico-chemical properties ofmicrowave-convective dried herbs. *Food and Bioproducts Processing,* 91, 421-428.

Smith, G. J., Thomsen, S. J., Markham, K. R., Andary, C. and Cardon, D. (2000). The photostabilities of naturally occurring 5-hydroxyflavones, flavonols, their glycosides and their aluminium complexes. *Journal of Photochemistry and Photobiology A: Chemistry,* 136(1), 87-91.

Srisittipokakuna, N., Kirdsiri, K. and Kaewkhao, J. (2012). Solar drying of *Andrographis paniculata* using a parabolic shaped solar tunnel dryer. *Procedia Engineering,* 32, 839 - 846.

Stafford, G. I., Jäger, A. K. and Van Staden, J. (2005). Effect of storage on the chemical composition and biological activity of several popular South African medicinal plants. *Journal of Ethnopharmacology,* 97, 107-115.

Stickel, F., Droz, S., Patsenker, E., Bögli-Stuber, K., Aebi, B. and Leib, S. L. (2009). Severe hepatotoxicity following ingestion of Herbalife® nutritional supplements contaminated with *Bacillus subtilis*. *Journal of Hepatology,* 50, 111-117.

Stevic, T., Pavlovic, S., Stankovic, S. and Savikin, K. (2012). Pathogenic microorganism of medicinal herbal drugs. *Archives of Biological Sciences, Belgrade,* 64(1), 49-58.

Subramanian, R., Asmawi, M. Z. and Sadikun, A. (2012). A bitter plant with a sweet future? A comprehensive review of an oriental medicinal plant: *Andrographis paniculata*. *Phytochemistry Reviews,* 11(1), 39-75.

Suciu, I., Cosma, C., Todica, M., Bolboaca, S. D. and Jantschi, L. (2008). Analysis of soil heavy metal pollution and pattern in Central Transylvania. *International Journal of Molecular Sciences,* 9, 434-453.

Sudhakaran, M. (2012). Botanical pharmacognosy of *Andrographis paniculata* (Burm. F.) Wall. Ex. Nees. *Pharmacognosy Journal,* 4(32), 1-10.

Sule, A., Ahmed, Q. U., Abd. Samah, O., Omar, M. N., M. Hassan, N., M. Kamal, L. Z. and Yarmo, M. A. (2011). Bioassay guided isolation of antibacterial compounds from *Andrographis paniculata*. *The American Journal of Applied Sciences,* 8(6), 525-534.

Sumner, L. W., Mendes, P. and Dixona, R. A. (2003). Plant metabolomics: Large-scale phytochemistry in the functional genomics era. *Phytochemistry,* 67, 817-836.

Sun, L., Zhang, J., Lu, X., Zhang, L. and Zhang, Y. (2011). Evaluation to the antioxidant activity of total flavonoids extract from persimmon (Diospyros kaki L.) leaves. *Food and Chemical Toxicology,* 49(10), 2689-2696.

Tahar, K. and Keltoum, B. (2011). Effects of heavy metals pollution in soil and plant in the industrial area, West Algeria. *Journal of the Korean Chemical Society,* 55(6), 1018-1023.

Talei, D., Valdiani, A., Abdullah, M. P. and Hassan, S. A. (2012). A rapid and effective method for dormancy breakage and germination of king of bitters (*Andrographis paniculata* Nees.) seeds. *Maydica,* 57(2), 98-105.

Tarhan, S., Telci, I., Tuncay, T. and Polatci, H. (2010). Product quality and energy consumption when drying peppermint by rotary drum dryer. *Industrial Crops and Products,* 32, 420-427.

Temple, N. J. (2000). Antioxidants and disease: more questions than answers. *Nutrition Research,* 20, 449-459.

Thaipong, K., Boonprakob, U., Crosby, K., Zevallos, L. C. and Byrne, D. H. (2006). Comparison of ABTS, DPPH, FRAP, and ORAC assays for estimating antioxidant activity from guava fruit extracts. *Journal of Food Composition and Analysis,* 19, 669-675.

