UNIVERSITI PUTRA MALAYSIA

ANTISTAPHYLOCOCCAL AND ANTIBIOFILM ACTIVITIES OF ETHANOLIC EXTRACT OF Piper cubeba L.

SELVI VELU

FSTM 2018 26

ANTISTAPHYLOCOCCAL AND ANTIBIOFILM ACTIVITIES OF ETHANOLIC EXTRACT OF *Piper cubeba* L.

By

SELVI VELU

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

April 2018

COPYRIGHT

DEDICATION

This thesis is dedicated to my beloved family, supervisors and friends

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

ANTISTAPHYLOCOCCAL AND ANTIBIOFILM ACTIVITIES OF ETHANOLIC EXTRACT OF *Piper cubeba* L.

By

SELVI VELU

April 2018

Chairman: Yaya Rukayadi, PhD
Faculty: Food Science and Technology

Staphylococcus aureus is a very adaptable foodborne pathogen responsible for food outbreaks and a source of cross contamination in fresh and processed foods worldwide. Methicillin-resistant *S. aureus* (MRSA) strains which were initially addressed in humans is being marked as emerging community acquired pathogen in recent years. The resistance of staphylococci towards various novel and existing antimicrobial agents has developed as a problem. Noticeably, the significance of medicinal plants and traditional health practices has gained increasing attentions principally in solving the impact of emergence, spread and resistance of microorganisms of the world. Simultaneously, there is a concern in the field of food safety, quality and preservation to counter the rising of resistant pathogens and the limitation of synthetic chemical additives in the food system. Among the plants investigated to date, one showing enormous potential is the pepper family otherwise known as Piperaceae. *Piper cubeba* L. has infinite medicinal properties and practiced to treat a number of diseases. In this study, the *Piper cubeba* L. extract was examined for its antistaphylococcal and antibiofilm activity against *Staphylococcus aureus* food isolates, *S. aureus* human isolates and a reference strain *S. aureus* ATCC6538P. *P. cubeba* L. berries were extracted using ethanol, methanol and water as solvent. The antimicrobial activity of ethanol, methanol and water extracts of *P. cubeba* L. against *S. aureus* isolates in terms of disc diffusion was performed. Further, minimum inhibitory concentration (MIC), minimum bactericidal concentration (MBC) and time kill curve were performed using ethanol extract referring to standard method of Clinical and Laboratory Standards Institute (CLSI). The ethanolic *P. cubeba* L. extract was assessed for its stability at various temperature and pH conditions relevant to food production and storage. Scanning electron microscopy (SEM) was used to visualize the effect of ethanolic *P. cubeba* L. extract on representative *S. aureus*. The bioactive compounds present in ethanolic *P. cubeba* L. extract were determined using Gas Chromatography-Mass Spectrometry (GC-MS) and Liquid Chromatography-Mass Spectrometry (LC-MS). Biofilm forming patterns of *S. aureus* isolates and antibiofilm activity of ethanolic *P. cubeba* L. extract were performed in presterilized flat-bottom 96-well microplate and were quantified using

2,3-bis (2-methoxy-4-nitro-5-sulfophenyl)-5-[(phenyl-amino) carbonyl]-2H tetrazolium-hydroxide (XTT) reduction assay. The effect of ethanolic *P. cubeba* L. extract was assessed on cut-up parts of chicken (breast, wing and drumstick) as natural sanitizer. Visual attribute sensory acceptability was evaluated on raw and steamed chicken meat treated with ethanolic *P. cubeba* L. extract. Toxicity effect of the extract was evaluated using the brine shrimp lethality assay. The results showed that ethanol and methanol *P. cubeba* L. extract exhibited significant diameter of inhibition zone in the range of 7.23 – 8.50 mm and 7.13 – 8.57 mm respectively, against *S. aureus* isolates. MIC and MBC of ethanolic extract were in the range of 0.625 – 2.5 mg/ml and 1.25 – 5 mg/ml against all tested isolates, respectively. The time-kill curve plots revealed *S. aureus* food isolates CM10 and CM14 were killed within 1 h of incubation at a concentration of 4× MIC. As for *S. aureus* human isolate and ATCC6538P the time-kill curve plot revealed bacteriostatic effect of the *P. cubeba* L. extract. Trends of increasing, decreasing and constant MIC and MBC values were observed upon heat treated ethanolic *P. cubeba* L. extract as compared to non-heat treated extract. Generally, the pH altered extracts varied the MIC and MBC values of the *S. aureus* isolates. Under SEM observation, the treated cells underwent a significant transition from initially smooth surfaces cells to completely distort and shrank cells. The major volatile bioactive compounds determined using GC-MS were β-cubebene, cubebol, α-copaene, α-cubebene, caryophyllene and germacrene-D. Non- volatile compounds identified by LC-MS were 5,7-dihydroxy-3',4'-dimethoxy-6,8-dimethylflavone, brosimacutin B, phellodensin D, 9E,12Z,15Z-octadecatrienoic acid, 2,4-dimethyl-tetradecanoic acid, eriodictyol 7,3'-dimethyl ether 4'-prenyl ether, erioflorin methacrylate, 12-oxo-5E,8E,10Z-dodecatrienoic acid and (S)-β-himachalene. *S. aureus* isolates exhibited strong adherent ability at 37°C and 28°C while weak and non-adherent capability mostly observed at 7°C. The biofilm formation of *S. aurues* can be inhibited by sessile minimal inhibitory concentration (SMIC) of 6.25 – 25 mg/ml and the formed *S. aurues* biofilm can be eradicated by minimal biofilm eradication concentration (MBEC) values of 25 – 50 mg/ml. In general, reduction 3 Log_{10} of *S. aureus,* total plate count, *E. coli* and coliform was started to observe at ethanolic *P. cubeba* L. extract of 0.50% on the cut-up parts of chicken. *P. cubeba* L. sanitized raw and steamed chicken meat at 0.05%, 0.50% and 5.00% was accepted by the panelists. Brine shrimp lethality test exhibited no significant toxicity (LC_{50} = 6.98 mg/ml) against brine shrimp naupili. In conclusion, ethanolic *P. cubeba* L. extract with potential antimicrobial and antibiofilm activities could be prominently marked as a valuable natural antimicrobial, antibiofilm, and sanitizing agent in the food safety field.

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

AKTIVITI ANTISTAPHYLOCOCCAL DAN ANTIBIOFILM EKSTRAK ETANOL *Piper cubeba* L.

Oleh

SELVI VELU

April 2018

Pengerusi: Yaya Rukayadi, PhD
Fakulti: Sains dan Teknologi Makanan

Staphylococcus aureus adalah patogen yang dapat disesuaikan dengan makanan dan menyebabkan wabak makanan. Ia menjadi sumber pencemaran dalam makanan segar dan diproses di seluruh dunia. Strain methicillin resistant *S. aureus* (MRSA) yang pada mulanya ditangani pada manusia ditandai sebagai pathogen dikaitkan dengan komuniti pada tahun-tahun kebelakangan ini. Rintangan staphylococci terhadap pelbagai novel dan agen antimikrob sedia ada telah berkembang sebagai masalah. Ketahuilah, pentingnya tumbuhan ubatan dan amalan kesihatan tradisional telah mendapat perhatian yang lebih banyak terutamanya dalam menyelesaikan kesan kemunculan, penyebaran dan penentangan mikroorganisma dunia. Pada masa yang sama, terdapat keprihatinan dalam bidang keselamatan makanan, kualiti dan pemeliharaan untuk mengatasi peningkatan patogen yang tahan dan batasan bahan kimia sintetik dalam sistem makanan. Antara tanaman yang disiasat setakat ini, yang menunjukkan potensi yang besar adalah keluarga lada yang dikenali sebagai Piperaceae. Piper cubeba L. mempunyai sifat perubatan yang tidak terhingga dan diamalkan untuk merawat sejumlah penyakit. Dalam kajian ini, ekstrak *P. cubeba* L. telah diperiksa untuk aktiviti antimikrob dan antibiofilmnya terhadap *Staphylococcus aureus* isolate makanan, *S. aureus* isolate manusia dan *S. aureus* ATCC6538P. Biji *P. cubeba* L. telah diekstrak menggunakan etanol, metanol dan air. Aktiviti antimikrob *P. cubeba* L. terhadap *S. aureus* dari segi cakera penyebaran telah dibuat menggunakan ekstrak etanol, metanol dan air. Kepekatan perencatan minimum (MIC), kepekatan pembunuhan bakteria (MBC) dan lengkungan masa-pembunuhan ekstrak telah dilakukan menggunakan ekstrak etanol merujuk kepada kaedah yang dinyatakan dalam Clinical and Laboratory Standards Institute (CLSI). Kestabilan ekstrak etanol *P. cubeba* L. telah dinilai pada pelbagai suhu dan keadaan pH. Mikroskop electron pengimbas (SEM) telah digunakan untuk menggambarkan kesan ekstrak etanol *P. cubeba* L. pada *S. aureus* yang terpilih. Sebatian bioaktif yang terdapat di dalam ekstrak etanol *P. cubeba* L. telah ditentukan menggunakan Gas

Chromatography-Mass Spectrometry (GC-MS) dan Liquid Chromatography-Mass Spectrometry (LC-MS). Corak pembentukan biofilm *S. aureus* dan aktiviti antibiofilm ekstrak etanol *P. cubeba* L. telah dilakukan dalam pra-disterilkan 96-microplate dan diukur menggunakan 2,3-Bis (2-methoxy-4-nitro-5-sulfophenyl)-5-[(phenyl-amino) karbonil]-2H-tetrazolium-hidroksida (XTT) assay. Kesan ekstrak etanol *P. cubeba* L. dinilai pada bahagian potongan ayam (dada, sayap dan drumstick) sebagai agent sanitizer semulajadi. Kesesuaian deria dinilai pada daging ayam mentah dan kukus yang telah dirawat dengan ekstrak etanol *P. cubeba* L. Ketoksikan ekstrak etanol *P. cubeba* L. telah dinilai menggunakan ujian kematian udang naupili air garam. Keputusan menunjukkan bahawa ekstrak etanol dan metanol *P. cubeba* L. telah menunjukkan diameter zon perencatan (DIZ) ketara dalam lingkungan 7.23 – 8.50 mm dan 7.13 – 8.57 mm masing- masing terhadap isolate *S. aureus*. Nilai MIC dan MBC ekstrak telah didapati dalam lingkungan 0.625 - 2.5 mg/ml dan 1.25 - 5 mg/ml, masing-masing. Plot masa-pembunuhan telah menunjukkan bahawa *S. aureus* isolate makanan CM10 dan CM14 dapat dibunuh pada masa 1 jam pada kepekatan 4× MIC. Ekstrak *P. cubeba* L. telah menujukkan aktiviti bacteriostatik pada plot masa-pembunuhan *S. aureus* isolate manusia dan ATCC6538P. Tren nilai MIC dan MBC yang meningkat, berkurang dan berkekalan diperhatikan pada ekstrak etanol *P. cubeba* L. yang telah dirawat haba berbanding dengan ekstrak yang tidak dirawat haba. Secara amnya, nilai MIC dan MBC yang berbeza didapati pada ekstrak yang telah berubah nilai pH. Daripada pemerhatian menggunakan SEM, sel-sel yang telah dirawat menjalani peralihan yang ketara dengan keadaan permukaan sel-sel yang terganggu dan merosot. β-cubebene, cubebol, α-copaene, α-cubebene, caryophyllene and germacrene-D adalah sebatian bioaktif yang telah ditentukan menggunakan GC-MS. 5,7-dihydroxy-3',4'-dimethoxy-6,8-dimethylflavone, brosimacutin B, phellodensin D, 9E,12Z,15Z-octadecatrienoic acid, 2,4-dimethyl-tetradecanoic acid, eriodictyol 7,3'-dimethyl ether 4'-prenyl ether, erioflorin methacrylate dan 12-oxo-5E,8E,10Z-dodecatrienoic acid adalah sebatian bioaktif yang telah ditentukan menggunakan LC-MS. Isolate *S. aurues* menunjukkan keupayaan berpengaruh yang tinggi pada suhu 37°C dan 28°C manakala keupayaan lemah dan tidak berpengaruh kebanyakannya diperhatikan pada suhu 7°C. Pembentukan biofilm dapat direncat pada nilai sessile kepekatan perencat minimal (SMIC) pada lingkungan 6.25 – 25 mg/ml dan kepekatan pembasmian biofilm minimal (MBEC) yang telah didapati adalah pada lingkungan 25 – 50 mg/ml. Secara amnya, pengurangan 3 Log_{10} *S. aureus*, jumlah bacteria, *E. coli* dan koliform mula diperhatikan pada ekstrak etanol *P. cubeba* L. 0.50% pada bahagian potongan ayam. Daging ayam mentah dan kukus yang telah disanitize dengan ekstrak etanol *P. cubeba* L. pada kepekatan 0.05%, 0.50% dan 5.00% telah diterima oleh panelis. Ekstrak etanol *P. cubeba* L. didapati tidak menunjukkan ketoksikan yang ketara (LC_{50} = 6.98 mg/ml) terhadap udang naupili air garam. Sebagai kesimpulan, ekstrak etanol *P. cubeba* L. dengan potensi antimikrob dan aktiviti antibiofilm boleh dianggap sebagai agen antimikrob, antibiofilm, dan agen sanitizer semulajadi dalam bidang keselamatan makanan.

ACKNOWLEDGEMENTS

In the name of ultimate God, most Gracious, most Merciful. All praise and gratitude be to God for His blessing and love that allow me to complete this piece of work.

First and foremost, I would like to extend my deepest gratitude to my supervisor, Assoc. Prof. Dr. Yaya Rukayadi for all his invaluable guidance and encouragement throughout my study and through the time I share. Thank you very much for his motivation, encouragement, patience and being so supportive. It has been a great pleasure to conduct research under his supervision. I would like to extend my sincere gratitude to my co-supervisors, Dr. Nor Khaizura Mahmud @ Ab Rashid and Assoc. Prof. Dr. Faridah Abbas for sharing their knowledge, experience, support and motivation.

My heartfelt thank goes to my beloved parents. To my beloved mom Salammah Sinniah, thank you so much for your unconditional love, support and understanding. I will never have moved this far in my life without your blessing and endless love. To my late dad Velu Munusamy, thank you very much for all your invaluable advice and teaching when you were around. To my sisters and my brothers, in laws, niece and nephews bunches of thanks for supporting and accompanying me throughout the hard times.

My special love and gratitude goes to my husband Kannen Ayakannu, for his courage. He has been kind of a positive force that kept me keep going till the very last seconds. I would never forget his unconditional love, encouragement, motivation, advice and support.

My warm thanks to all my dearest research mates in the Laboratory of Food Safety and Quality II and other friends in the faculty. I also extend my sincere thanks to all staff of Faculty of Food Science and Technology and Institute of Bioscience for whatever helps during my study.

I would like to acknowledge research grant FRGS, Project No: 02-02-14-1569FR and also the Ministry of Science, Technology and Innovation (MOSTI) of Malaysia for the financial support, MyBrain 15.

Last but not least, a special appreciation and gratitude to someone else whose name is not mentioned here for their invaluable help and encouragement making this piece of work feasible.

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:

Yaya Rukayadi, PhD
Associate Professor
Faculty of Food Science and Technology
Universiti Putra Malaysia
(Chairman)

Nor Khaizura Mahmud @ Ab Rashid, PhD
Faculty of Food Science and Technology
Universiti Putra Malaysia
(Member)

Faridah Abbas, PhD
Associate Professor
Faculty of Food Science and Technology
Universiti Putra Malaysia
(Member)

ROBIAH BINTI YUNUS, PHD
Professor and Dean
School of Graduate Studies
Universiti Putra Malaysia

Date:

Declaration by Members of Supervisory Committee

This is to confirm that:

- The research conducted and the writing of this thesis was under our supervision;
- Supervisions 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: Assoc. Prof. Dr. Yaya Rukayadi

Signature: _____
Name of Member of
Supervisory Committee: Dr. Nor-Khaizura Mahmud @ Ab Rashid

Signature: _____
Name of Member of
Supervisory Committee: Assoc. Prof. Dr. Faridah Abbas

TABLES OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

ATCC	American Type Culture Collection
CDC	Centers for Disease Control and Prevention
CHX	Chlorhexidine
Cfu	Colony forming unit
CLSI	Clinical and Laboratory Standards Institute
ddH_2O	Deionized distilled water
DIZ	Diameter of inhibition zone
DMSO	Dimethyl sulfoxide
EPS	Extracellular polymeric substances
G	Gram
GC-MS	Gas Chromatography - Mass Spectrometry
GRAS	Generally Regarded as Safe
H	Hour
HPLC	High Performance Liquid Chromatography
IBS	Institute of Bioscience
Lf	Lactoferrin
LC50	Median Lethality Concentration
LC-MS	Liquid Chromatography - Mass Spectroscopy
MHA	Mueller Hinton agar
MHB	Mueller Hinton broth
MBC	Minimum Bactericidal Concentration
MBEC	Minimum Biofilm Eradication Concentration
MIC	Minimum Inhibitory Concentration
Min	Minute
Ml	Milliliter
µl	Microliter
MRSA	Methicillin resistant *Staphylococcus aureus*

Nacl	Sodium chloride
OD	Optical density
PBS	Phosphate buffered saline
SEM	Scanning Electron Microscopy
SMIC	Sessile Minimum Inhibitory Concentration
spp.	Species
TPC	Total plate count
TSA	Tryptic soy agar
UV	Ultraviolet
UPM	Universiti Putra Malaysia
WHO	World health organization

CHAPTER 1

INTRODUCTION

1.1 Background

Worldwide, there is awareness about the consequences of emerging, spread and resistance of microorganisms. Likewise, there happens to be about 30% rise yearly on people suffering from foodborne diseases significantly in industrialized countries (WHO, 2016). A survey has revealed that about 60% of the foodborne infections are related to microbial transfer from the food processing equipment's to foods that are being processed and vice versa. Disgracefully, people acquired with infections due to food contamination with foodborne pathogens are most likely leads to death (Bridier *et al.,* 2014).The consequences include increased rate of foodborne diseases in several countries, tremendous economic losses due to food spoilage, rising cost of treatment and occurrence of treatment failure.

The significance of medicinal plants and traditional health practices has gained increasing attentions principally in solving the health care problems of the world. Extensively, traditional practices have been linked to history of human interfaces with the environment (Sasidharan *et al.,* 2011). Moreover, in recent years, adversative toxicological reports on many synthetic compounds have led to an enormous request for natural antioxidants/ preservatives. Thus, most of the recent discoveries has been focused towards natural sources, particularly of plant origin (Shah *et al.,* 2014).