Thoo, Y. Y., Ng, S. Y., Khoo, M. Z., Wan Aida, W. M. and Ho, C. W. (2013). A binary solvent extraction system for phenolic antioxidants and its application to the estimation of antioxidant capacity in *Andrographis paniculata* extracts. *International Food Research Journal,* 20(3), 1103-1111.

Tian, Y., Zhao, Y., Huang, J., Zeng, H. and Zheng, B. (2016). Effects of different drying methods on the product quality and volatile compounds of whole shiitake mushrooms. *Food Chemistry,* 197, 714-722.

Ting, A., Chow, Y. and Tan, W. (2013). Microbial and heavy metal contamination in commonly consumed traditional Chinese herbal medicines. *Journal of Traditional Chinese Medicine,* 33(1), 119-124.

Tipakorn, N. (2002). *Effects of Andrographis paniculata (Burm. f.) Nees on performance mortality, and coccidiosis in bloiler chickens.* (Unpublished Doctoral dissertation), GeorgAugust-Universität Göttingen, Germany.

Tournas, V. (2005). Spoilage of vegetable crops by bacteria and fungi and related health hazards. *Critical Reviews in Microbiology,* 31(1), 33-44.

Tripathy, V., Basak, B. B., Varghese, T. S. and Saha, A. (2015). Residues and contaminants in medicinal herbs—A review. *Phytochemistry Letters,* 14, 67-78.

Tsai, Y. H., Kung, H. F., Lee, T. M., Chen, H. C., Chou, S. S., Wei, C. I. and Hwang, D.-F. (2005). Determination of histamine in canned mackerel implicated in a food borne poisoning. *Food Control,* 16, 579-585.

Udomkun, P., Nagle, M., Mahayothee, B., Nohr, D., Koza, A. and Müller, J. (2015). Influence of air drying properties on non-enzymatic browning, major bio-active compounds and antioxidant capacity of osmotically pretreated papaya. *LWT - Food Science and Technology,* 60, 914-922.

Uribe, E., Marín, D., Vega-Gálvez, A., Quispe-Fuentes, I. and Rodríguez, A. (2016). Assessment of vacuum-dried peppermint (*Mentha piperit*a L.) as a source of natural antioxidants. *Food Chemistry 190,* 190, 559-565.

Valdiani, A., Kadir, M., Tan, S., Talei, D., Abdullah, M. and Nikzad, S. (2012). *Andrographis paniculata* present yesterday, absent today: a plenary review on underutilized herb of Iran's pharmaceutical plants. *Molecular Biology Reports,* 39, 5409-5424.

Vallverdú-Queralt, A., Arranz S, Casals-Ribes I, Lamuela-Raventós RM. (2012). Stability of the phenolic and carotenoid profile of gazpachos during storage. *Journal of Agriculture Food Chemistry*, 60(8),1981-1988.

van Breemen, R. B., Fong, H. H. and Farnsworth, N. R. (2007). The role of quality assurance and standardization in the safety of botanical dietary supplements. *Chemical Research in Toxicology,* 20, 577-582.

Vasu, S., Palaniyappan, V. and Badami, S. (2010). A novel microwave assisted extraction for the isolation of andrographolide from *Andrographis paniculata* and its in vitro antioxidant activity. *Natural Product Research,* 24(16), 1560-1567.

Vázquez-Boland, J. A., Kuhn, M., Berche, P., Chakraborty, T., Domínguez-Bernal, G., Goebel, W., González-Zorn, B., Wehland, *J*. and Kreft, J. (2001). *Listeria* pathogenesis and molecular virulence determinants. *Clinical Microbiology Reviews,* 14, 584-640.