Interestingly, nature has been an utmost continuous source of medicinal plants that harbor infinite resources of bioactive compounds. About 80% of world requirements of medicines for health requirements are obtained from botanical preparations in the form of plant extracts or their bioactive components. World Health Organization (WHO, 2005) has outlined medicinal plants as plants/ part of plants that possess compounds/ components that reveal therapeutic properties or those that synthesize metabolites that can be converted into useful drugs and antimicrobial agents. The wide ranges of pure compounds or standardized extracts were being utilized widely for the treatment of infectious as well as chronic diseases. Remarkably, these phytochemicals are being well defined as safe with less adverse effects (Sasidharan *et al.,* 2011). Indeed, the research on alternative antimicrobials is more crucial than ever (Salaheen *et al.,* 2014).

Pepper family otherwise known as Piperaceae is one that exhibits enormous potential among those medicinal plants researched to date. *Piper cubeba* L. belonging to Piperaceae family known as cubeb or tailed pepper. It has been commonly incorporated in food preparations and into food to boost flavor and impart piquancy/ spiciness despite being well known as a spice. It has infinite medicinal properties and

practiced to treat a number of diseases. Therefore, *P. cubeba* L. extract could be identified as an infinite novel natural antimicrobial/ antibiofilm agent in inhibiting human pathogen/ foodborne pathogen, *S. aureus*.

1.2 Problem Statements

Pathogens perseverance in the food chain is majorly due to the bacterial contamination on the food contact surfaces. *Staphylococcus aureus* is a very adaptable foodborne pathogen that has been recurrently related to food processing environments especially on poultry and meat industries and mostly associated with slaughtering process in the food processing facilities. Remarkably, it is concerned as a source of cross contamination and reveals behavior of biofilms production in the food production and processing conditions (Schneid *et al.*, 2016). Moreover, persistence of *S. aureus* has been associated with hospital environments inclusive issues on biofilm formations (Mari *et al.*, 2007). Noticeably, in current years, the resistance of staphylococci towards various novel and existing antimicrobial agents has developed as a problem.

Methicillin-resistant *S. aureus* (MRSA) strains were initially addressed in humans in the year of 1960s. However, in recent years MRSA is being classified as emerging community acquired pathogen. Those strains associated in hospital environments and farms are now commonly found in foods such as poultry, dairy products, milk, meat and fish products which prompted awareness among researchers. Moreover, these MRSA has been reported for its occurences in meat producing animals (Gutierrez *et al.*, 2012; Doulgeraki *et al.*, 2016; Oniciuc *et al.*, 2017).

Simultaneously, there is a concern and consumer awareness in the scope of food safety, quality and conservation to counter the limitation of synthetic chemical additives in the food system. Consumer preference on natural preservatives found to be in a firm rising trend. Substantial source of valuable bioactive constituents are persistently obtained from plants. Consequently, wide range of plant products been assessed for natural antioxidants to preserve and advance the overall quality of food products especially meat and meat products (Shah *et al.*, 2014). *P. cubeba* L. was commonly known as condiment. It was widely accepted in food preparations as a flavour enhancer and to impart piquancy/ spiciness. *P. cubeba* L. extract consisting of prominent antimicrobial activities could lead it to be a natural preservative in the food system. Therefore, in this study, antistaphylococcal and antibiofilm activites of ethanolic *P. cubeba* L. extract was studied in addition to its application in chicken meat.

1.3 Objectives

The general objective of this study is to evaluate the antistaphylococcal and antibiofilm activities of *Piper cubeba* L. extract. The specific objectives of this study are:

1. To determine the antistaphylococcal activity of *P. cubeba* L. extract and to identify the bioactive compounds present in ethanolic *P. cubeba* L. extract.
2. To assess *in vitro* biofilm formation of *S. aureus* isolates and to evaluate the antibiofilm activity of ethanolic *P. cubeba* L. extract.
3. To analyse the effect of ethanolic *P. cubeba* L. extract on microflora in chicken meat, the sensory acceptability of ethanolic *P. cubeba* L. extract sanitized raw and steamed chicken meat and to determine the toxicity effect of ethanolic *P. cubeba* L. extract on eukaryotic cells.

BIBLIOGRAPHY

Ababouch, L., Afilal, M. E., Rhafiri, S. & Busta, F. F. (1991). Identification of histamine-producing bacteria isolated from sardine (*Sardina pilchardus*) stored in ice and at ambient temperature (25°C). *Food Microbiology*, 8(2): 127–136.

Ait-Ouazzou, A., Loran, S., Arakrak, A., Laglaoui, A., Rota, C., Herrera, A., Pagan, R. & Conchello, P. (2012). Evaluation of the chemical composition and antimicrobial activity of *Mentha pulegium*, *Juniperus phoenicea*, and *Cyperus longus* essential oils from Morocco. *Food Research International,* 45(1): 313-319.

Abayomi Olalere, O., Abdurahman, N. H. & Alara, O. R. (2017). Extraction, radical scavenging activities and physicochemical fingerprints of black pepper (*Piper nigrum*) extract. *Journal of Food Measurement and Characterization*, 11(4): 2195-2201.

Aboaba, O. O., Smith, S. I. & Olude, F. O. (2006). Antibacterial effect of edible plant extract on *Escherichia coli* 0157: H7. *Pakistan Journal of Nutrition*, 5(4): 325–327.

Adams, M. (2009). *Staphylococcus aureus* and other pathogenic Gram-positive cocci. Foodborne pathogens: Hazards, risk analysis and control. *Food Science, Technology and Nutrition*, 2009: 802-819.

Adetunji, V. O. & Isola, T. O. (2011). Crystal violet binding assay for assessment of biofilm formation by *Listeria monocytogenes* and *Listeria* spp. on wood, steel and glass surfaces. *Global Veterinaria*, 6(1): 6–10.

Agarwal, R.K., Singh, S., Bhilegaonkar, K.N. & Singh, V. P. 1. (2011). Optimization of microtitre plate assay for the testing of biofilm formation ability in different Salmonella serotypes. *International Food Research Journal*, 18(4): 1493–1498.

Al-Habib, A., Al-Saleh, E., Majeed Safer, A. & Afzal, M. (2010). Bactericidal effect of grape seed extract on methicillin-resistant *Staphylococcus aureus* (MRSA). *The Journal of Toxicological Sciences*, 35(3): 357-364.

Al-Harrasi, A., & Al-Saidi, S. (2008). Phytochemical analysis of the essential oil from botanically certified oleogum resin of *Boswellia sacra* (Omani Luban). *Molecules,* 13(9), 2181-2189.

Allende, A., Selma, M. V., Lopez-Galvez, F., Villaescusa, R., & Gil, M. I. (2008). Role of commercial sanitizers and washing systems on epiphytic microorganisms and sensory quality of fresh-cut escarole and lettuce. *Postharvest Biology and Technology*, 49(1): 155-163.

Alsaid, M., Al-mofleh, I., Raish, M., Al-sobaihani, M., Al-yahya, M. & Rafatullah, S. (2013). Antiulcerogenic , Anti-secretory and cytoprotective effects of *Piper cubeba* (L.) on experimental ulcer models in rat. *International Journal of Biotechnology for Wellness Industries*, 2(4): 173–181.

AlSaid, M., Mothana, R., Raish, M., Al-Sohaibani, M., Al-Yahya, M., Ahmad, A., Al-Dosari, M. & Rafatullah, S. (2015). Evaluation of the effectiveness of *Piper*

cubeba extract in the amelioration of CCl_4-induced liver injuries and oxidative damage in the rodent model. *BioMed Research International*. Retrieved from https://www.hindawi.com/journals/bmri/2015/359358/.

Al-tememy, T. M. K. (2013). Extracts against selected bacterial pathogens in Basrah city. *Basrah Journal of Veterinary Research*, 12(1): 142–151.

Amrita, V., Sonal, D. & Shalini, R. (2009). Antibacterial effect of herbs and spices eextract on *Escherichia coli*. *Electronic Journal of Biology*, 5(2), 40–44.

Aneja, K. R., Joshi, R., Sharma, C. & Aneja, A. (2010). Antimicrobial efficacy of fruit extracts of two *Piper* species against selected bacterial and oral fungal pathogens. *Brazilian Journal of Oral Sciences*, *9*(4): 421–426.

Argudín, M. A., Mendoza, M. C. & Rodicio, M. R. (2010). Food poisoning and *Staphylococcus aureus* enterotoxins. *Toxins*, 2: 1751–1773.

Asuquo, E. G. & Udobi, C. E. (2016). Antibacterial and toxicity studies of the ethanol extract of *Musa paradisiaca* leaf. *Microbiology, Parasitology & Virology*, 1–10.

Ayyad W. AL Shahwany,, Heba K. & Tawfeeq, S. E. H. (2016). Antibacterial and anti-biofilm activity of three phenolic plant extracts and silver nanoparticles on *Staphylococcus aureus* and *Klebsiella pneumoniae*. *Biomedicine and Biotechnology*, 4(1): 12-18.

Bachmann, S. P., Vandewalle, K., Ramage, G., Patterson, T. F., Wickes, B. L., Graybill, J. R. & Lo, L. (2002). *In vitro* activity of caspofungin against *Candida albicans* biofilms. A*ntimicrobial Agents and Chemotherapy*, 46(11): 3591–3596.

Baird-Parker, A. C. (1958). Section I . An analysis of the *Staphylococcus*: Inherent properties of the organism. *Annals New York Academy of Sciences*, (1920): 4–25.

Baird-Parker, A. C. (1962). An improved diagnostic and selective medium for isolating coagulase positive staphylococci. *Journal of Applied Microbiology*, 25(1): 12-19.

Bazaka, K., Jacob, M. V., Chrzanowski, W. & Ostrikov, K. (2015). Anti-bacterial surfaces: natural agents, mechanisms of action, and plasma surface modification. *Royal Society of Chemistry*, 5: 48739-48759.

Belguith, H., Kthiri, F., Ben Ammar, a, Jaafoura, H., Ben Hamida, J. & Landoulsi, A. (2009). Morphological and biochemical changes of *Salmonella hadar* exposed to aqueous garlic extract. *International Journal of Morphology*, 27(3): 705–713.

Bhattacharya, M., Wozniak, D. J., Stoodley, P. & Hall-Stoodley, L. (2016). Prevention and treatment of *Staphylococcus aureus* biofilms. *Expert Review of Anti-Infective Therapy*, 13(12): 1499–1516.

Bode, L. G. M., Kluytmans, A. J. W., Wertheim, H. F. L., Bogaers, D., Vandenbroucke-Grauls, C. M. J. E., Roosendaal, R., Troelstra, A., Box, A. T. A., Van der Tweel, I., Van Belkum, A., Verbrugh, H. A., Vos, M. C. (2010).

Preventing surgical-site infections in nasal carriers of *Staphylococcus aureus. The New England Journal of Medicine,*362: 9-17.

Bos, R., Woerdenbag, H. J., Kayser, O., Quax, W. J., Ruslan, K. & Elfami. (2007). Essential oil constituents of *Piper cubeba* L. fils. from Indonesia. *Journal of Essential Oil Research*, 19(1), 14–17.

Brambilla, L. Z. S., Endo, E. H., Cortez, D. A. G. & Dias, B. P. (2017). Anti-biofilm activity against *Staphylococcus aureus* MRSA and MSSA of neolignans and extract of *Piper regnellii*. *Revista Brasileira de Farmacognosia*, 27(1): 112–117.

Brasil, I. M., Gomes, C., Puerta-Gomez, A., Castell-Perez, M. E., & Moreira, R. G. (2012). Polysaccharide-based multilayered antimicrobial edible coating enhances quality of fresh-cut papaya. *LWT - Food Science and Technology*, 47(1): 39-45.

Bridier, A., Sanchez-vizuete, P., Guilbaud, M., Piard, J. & Naitali, M. (2014). Biofilm-associated persistence of food-borne pathogens. *Food Microbiology*, 1-12.

Bulow, N. & Konig, W. A. (2000). The role of germacrene D as a precursor in sesquiterpene biosynthesis: investigations of acid catalyzed, photochemically and thermally induced rearrangements. *Phytochemistry*, 55(2): 141-168.

Cascioferro, S., Maggio, B., Raffa, D., Valeria, M., Grazia, M., Domenico, S., Manachini, B., Leonchiks, A. & Daidone, G. (2016). A new class of phenylhydrazinylidene derivatives as inhibitors of *Staphylococcus aureus* biofilm formation. *Medicinal Chemistry Research*, 25(5): 870-878.

Cerca N, J. K. (2008). Effect of growth conditions on poly-N-acetylglucosamine expression and biofilm formation in *Escherichia coli. FEMS Microbiology Letters*, 283(1):36-41.

Chamdit, S. & Siripermpool, P. (2012). Antimicrobial effect of clove and lemongrass oils against planktonic cells and biofilms of *Staphylococcus aureus*. *Mahidol University Journal of Pharmaceutical Siences*, 39(2): 28–36.

Charlier, C., Crenet, M., Even, S. & Loir, Y. L. (2009). Interactions between *Staphylococcus aureus* and lactic acid bacteria: An old story with new perspectives. *International Journal of Food Microbiology*, 131: 30-39.

Chunlaratthanaphorn, S., Lertprasertsuke, N., Srisawat, U., Thuppia, A., Ngamjariyawat, A., Suwanlikhid, N. & Jaijoy, K. (2007). Acute and subchronic toxicity study of the water extract from dried fruits of *Piper nigrum* L. in rats. *Songklanakarin Journal of Science and Technology*, 29(1): 109-124.

Ciccio, P. Di, Vergara, A., Festino, A. R., Paludi, D., Zanardi, E., Ghidini, S. & Ianieri, A. (2015). Biofilm formation by *Staphylococcus aureus* on food contact surfaces: Relationship with temperature and cell surface hydrophobicity. *Food Control*, *50*: 930–936.

Clinical and Laboratory Standards Institute (CLSI). (2012a). Reference method for dilution antimicrobial susceptibility tests for bacteria that grow aerobically; approved standard-ninth edition; CLSI document M07-A9. Clinical and

Laboratory Standards Institue, Wayne, PA, USA.

Clinical and Laboratory Standards Institute (CLSI). (2012b). Reference method for performance standards for antimicrobial disc susceptibility tests; approved standard-eleventh edition; CLSI document M02-A11. Clinical and Laboratory Standards Institue, Wayne, PA, USA.

Crago, B., Ferrato, C., Drews, S. J., Svenson, L. W., Tyrrell, G. & Louie, M. (2012). Prevalence of *Staphylococcus aureus* and methicillin-resistant *S. aureus* (MRSA) in food samples associated with foodborne illness in Alberta , Canada from 2007 to 2010. *Food Microbiology*, 32(1): 202-205.

Daka, D. (2013). Antibacterial effect of garlic (*Allium sativum*) on *Staphylococcus aureus*: An *in vitro* study. *African Journal of Biotechnology*, 10(4): 666–669.

Das, K., Tiwari, R. K. S. & Shrivastava, D. K. (2010). Techniques for evaluation of medicinal plant products as antimicrobial agent. *Current Methods and Future Trends*, 4(2): 104–111.

Dennis, L. S., Daneil, H., Harry, L., John, L. H., Donald, H. B., Barry, F. & Group, L. M. S. (2002). Linezolid versus vancomycin for the treatment of methicillin-resistant *Staphylococcus aureus* infections. *Clinical Infectious Diseases*, 34(11): 1481-1490.

Delaquis, P. J., Ward, S. M., Holley, R. A., Cliff, M. C. & Mazza, G. (1999). Microbiological, chemical and sensory properties of pre-cooked roast beef preserved with horseradish essential oil. *Journal of Food Science*, 64(3): 519–524.

Djordjevic, D., Wiedmann, M., Mclandsborough, L. A., Djordjevic, D., Wiedmann, M. & Mclandsborough, L. A. (2002). Microtiter plate assay for assessment of *Listeria monocytogenes* biofilm formation. *Applied and Environmental Microbiology*, 68(6): 2950-2958.

Do, D., Angkawijaya, A., Tran-Nguyen, P. L., Huynh, L. H., Soetaredjo, F. E., Ismadji, S. & Ju, Y. (2014). Effect of extraction solvent on total phenol content, total flavonoid content, and antioxidant activity of *Limnophila aromatica*. *Journal of Food and Drug Analysis*, 22: 296-302.

Donlan, R. M. (2002). Biofilms: Microbial life on surfaces. *Emerging Infectious Diseases*, 8(9): 881–890.

Doulgeraki, A. I., Di Ciccio, P., Ianieri, A., Nychas, G. E. (2016). Methicillin-resistant food-related *Staphylococcus aureus*: a review of current knowledge and biofilm formation for future studies and applications. *Research in Microbiology*, 168(1): 1-15.

Durairaj, S., Sangeetha, S. & Lakshmanaperumalsamy, P. (2009). In vitro antibacterial activity and stability of garlic extract at different pH and temperature. *Electronic Journal of Biology*, 5(1): 5–10.

Edris, A. M., Amin, R. A., Nassif, M. Z. & Mahmoud, M. Z. (2015). Bcaterial status of fresh marketed chicken meat cuts-up. *Benha Veterinary Medical Journal*, 28(2): 52-57.

El-hadedy, D. & El-nour, S. A. (2012). Identification of *Staphylococcus aureus* and *Escherichia coli* isolated from Egyptian food by conventional and molecular methods. *Journal of Genetic Engineering and Biotechnology*, 10(1): 129–135.

Fetsch, A., Contzen, M., Hartelt, K., Kleiser, A., Maassen, S., Rau, J., Kraushaar, B., Layer, F. & Strommenger, B. (2014). *Staphylococcus aureus* food-poisoning outbreak associated with the consumption of ice-cream. *International Journal of Food Microbiology*, 187: 1-6.

Filocamo, A., Bisignano, C., Mandalari, G. & Navarra, M. (2015). *In vitro* antimicrobial activity and effect on biofilm production of a white grape juice (*Vitis vinifera*) extract. *Evidence-Based Complementary and Alternative Medicine.* Retrieved from https://www.hindawi.com/journals/ecam/2015/856243/.

Fletcher, S., Boonwaat, L., Moore, T., Chavada, R. & Conaty, S. (2015). Investigating an outbreak of staphylococcal food poisoning among travellers across two Australian states. *Western Pacific Surveillance and Response*, 6(2): 17-21.

Gironas-Vilaplana, A., ValentÃ£o, P., Andrade, P. B., Ferreres, F., Moreno, D. A. & Garca-a-Viguera, C. (2012). Phytochemical profile of a blend of black chokeberry and lemon juice with cholinesterase inhibitory effect and antioxidant potential. *Food Chemistry*, 134(4): 2090-2096.

Gnecco, S., Poyser, J. P., Silva, M., Sammes, P. G., & Tyler, T. W. (1973). Sesquiterpene lactones from *Podanthus ovatifolius*. *Phytochemistry*, 12: 2469-2477.