Vázquez-Sánchez, D., López-Cabo, M., Saá-Ibusquiza, P. and Rodríguez-Herrera, J. J. (2012). Incidence and characterization of Staphylococcus aureus in fishery products marketed in Galicia (Northwest Spain). *International Journal of Food Microbiology,* 157(2), 286-296.

Vega-Gálvez, A., Lemus-Mondaca, R., Bilbao-Sainz, C., Fito, P. and Andrea, A. (2008). Effect of air drying temperature on the quality of rehydrated dries red bell pepper (var.Lamuyo). *Journal of Food Engineering.,* 85, 42-50.

Vega-Galvez, A., Di Scala, K., Rodríguez, K., Lemus-Mondaca, R., Miranda, M., Lopez, J. and Perez-Won, M. (2009). Effect of air-drying temperature on physic-chemical properties, antioxidant capacity, colour and total phenolic content of red pepper (*Capsicum annuum*, L., Var. Hungarian). *Food Chemistry,* 117, 647-653.

Vekiari, S. A., Oreopoulou, V., Kourkoutas, Y., Kamoun, N., Msallem, M., Psimouli, V. and Arapoglou, D. (2010). Characterization and seasonal variation of the quality of virgin olive oil of the Throumbolia and Koroneiki varieties from Southern Greece. *Grasas Y Aceites,* 61, 221-231.

Verpoorte, R., Choi, Y. H., Mustafa, N. R. and Kim, H. K. (2008). Metabolomics: back to basics. *Phytochemistry Reviews,* 7, 525-537

Viacava, G. E., Gonzalez-Aguilar, G. and Roura, S. I. (2014). Determination of phytochemicals and antioxidant activity in butterhead lettuce related to leaf age and position. *Journal of Food Biochemistry,* 38(3), 352-362.

Vijayakumar, A. D. and Kalaichelvan, P. T. (2012). In-vitro antimicrobial and antioxidant activity screening of *Andrographis paniculata* leaf ethanolic extract in Tamil Nadu. *International Journal of Pharmacy and Pharmaceutical Sciences*, 4(1), 227-229.

Vitullo, M., Ripabelli, G., Fanelli, I., Tamburro, M., Delfine, S. and Sammarco, M. L. (2011). Microbiological and toxicological quality of dried herbs. *Letters in Applied Microbiology,* 52, 573-580.

Vuuren, S. V., Williams, V. L., Sooka, A., Burger, A. and Haar, L. V. d. (2014). Microbial contamination of traditional medicinal plants sold at the Faraday muthi market, Johannesburg, South Africa. *South African Journal of Botany,* 94, 95-100.

Walker, M. (2011). *Aluminium In Imported Noodles*. Middlesex, UK: Crown Retrieved from http://www.gov.uk.

Wang, H. Y., Qian, H. and Yao, W. R. (2011). Melanoidins produced by the Maillard reaction: Structure and biological activity. *Food Chemistry,* 128, 573-584.

Wang, S. W., Chen, J., Jia, X., Tam, V. H. and Hu, M. (2006). Disposition of flavonoids via enteric recycling: structural effects and lack of correlations between in vitro and in situ metabolic properties. *Drug Metabolism and Disposition,* 34, 1837-1848.

Wang, X., Sun, H., Zhang, A., Sun, W., Wang, P. and Wang, Z. (2011). Potential role of metabolomics apporoaches in the area of traditional Chinese medicine: As pillars of the bridge between Chinese and Western medicine. *Journal of Pharmaceutical and Biomedical Analysis,* 55, 859-868.

Warriner, K. and Namvar, A. (2009). Why is the hysteria with *Listeria*? *Trends in Food Science and Technology,* 20, 245-254.

Wasman, S. Q., Mahmood, A. A., Chua, L. S., Alshawsh, M. A. and Hamdan, S. (2011). Antioxidant and gastroprotective activities of *Andrographis paniculata* (Hempedu Bumi) in Sprague Dawley rats. *Indian Journal of Experimental Biology,* 49, 767-772.