Gorgani, L., Mohammadi, M., Najafpour, G.D. & Nikzad, M. (2016). Piperine—The bioactive compound of Black Pepper: from isolation to medicinal formulations. *Comprehensive Reviews in Food Science and Food Safety*, 16(1): 124-140.

Gramile, Q., Medeiros, I. De, Julia, A., Aguiar, A., Siqueira-junior, J. P. De, Leite, E. & Souza, D. (2012). Influence of temperature and surface kind on biofilm formation by *Staphylococcus aureus* from food-contact surfaces and sensitivity to sanitizers. *Food Control*, 25(2): 469–475.

Greenwell, M. & Rahman, P. K. S. M. (2015). Medicinal plants: Their use in anticancer treatment. *International Journal of Pharmaceutical Sciences and Research*, 6(10): 4103-4112.

Grinevicius, V. M. A. S., Andrade, K. S., Ourique, F., Micke, G. A., Ferreira, S. R. S. & Pedrosa, R. C. (2017). Antitumor activity of conventional and supercritical extracts from *Piper nigrum* L. cultivar Bragantina through cell cycle arrest and apoptosis induction. *The Journal of Supercritical Fluids*, 128: 94-101.

Gutierrez, D., Delgado, S., Vazquez-Sanchez, D., Martinez, B., Cabo, M. L., Rodriguez, A., Herrera, J. J. & Garcia, P. (2012). Incidence of *Staphylococcus aureus* and analysis of associated bacterial communities on food industry surfaces. *Applied and Environmental Microbiology*, 78(24), 8547–8554.

Gutierrez, D., Ruas-madiedo, P., Martı, B., Rodrı, A., Garcı, P. & Gutie, D. (2014). Effective removal of Staphylococcal biofilms by the endolysin LysH5. *Plos*

One, 9(9).

Gyawali, R. & Ibrahim, S. A. (2014). Natural products as antimicrobial agents. *Food Control*, 46: 412–429.

Hamadi, F., Asserne, F., Elabed, S., Bensouda, S., Mabrouki, M. & Latrache, H. (2014). Adhesion of *Staphylococcus aureus* on stainless steel treated with three types of milk. *Food Control*, 38: 104–108.

Hancock, V., Witso, I. L. & Klemm, P. (2011). Biofilm formation as a function of adhesion, growth medium, substratum and strain type. *International Journal of Medical Microbiology*, 301(7): 570–576.

Hanson, B. M., Dressler, A. E., Harper, A. L., Scheibel, R. P., Wardyn, S. E., Roberts, L. K., Kroeger, J. S. & Smith, T. C. (2011). Prevalence of *Staphylococcus aureus* and methicillin-resistant *Staphylococcus aureus* (MRSA) on retail meat in Iowa. *Journal of Infection and Public Health*, 4(4): 169–174.

Hema, R., Kumaravel, S. & Elanchezhiyan, N. (2009). Antimicrobial activity of some of the South-Indian spices and herbals against food pathogens. *Global Journal of Pharmacology*, 3(1): 38–40.

Herrera, J. J. R., Cabo, M. L., Gonzalez, A., Pazos, I. & Pastoriza, L. (2007). Adhesion and detachment kinetics of several strains of *Staphylococcus aureus* subsp. *aureus* under three different experimental conditions. *Food Microbiology*, 24(6): 585–591.

Hoeneisen, M., Kodama, M. & Ito, S. (1981). Sesquiterpene lactones of *Podanthus mitiqui*. *Phytochemistry*, 20(7): 1743.

Hussain, S. Z., & Maqbool, K. (2014). GC-MS : Principle, technique and its application in Food Science. *International Journal of Current Science*, 13: 116-126.

ICMSF. (1986). Microorganisms in foods, sampling for microbiological analysis: principles and specific applications. 2 Eden. University of Toronto Press, Toronto.

Ilansuriyan, P., Marimuthu, P. & Sasikala, S. (2015). Physio-chemical, storage and sensory characteristics of chicken drumstick dried powder. *European Journal of Biotechnology and Bioscience*, 3(7): 12-16.

Indu, M. N., Hatha, A. A. M., Abirosh, C., Harsha, U. & Vivekanandan, G. (2006). Antimicrobial activity of some of the south-Indian spices against serotypes of *Escherichia coli*, *Salmonella*, *Listeria monocytogenes* and *Aeromonas hydrophila*. *Brazilian Journal of Microbiology*, 37(2): 153–158.

Ingham, S. C., Vang, S., Levey, B. E. N., Fahey, L., Norback, J. P., Fanslau, M. A., Senecal, A. G., Burnham, G. M. & Ingham, B. H. (2009). Predicting Behavior of *Staphylococcus aureus, Salmonella* Serovars, and *Escherichia coli* O157 : H7 in pork products during single and repeated temperature abuse periods. *Journal of Food Protection*, 72(10): 2114–2124.

Jaglic, Z. & Michu, E. (2012). Bacterial biofilms resist oxidising agents due to the presence of organic matter. *Czech Journal of Food Science*, 30(2): 178–187.

Jimenez, S. M., Salsi, M. S., Tiburzi, M. C., Rafaghelli, R. C., Tessi, M. A. & Coutaz, V. R. (1997). Spoilage microflora in fresh chicken breast stored at 4°C: Influence of packaging methods. *Journal of Applied Microbiology*, 83(5): 613–618.

Jans, C., Merz, A. Johler, S., Younan, M., Tanner, S. A., Kaindi, D. W. M., Wangoh, J., Bonfoh, B., Meile, L & Tasara, T. (2017). East and West African milk products are reservoirs for human and livestock-associated *Staphylococcus aureus. Food Microbiology*, 65: 64-73.

Jo, S., Lachumy, T., Sasidharan, S., Sumathy, V. & Zuraini, Z. (2010). Pharmacological activity, phytochemical analysis and toxicity of methanol extract of *Etlingera elatior* (torch ginger) flowers. *Asian Pacific Journal of Tropical Medicine*, 3(10): 769–774.

Jones, T. F., Kellum, M. E., Porter, S. S., Bell, M. & Schaffner, W. (2002). An outbreak of community-acquired foodborne illness caused by methicillin-resistant *Staphylococcus aureus. Emerging Infectious Diseases*, 8(1): 82-84.

Johler, S., Tichaczek-Dischinger, P. S., Rau, J., Sihto, H. M., Lehner, A., Adam, M. & Stephan, R. (2013). Outbreak of staphylococcal food poisoning due to SEA-producing *Staphylococcus aureus. Foodborne Pathogens and Disease*, 10(9): 777-781. 10.

Johler, S., Weder, D., Bridy, C., Huguenin, M. C., Robert, L., Hummerjohann, J. & Stephan, R. (2015). Outbreak of staphylococcal food poisoning among children and staff at a Swiss boarding school due to soft cheese made from raw milk. *Journal of Dairy Science*, 98(5): 2944-2948.

Jun, H., Kim, J., Bang, J., Kim, H., Beuchat, L. R. & Ryu, J. H. (2013). Combined effects of plant extracts in inhibiting the growth of *Bacillus cereus* in reconstituted infant rice cereal. *International Journal of Food Microbiology*, 160(3): 260–266.

Juneja, V. K., Dwivedi, H. P. & Yan, X. (2012). Novel natural food antimicrobials. *Annual Review of Food Science and Technology*, 3: 381-403.

Junqueira, A. P. F., Perazzo, F. F., Souza, G. H. B. & Maistro, E. L. (2007). Clastogenicity of *Piper cubeba* (Piperaceae) seed extract in an *in vivo* mammalian cell system. *Genetics and Molecular Biology*, 30(3): 656–663.

Kappell, G. M., Grover, J. P. & Chrzanowski, T. H. (2009). Micro-scale surface-patterning influences biofilm formation. *Electronic Journal of Biotechnology*, 12(3).

Kawamura, H., Mishima, K., Sharmin, T., Ito, S., Kawakami, R., Kato, T., Misumi, M., Suetsugu, T., Orii, H., Kawano, H., Irie, K., Sano, K., Mishima, K., Harada, T., Mustofa, S., Hasanah, F., Siregar, Y. D., Zahroh, H., Putri, L. S. & Salim, A.

(2016). Ultrasonically enhanced extraction of luteolin and apigenin from the leaves of *Perilla frutescens* (L.) Britt. using liquid carbon dioxide and ethanol. *Ultrasonics Sonochemistry*, 29: 19–26.

Khan, M., Siddiqui, M., Vahl, P., Linn, P., Antimicrobial, K., Pepper, B. & Long, I. (2007). Antimicrobial activity of *Piper* fruits as herbal ingredients of Asian medicines. *Analysis*, 6(2): 111–113.

Kirmusaoglu, S. (2016). Staphylococcal biofilms: Pathogenicity, mechanism and regulation of biofilm formation by quorum-sensing system and antibiotic resistance mechanisms of biofilm-embedded microorganisms. *Immunology and Microbiology "Microbial Biofilms - Importance and Applications.* Retrieved from https://www.intechopen.com/books/microbial-biofilms-importance-and-applications.

Kohler, F. E. (1887). Piperaceae - *Piper cubeba - Cubeba officinalis*. Retrieved from http://www.meemelink.com/prints_pages/24096.Piper.htm.

Kokare, C. R., Chakraborty, S., Khopade, A. N. & Mahadik, K. R. (2009). Biofilm: Importance and applications. *Indian Journal of Biotechnology*, 8: 159–168.

Korfmacher, W. A. (2005). Principles and applications of LC-MS in new drug discovery. *Drug Discovery Today*, 10(20): 1357–67.

Kozacinski, L., Fleck, Z. C., Kozacinski, Z., Filipovic, I., Mitak, M., Bratulic, M. & Mikus, T. (2012). Evaluation of shelf life of pre-packed cut poultry meat. *Veterinarski Arhiv*, 82(1): 47–58.

Kumar, C. G. & Anand, S. K. (1998). Significance of microbial biofilms in food industry: a review. *International Journal of Food Microbiology*, 42: 9–27.

Kusumaningrum, H. D., Riboldi, G., Hazeleger, W. C. & Beumer, R. R. (2003). Survival of foodborne pathogens on stainless steel surfaces and cross-contamination to foods. *International Journal of Food Microbiology*, 85(3): 227–236.

Labbe, R. G. & Garcia, S. (2013). Guide to foodborne pathogens, 2nd Revised Edition. John Wiley and Sons Ltd.

Lachumy, S. J. T., Sasidharan, S., Sumathy, V. & Zuraini, Z. (2010). Pharmacological activity, phytochemical analysis and toxicity of methanol extract of *Etlingera elatior* (torch ginger) flowers. *Asian Pacific Journal of Tropical Medicine*, 2010: 769-774.

Lang, G., & Buchbauer, G. (2012). A review on recent research results (2008-2010) on essential oils as antimicrobials and antifungals. A review. *Flavour and Fragrance Journal*, 27(1): 13–39.

Lawal, S. K. & Akolade, M. A. (2011). Microbial flora of frozen chicken part varieties. *International Research Journal of Microbiology*, 2: 423–427.

Lee, S. H. I., Mangolin, B. L. C., Gonçalves, J. L., Neeff, D. V, Silva, M. P., Cruz, A. G. & Oliveira, C. A. F. (2014). Biofilm-producing ability of *Staphylococcus aureus* isolates from Brazilian dairy farms. *Journal of Dairy Science*, 97(3),

1812–1816.

Le Loir, Y., Baron, F. & Gautier, M. (2003). *Staphylococcus aureus* and food poisoning. *Genetic and Molecular Research*, 2(1): 63-76.

Lie, C., Bayer, A., Cosgrove, S. E., Daum, R. S., Fridkin, S. K., Gorwitz, R. J., Kaplan, S. L., Karchmer, A. W., Levine, D. P., Rybak, B. E. M. M. J., Talan, D. A. & Chambers, H. F. (2011). Clinical practice guidelines by the infectious diseases society of America for the treatment of methicillin-resistant *Staphylococcus aureus* infections in adults and children. *Clinical Infectious Diseases*, 52(3): 18-55.

Lopez-Galvez, F., Allende, A., Selma, M. V. & Gil, M. I. (2009). Prevention of *Escherichia coli* cross-contamination by different commercial sanitizers during washing of fresh-cut lettuce. *International Journal of Food Microbiology*, 133 (1-2): 167–171.

Ludwiczuk, A., Odrzykoski, I. J. & Asakawa. (2013). Identification of cryptic species within liverwort *Conocephalum conicum* based on the volatile components. *Phytochemistry*, 95(2013): 234-241.

Magalhaes, L. G., Souza, J. M. D. & Wakabayashi, K. A. L. (2012). In vitro efficacy of the essential oil of *Piper cubeba* L. (Piperaceae) against *Schistosoma mansoni*. *Parasitology Research*, 110: 1747–1754.

Mari, T., Langsrud, S., Holck, A. & Moretro, T. (2007). Different patterns of biofilm formation in *Staphylococcus aureus* under food-related stress conditions. *International Journal of Food Microbiology*, 116: 372–383.

Martins, C. D. M., Nascimento, E. A. Do., de Morais, S. A. L., de Oliveira, A., Chang, R., Cunha, L. C. S., Martins, M. M., Martins, C. H. G., da S. Moraes, T., Rodrigues, P. V., da Silva, C. V. & de Aquino, F. J. T. (2015). Chemical constituents and evaluation of antimicrobial and cytotoxic activities of *Kielmeyera coriacea* Mart. & Zucc. essential oils. *Evidence-Based Complementary and Alternative Medicine*, 9.

Mathur, A., Bhat, R., Prasad, G. B. K. S., Dua, V. K., Verma, S. K. & Agarwal, P. K. (2010). Antimicrobial activity of plants traditionally used as medicines against some pathogens. *Rayasan Journal of Chemistry*, 3(4): 615–620.

Maurya, R. Yadav, P. P (2005). Furanoflavonoids: an overview. *Natural Product Reports*, 22: 400-424.

Meyer, B. N., Ferrigni, N. R., Putnam, J. E., Jacobsen L. B., Nicholes, D. E. & McLaughlin, J. L. (1982). Brine Shrimp : A convenient general bioassay for active plant constituents. *Journal of Medicinal Plant Research*, 45: 31-34.

Mohammadi, M. & Rohloff, J. (2016). Antibiofilm activity of essential oils and plant extracts against *Staphylococcus aureus* and *Escherichia coli* biofilms. *Food Control*, 61: 156–164.

Mohanta, T. K., Patra, J. K., Rath, S. K., Pal, D. K. & Thatoi, H. N. (2007). Evaluation of antimicrobial activity and phytochemical screening of oils and

nuts of *Semicarpus anacardium*. *Scientific Research and Essay*, 11: 486–490.

Molan, P. C. (1992). The antibacterial activity of honey: The nature of the antibacterial activity. *Bee World*, 73(1), 5-28.

Morris, W. L., Ducreux, L. J. M., Shepherd, T., Lewinsohn, E., Davidovich-Rikanati, R., Sitrit, Y. & Taylor, M. A. (2011). Utilisation of the MVA pathway to produce elevated levels of the sesquiterpene a-copaene in potato tubers. *Phytochemistry*, 72(2011): 2288-2293.

Morton, L. H. G., Greenway, D. L. A., Gaylarde, C. C. & Surman, S. B. (1998). Consideration of some implications of the resistance of biofilms to biocides. *International Biodeterioration and Biodegradation*, 41(3–4): 247–259.

Mosbah, H., Louati, H., Boujbiha, M. A., Chahdoura, H., Snoussi, M., Flamini, G., Ascrizzi, R., Bouslema, Al., Achour, L. & Selmi B. (2018). Phytochemical characterization, antioxidant, antimicrobial and pharmacological activities of *Feijoa sellowiana* leaves growing in Tunisia. *Industrial Crop and Products*, 111: 521-531.

Nagappan, R. (2012). Evaluation of aqueous and ethanol extract of bioactive medicinal plant, *Cassia didymobotrya* (Fresenius) Irwin & Barneby against immature stages of filarial vector, *Culex quinquefasciatus* Say (Diptera: Culicidae). *Asian Pacific Journal of Tropical Biomedicine*, 2(9): 707–711.

Nahak, G. & Sahu, R. K. (2011). Phytochemical evaluation and antioxidant activity of *Piper cubeba* and *Piper nigrum*. *Journal of Applied Pharmaceutical Science*, 1(8): 153–157.

Namasivayam, S. K. R. & Roy, E. A. (2014). Anti biofilm effect of medicinal plant extracts against clinical isolate of biofilm of *Escherichia coli. International Journal of Pharmacy and Pharmaceutical Sciences* (5)2: 1–5.

Ncube, N. S., Afolayan, A. J. & Okoh, A. I.. (2008). Assessment techniques of antimicrobial properties of natural compounds of plant origin: Current methods and future trends. *African Journal of Biotechnology*, 7(12), 1797–1806.

Negi, P. S. (2012). Plant extracts for the control of bacterial growth : Efficacy, stability and safety issues for food application. *International Journal of Food Microbiology*, 156(1): 7–17.

Nguyen, L. T., Mysliveckova, Z., Szotakova, B., Spicakova, A., Lnenickova, K., Ambroz, M., Kubicek, V., Krasulova, K., Anzerbacher, P. & Skalova, L. The inhibitory effects of β-caryophyllene, β-caryophyllene oxide and α-humulene on the activities of the main drug-metabolizing enzymes in rat and human liver *in vitro. Chemico-Biological Interactions*, 278(2017): 123-128.

Nikolic, M., Vasic, S., Durdevic, J., Stefanovic, O. & Comic, L. (2014). Antibacterial and anti-biofilm activity of ginger (*Zingiber officinale* (Roscoe)) ethanolic extract. *Kragujevac Journal of Science*, 36(2014): 129-136.

Nithya, C. & Begum, M. F. (2010). Marine bacterial isolates inhibit biofilm formation and disrupt mature biofilms of *Pseudomonas aeruginosa* PAO1. *Applied Microbiol Biotechnology*, 88: 341–358.

Nkambule, T. P. (2008). Antimicrobial properties of selected Asian herbs. University of Florida.

Norhana, W., Azman, A. M. N., Poole, S. E., Deeth, H. C. & Dykes, G. A. (2009). Effects of bilimbi (*Averrhoa bilimbi* L.) and tamarind (*Tamarindus indica* L.) juice on *Listeria monocytogenes* Scott A and *Salmonella* Typhimurium and the sensory properties of raw shrimps.. *International Journal of Food Microbiology*, 136(1): 88–94.

Normanno, G., Firinu, A., Virgilio, S., Mula, G., Dambrosio, A., Poggiu, A., Decastelli, L., Mioni, R., Scuota, S., Bolzoni, G., Di Giannatale, E., Salinetti, A. P., La Salandra, G., Bartoli, M., Zuccon, F., Pirino, T., Sias, S., Parisi, A., Quagliaa, N. C., & Celanoa, G. V. (2005). Coagulase-positive Staphylococci and *Staphylococcus aureus* in food products marketed in Italy. *International Journal of Food Microbiology*, 98: 73-79.