Weissinger, W. R., McWatters, K. H. and Beuchat, L. R. (2001). Evaluation of volatile chemical treatments for lethality to *Salmonella* on alfalfa seeds and sprouts. *Journal of Food Protection,* 64(4), 442-450.

WHO. (2005). *Quality control methods for medicinal plant materials*. Geneva, Switzerland: WHO Press.

WHO. (2007). *World Health Organization guidelines for assessing quality of herbal medicines with reference to contaminants and residues*. Geneva, Switzerland: WHO Press.

Wiart, C., Kumar, K., Yusof, M. Y., Hamimah, H., Fauzi, Z. M. and Sulaiman, M. (2005). Antiviral properties of ent-labdene diterpenes of *Andrographis paniculata* nees, inhibitors of herpes simplex virus type 1. *Phytotherapy Research,* 19(12), 1069-1070.

Witkowska, A. M., Hickey, D. K., Gomez, M. A. and Wilkinson, G. M. (2011). The microbiological quality of commercial herb and spice preparations used in the formulation of a chicken supreme ready meal and microbial survival following a simulated industrial heating process. *Food Control,* 22, 616-625.

Witrowa-Rajchert, D., Hankus, M. and Pawlak, E. (2009). Effect of drying method on chlorophyll content and colour of oregano and basil. *Inżynieria i Aparatura Chemiczna,* 1, 70-71.

Wojdyło, A., Figiel, A. and Oszmiański, J. (2009). Effect of drying methods with the application of vacuum microwaves on the bioactive compounds, color, and antioxidant activity of strawberry fruits. *Journal of Agricultural and Food Chemistry,* 57(4), 1337-1343.

Wojdyło, A., Figiel, A., Legua, P., Lech, K., Carbonell-Barrachina, Á. A. and Hernández, F. (2016). Chemical composition, antioxidant capacity, and sensory quality of dried jujube fruits as affected by cultivar and drying method. *Food Chemistry,* 207, 170-179.

Wolfgang, K., Erich, C. and Brigitte, K. (2002). Microbial contamination of medicinal plants-A review. *Planta Medica,* 68, 5-15.

Xiao, C., Dai, H., Liu, H., Wang, Y. and Tang, H. (2008). Revealing the metabonomic variation of rosemary extracts using ^{1}H-NMR spectroscopy and multivariate data analysis. *Journal of Agricultural and Food Chemistry,* 56, 10142-10153.

Xu, C., Chou, G. X., Wang, C. H. and Wang, Z. T. (2012). Rare noriridoids from the roots of *Andrographis paniculata*. *Phytochemistry Reviews,* 77, 275-279.

Xu, C., Chou, G. X. and Wang, Z. T. (2010). A new diterpene from the leaves of *Andrographis paniculata* Nees. *Fitoterapia,* 81(6), 610-613.

Xu, H. X., Wan, M., Loh, B. N., Kon, O. L., Chow, P. W. and Sim, K. Y. (1996). Screening of traditional medicines for their inhibitory activity against HIV-1 protease. *Phytotherapy Research,* 10(3), 207-210.

Yang, J., He, X. and Zhao, D. (2013). Factor affecting phytochemical stability. In B. K. Tiwari, N. P. Brunton, and C. S. Brennan (Eds.), *Handbook of plant food phytochemicals: sources, stability and extraction*. Iowa, USA: Wiley-Blackwell, John Wiley & Son.

Yang, L., Wu, D., Luo, K., Wu, S. and Wu, P. (2009). Andrographolide enhances 5-fluorouracil-induced apoptosis via caspase-8-dependent mitochondrial pathway involving p53 participation in hepatocellular carcinoma (SMMC-7721) cells. *Cancer Letters,* 276, 180-188.