Nr, B. & Vj, S. (2011). Antibacterial and antifungal activities from leaf extracts of *Cassia fistula* l.: An ethnomedicinal plant. *Journal of Advanced Pharmaceutical Teachnology and Research*, 2(2): 104-109.

Ohta, Y., Sakai, T. & Hirosa, Y. (1966). Sesquiterpens hydrocarbons from the oil of cubeb: α-cubebene and β-cubebene. *The Institute of Food Chemistry Dojimanaka, Kita-ku, Oeaka, Japan*, 5: 6365–6370.

Oniciuc, E. A., Nicolau, A. l., Hernandez, M.& Rodriguez-Lazaro, D. (2017). Presence of methicillin-resistant *Staphylococcus aureus* in the food chain. *Trends in Food Science & Technology*, 61: 49-59.

Oniciuc, E., Cerca, N. & Nicolau, A. I. (2016). Compositional analysis of biofilms formed by *Staphylococcus aureus* isolated from food sources. *Frontiers in Microbiology*, 7: 390.

Onyeagba, R. A., Ugbogu, O. C., Okeke, C. U. & Iroakasi, O. (2005). Studies on the antimicrobial effects of garlic (*Allium sativum* Linn), ginger (*Zingiber officinale* Roscoe) and lime (*Citrus aurantifolia* Linn). *African Journal of Biotechnology*, 3(10): 552–554.

Pandey, A. & Agnihotri, V. (2015). Antimicrobials from medicinal plants: Research initiatives, challenges, and the future prospects. *Biotechnology of Bioactive Compounds: Sources and Applications*, 1: 123-150.

Pandey, J. K. & Singh, D. K. (2009). Molluscicidal activity of *Piper cubeba* Linn., *Piper longum* Linn. and *Tribulus terrestris* Linn. and their combinations against snail *Indoplanorbis exustus* Desh. *Indian Journal of Experimental Biology*, 47(8): 643-648.

Pandy, V., Narasingam, M., Kunasegaran, T., Murugan, D. D., & Mohamed, Z. (2014). Effect of noni (*Morinda citrifolia* Linn.) fruit and its bioactive principles scopoletin and rutin on rat vas deferens contractility: An *Ex vivo* study. *Scientific World Journal*, 1-11.

Paniwnyk, L., Beaufoy, E., Lorimer, J. P. & Mason, T. J. (2001). The extraction of rutin from flower buds of *Sophora japonica*. *Ultrasonics Sonochemistry*, 8(3):

299–301.

Pankey, G. A. & Ashcraft, D. S. (2009). *In vitro* antibacterial activity of tigecycline against resistant Gram-negative bacilli and enterococci by time-kill assay. *Diagnostic Microbiology and Infectious Disease*, 64(3): 300–304.

Parvez, M., Gayasuddin, M., Basheer, M. & Janakiraman, K. (2010). Screening of *Piper cubeba* (Linn) fruits for anti-ulcer activity. *International Journal of PharmTech Research*, 2(2): 1128–1132.

Pascu, C., Costinar, L., Herman, V. & Vaduva, I. (2010). Assessment of biofilm formation in *Actinobacillus pleuropneumoniae* strains. *Lucrari Stiinlifice Medicina Veterinara,* 43(1), 170–172.

Pavithra,G. (2014). Effect of spices on bacteria – A short review. *Journal of Pharmaceutical Sciences and Research*, 6(8): 268-270.

Pengov, A. & Ceru, S. (2003). Antimicrobial drug susceptibility of *Staphylococcus aureus* strains isolated from bovine and ovine mammary glands. *Journal of Dairy Science*, 86(10): 3157–63.

Picaud, S., Olsson, M. E., Brodelius, M. & Brodelius. (2006). Cloning, expression, purification and characterization of recombinant (+)-germacrene D synthase from *Zingiber officinale*. *Archives of Biochemistry and Biophysics*, 452(1): 17-28.

Picman, A. K. (1986). Review Article Number 7 Biological activities of sesquiterpene lactones. *Biochemical Systematics and Ecology*, 14(3), 255–281.

Pierce, C. G., Uppuluri, P., Tristan, A. R., Jr, F. L. W., Ramage, G. & Lopez-ribot, J. L. (2009). A simple and reproducible 96-well plate-based method for the formation of fungal biofilms and its application to antifungal susceptibility testing. *Nature Protocols*, 3(9), 1494–1500.

Pisutthanan, S., Plianbangchang, P. & Pisutthanan, N. (2004). Brine shrimp lethality activity of Thai medicinal plants in the family Meliaceae. *Naresuan University Journal*, 12(2): 13–18.

Pitt, J. J. (2009). Principles and applications of liquid chromatography-mass spectrometry in clinical biochemistry. *The Clinical Biochemist. Reviews / Australian Association of Clinical Biochemists*, 30(1): 19–34.

Pradal, D., Vauchel, P., Decossin, S., Dhulster, P. & Dimitrov, K. (2016). Ultrasonics sonochemistry kinetics of ultrasound-assisted extraction of antioxidant polyphenols from food by-products : Extraction and energy consumption optimization. *Ultrasonics Sonochemistry*, 32: 137–146.

Public Health Agency of Canada. (2004). In Best M., Graham M. L., Leitner R., Ouellette M. & Ugwu K. (Eds.), Laboratory biosafety guidelines (3rd ed.). Canada: Public Health Agency of Canada.

Rani, A., Syahmi, M., Vijayarathna, S., Sasidharan, S., Latha, L. Y., Kwan, Y. P., Lau, Y. L., Shin, L. N. & Chen, Y. (2010). Acute oral toxicity and brine shrimp lethality of *Elaeis guineensis* Jacq., (oil palm leaf) methanol extract. *Molecules*, 15: 8111–8121.

Rayner, C., & Munckhof, W. J. (2006). Antibiotics currently used in the treatment of infections caused by *Staphylococcus aureus*. *Internal Medicine Journal*, 36(2): 142-3.

Razmavar, S., Abdulla, M. A., Ismail, S. B. & Hassandarvish, P. (2014). Antibacterial activity of leaf extracts of *Baeckea frutescens* against methicillin-resistant *Staphylococcus aureus*. *BioMed Research International*, 2014–2017.

Reffuveille, F., Josse, J., Valle, Q., Mongaret, C. & Gangloff, S. C. (2017). *Staphylococcus aureus* biofilms and their impact on the medical field. Retrieved from https://www.intechopen.com/books/the-rise-of-virulence-and-antibiotic-resistance-in-*staphylococcus-aureus*/.

Ren, D., Zuo, R., Barrios, A. F. G., Bedzyk, L. A., Eldridge, G. R., Pasmore, M. E. & Wood, T. K. (2005). Differential gene expression for investigation of *Escherichia coli* biofilm inhibition by plant extract ursolic acid. *Applied and Environmental Microbiology*, 71(7): 4022.

Rendueles, O. & Ghigo, J. M. (2012). Multi-species biofilms: How to avoid unfriendly neighbors. *FEMS Microbiology Reviews*, 36(5), 972–989.

Rezende, K. C. S., Lucarini, R., Símaro, G. V, Pauletti, P. M., Januario, A. H., Esperandim, V. R., Martins, C. H. G., Silva, M. A., Cunha, W. R., Bastos, J. K., Silva, M. L. A. E. (2016). Antibacterial activity of (−) -cubebin isolated from *Piper cubeba* and its semisynthetic derivatives against microorganisms that cause endodontic infections. *Revista Brasileira de Farmacognosia*, 26(3): 296–303.

Rinaudi, L., Fujishige, N. A., Hirsch, A. M. & Banchio, E. (2006). Effects of nutritional and environmental conditions on *Sinorhizobium meliloti* biofilm formation. *Research in Microbiology*, 157*:* 867–875.

Rode, T. M., Moretro, T., Langsrud, S., Langsrud, O., Vogt, G. & Holck, A. (2015). Responses of *Staphylococcus aureus* exposed to HCl and organic acid stress. *Canadian Journal of Microbiology*, 56: 777-792.

Rosengren, A., Fabricius, A., Guss, B., Sylvén, S. & Lindqvist, R. (2010). Occurrence of foodborne pathogens and characterization of *Staphylococcus aureus* in cheese produced on farm-dairies. *International Journal of Food Microbiology*, 144(2): 263–269.

Ruenroengklin, N., Zhong, J., Duan, X., Yang, B. & Li, J. (2008). Effects of various temperatures and pH values on the extraction yield of phenolics from litchi fruit pericarp tissue and the antioxidant activity of the extracted anthocyanins. *International Journal of Molecular Sciences*, 9: 1333–1341.

Rukayadi, K. Y. Lau, N. S. Zainin, M. Zakaria. & F. A. (2013). Screening antimicrobial activity of tropical edible medicinal plant extracts against five standard microorganisms for natural food preservative. *International Food Research Journal*, 20(5): 2905–2910.

Rukayadi, Y., Han, S., Yong, D. & Hwang, J.-K. (2010). *In vitro* antibacterial activity of panduratin A against enterococci clinical isolates. *Biological & Pharmaceutical Bulletin*, 33(9): 1489–1493.