Yang, M., Wang, J. and Kong, L. (2012). Quantitative analysis of four major diterpenoids in *Andrographis paniculata* by ^{1}H NMR and its application for quality control of commercial preparations. *Journal of Pharmaceutical and Biomedical Analysis,* 70, 87-93.

Yang, T., Shi, H. X., Wang, Z. T. and Wang, C. H. (2013). Hypolipidemic effects of andrographolide and neoandrographolide in mice and rats. *Phytotherapy Research,* 27(4), 618-623.

Yang, Z., Xu, Y., Jie, G., He, P. and Tu, Y. (2007). Study on the antioxidant activity of tea flowers (*Camellia sinensis*). *Asia Pacific Journal of Clinical Nutrition,* 16, 148-152.

Yilmaz, Y. and Toledo, R. (2005). Antioxidant activity of water-soluble Maillard reaction products. *Food Chemistry,* 93, 273-278.

You, Y., Rankin, S. C., Aceto, H. W., Benson, C. E., Toth, J. D. and Dou, Z. (2006). Survival of *Salmonella enterica* serovar Newport in manure and manure-amended soils. *Applied and Environmental Microbiology,* 72, 5777-5783.

Youssef, K. M. and Mokhtar, S. M. (2014). Effect of drying methods on the antioxidant capacity, color and phytochemicals of *Portulaca oleracea* L. leaves. *Journal of Nutritonal Food Science,* 4, 1-6.

Yuan, J., Hao, L. J., Wu, G., Wang, S., Duan, J. A., Xie, G. Y. and Qin, M. J. (2015). Effects of drying methods on the phytochemicals contents and antioxidant properties of chrysanthemum flower heads harvested at two developmental stages. *Journal of Functional Foods,* 19, 786-795.

Zagory, D. (1999). Effects of post-processing handling and packaging on microbial populations. *Postharvest biology and Technology,* 14, 313-321.

Zain, M. E. (2011). Impact of mycotoxins on humans and animals. *Journal of Saudi Chemical Society,* 15, 129-144.

Zakipour, E. and Hamidi, Z. (2011). Vacuum drying characteristics of some vegetables. *Iranian Journal of Chemistry and Chemical Engineering,* 30, 4.

Zeng, Z., Chau, F. T., Chan, H. Y., Cheung, C. Y., Lau, T. Y., Wei, S. and Liang, Y. (2008). Recent advances in the compound-oriented and pattern-oriented approaches to the quality control of herbal medicines. *Chinese Medicine,* 3(9).

Zimbro, M. J. and Power, D. A. (2003). Difco™ and BBL™ Manual: Manual of microbiology culture media. Becton, Dickinson and Company: Maryland, USA.

Zhang, J., Wider, B., Shang, H., Li, X. and Ernst, E. (2012). Quality of herbal medicines: challenges and solutions. *Complimentary Therapies in Medicine,* 20, 100-106.

Zhang, M., Tang, J., Mujumdar, A. S. and Wang, S. (2006). Trends in microwave-related drying of fruits and vegetables. *Trends in Food Science and Technology,* 17(10), 524-534.

Zhao, F., He, E. Q., Wang, L. and Liu, K. (2008). Anti-tumor activities of andrographolide, a diterpene from *Andrographis paniculata*, by inducing apoptosis and inhibiting VEGF level. *Journal of Asian Natural Product Reseach,*10, 467-473.

Zhou, H. Y. and Liu, C. Z. (2006). Microwave-assisted extraction of solanesol from tobacco leaves. *Journal of Chromatography A,* 1129, 135-139.

Zheng, N., Wang, Q., Zhang, X., Zheng, D., Zhang, Z. and Zhang, S. (2007). Population health risk due to dietary intake of heavy metals in the industrial area of Huludao city, China. *Science of the Total Environment,* 387, 96-104.

Zhishen, J., Mengcheng, T. and Jianming, W. (1999). The determination of flavonoid contents in mulberry and their scavenging effects on superoxide radicals. *Food Chemistry,* 64, 555−559.