Rukayadi, Y., Lee, K., Han, S., Yong, D. & Hwang, J. K. (2009). *In vitro* activities of panduratin A against clinical *Staphylococcus* strains. *Antimicrobial Agents and Chemotherapy*, *53*(10), 4529–4532.

Rukayadi, Y., & Hwang, J. K. (2006). *In vitro* activity of xanthorrhizol against *Streptococcus mutans* biofilms. *Letters in Applied Microbiology*, 42(4): 400–404.

Sahgal, G., Ramanathan, S., Sasidharan, S., Nizam Mordi, M., Ismail, S. & S. M. M. (2010). Brine shrimp lethality and acute oral toxicity studies on *Swietenia mahagoni* (Linn.) Jacq. seed methanolic extract. *Pharmacognosy Research*, 2(4): 215-220.

Salaheen, S., Nguyen, C., Hewes, D. & Biswas, D. (2014). Cheap extraction of antibacterial compounds of berry pomace and their mode of action against the pathogen *Campylobacter jejuni*. *Food Control*, 46: 174–181.

Sanchez, E., Morales, C. R., Castillo, S., Leos-rivas, C., García-becerra, L., Mizael, D. & Martínez, O. (2016). Antibacterial and antibiofilm activity of methanolic plant extracts against nosocomial microorganisms. *Evidence-Based Complementary and Alternative Medicine*, vol. 2016, Article ID 1572697, 8 pages.

Sasidharan, S., Chen, Y., Saravanan, D., Sundram, K. M. & Latha, L. Y. (2011). Extraction, isolation and characterization of bioactive compounds from plants' extracts. *African Journal of Traditional, Complementary and Alternative Medicines* 8(1): 1-10.

Schneid, I., Almeida, M., Pohl, C., Padilha, W., Kuka, T., Gandra, V. & Magalh, M. (2016). *Staphylococcus aureus* isolated from handmade sweets: Biofilm formation, enterotoxigenicity and antimicrobial resistance. *Food Microbiology*, 58: 105-111.

Shah, M. A., John, S., Bosco, D. & Mir, S. A. (2014). Plant extracts as natural antioxidants in meat and meat products. *Meat Science*, 98(1): 21–33.

Shahwany, A. W. A. L., Tawfeeq, H. K. & Hamed, S. E. (2016). Antibacterial and anti-biofilm activity of three phenolic plant extracts and silver nanoparticles on *Staphylococcus aureus* and *Klebsiella pneumoniae*. *Biomedicine and Biotechnology*, 4(1): 12–18.

Shwter, A. N., Abdullah, N. A., Alshawsh, M. A., El-Seedi, H. R., Al-Henhena, N. A., Khalifa, S. A. M., & Abdulla, M. A. (2016). Chemopreventive effect of *Phaleria macrocarpa* on colorectal cancer aberrant crypt foci *in vivo*. *Journal of Ethnopharmacology*, *193*: 195–206.

Shen, J., Tian, Y., Li, Y., Ma, R., Zhang, Q., Zhang, Z. & Fang, J. (2016). Bactericidal effects against *S. aureus* and physicochemical properties of plasma activated water stored at different temperatures. *Scientific Reports*, 6: 28505

Silhavy, T. J., Kahne, D. & Walker, S. (2010). The bacterial cell envelope. *Cold Spring Harbor Perspectives in Biology*, 2(5): 1–16.

Silva, J. K. R., Pinto, L. C., Burbano, R. M. R., Montenegro, R. C., Andrade, E. H. A. & Maia, J. G. S. (2016). Composition and cytotoxic and antioxidant activities of the oil of *Piper aequale* Vahl. *Lipids in Health and Disease*, 15: 174.

Silva, M. L. A., Coímbra, H. S., Pereira, A. C., Almeida, V. A., Lima, T. C., Costa, E. S., Vinholis, A. H., Royo, V. A., Silva, R., Filho, A. A. S., Cunha, W. R., Furtado, N. A. J. C., Martins, C. H. G., Calvalho, T. C. & Bastos, J. K. (2007). Evaluation of *Piper cubeba* extract, (-)-cubebin and its semi-synthetic derivatives against oral pathogens. *Phytotheraphy Research*, 21: 420–422.

Simoes, M., Simoes, L. C.& Vieira, M. J. (2010). A review of current and emergent biofilm control strategies. *LWT - Food Science and Technology*, 43(4): 573–583.

Siroli, L., Patrignani, F., Serrazanetti, D. I., Tappi, S., Rocculi, P., Gardini, F. & Lanciotti, R. (2015). Natural antimicrobials to prolong the shelf-life of minimally processed lamb's lettuce. *Postharvest Biology and Technology*, 103: 35–44.

Sofowora, A., Ogunbodede, E. & Onayade, A. (2013). The role and place of medicinal plants in the strategies for disease prevention. *African Journal of Traditional, Complementary and Alternative medicines*, 10(5): 210-229.

Souza, E. L. De, Gramile, Q., Meira, S., Barbosa, I. D. M., Júlia, A., Aguiar, A., Conceicao, L. & Siqueira, J. P. De. (2014). Biofilm formation by *Staphylococcus aureus* from food contact surfaces in a meat-based broth and sensitivity to sanitizers. *Brazilian Journal of Microbiology*, 45(1): 67-75.

Sperber, W. H. & Tatini, S. R. (1975). Interpretation of the tube coagulase test for identification of *Staphylococcus aureus*. *Applied Microbiology*, 29(4): 502–5.

Stepanovic, S., Vukovic, D., Hola, V., Bonaventura, G. D. I., Djukic, S., Cirkovic, I. & Ruzicka, F. (2007). Quantification of biofilm in microtiter plates : overview of testing conditions and practical recommendations for assessment of biofilm production by staphylococci. *Journal Compilation*, 891–899.

Suginome, H. & Nakayama, Y. (1994). Photoinduced molecular transformations. Part 150. A new total synthesis of (+)-α-himachalene based on a sequence involving [2+2] photoaddition and regioselective p-scission of alkoxyl radicals generated from the resulting cyclobutanols. *Tetrahedron*, 50(26): 7771-7782.

Sugumaran, M., Suresh Gandhi, M., ankarnarayanan, K., Yokesh, M., Poornima, M. & Rajasekhar, S. (2011). Chemical composition and antimicrobial activity of vellaikodi variety of *Piper betle* Linn leaf oil against dental pathogens. *International Journal of PharmTech Research*, 3(4): 2135-2139.

Sun, C., Wu, Z., Wang, Z. & Zhang, H. (2015). Effect of ethanol/water solvents on phenolic profiles and antioxidant properties of Beijing propolis extracts. *Evidence-Based Complementary and Alternative Medicine.* Retrived from https://www.hindawi.com/journals/ecam/2015/595393/.

Supardy, N. A., Ibrahim, D., Sulaiman, S. F. & Zakaria, N. A. (2012). Inhibition of *Klebsiella pneumonia* ATCC 13883 by hexane extract of *Halimeda discoidea*

(Decaisne) and the identification of its potential bioactive compounds. *Journal of Microbiology and Biotechnology*, 22(6): 872-881.

Suzana, A. K. & Ferreira, S. R. S. (2013). Antioxidant activity of black pepper (*Piper nigrum* L.) oil obtained by supercritical CO_2. III Iberoamerican conference on super critical fluids, Cartagena de Indias (Colombia). www.nupeg.ufrn.br/prosciba/prosciba2013/Papers/T2-30.pdf.

Taemchuay, D. & Rukkwamsuk, T. (2009). Antibacterial activity of crude extracts of *Centella asiatica* against *Staphylococcus aureus* in bovine mastitis. *Kasetsart Veterinarians*, 19(3): 119–128.

Tagoe, D. N. A., Baidoo, S. E., Dadzie, I., Kangah, V. G. & Nyarko, H. D. (2010). A comparison of the antimicrobial (antifungal) properties of garlic, ginger and lime on *Aspergillus Flavus, Aspergillus Niger* and *Cladosporium Herbarum* using organic and water base extraction methods. *The Internet Journal of Tropical Medicine*, 7(1).

Taylor, P. W. (2013). Alternative natural sources for a new generation of antibacterial agents. *International Journal of Antimicrobial Agents*, 42(3): 195–201.

Teanpaisan, R., Senapong, S. & Puripattanavong, J. (2014). In vitro antimicrobial and antibiofilm activity of *Artocarpus Lakoocha* (Moraceae) extract against some oral pathogens. *Tropical Journal of Pharmaceutical Research*, 13(7): 1149–1155.

Thanh, M. D., Frentzel, H., Fetsch, A., Appel, B. & Mader, A. (2016). Impact of spiking techniques on the survival of *Staphylococcus aureus* in artificially contaminated condiments. *Food Control*, 73: 117-126.

Tiwari, B. K., Valdramidis, V. P., ODonnell, C. P., Muthukumarappan, K., Bourke, P. & Cullen, P. J. (2009). Application of natural antimicrobials for food preservation. *Journal Agricultural and Food Chemistry*, 57(14): 5987-6000.

Tomsik, A., Pavlic, B., Vladic, J., Ramic, M., Brindza, J. & Vidovic, S. (2016). Optimization of ultrasound-assisted extraction of bioactive compounds from wild garlic (*Allium ursinum* L.). *Ultrasonics Sonochemistry*, 29: 502-511.

Traversa, A., GAriano, G. R., Gallina, S., Bianchi, D. M., Orusa, R., Domenis, L., Cavallerio, P., Fossati, L., Serra, R. & Decastelli. L. (2015). Methicillin resistance in *Staphylococcus aureus* strains isolated from food and wild animal carcasses in Italy. *Food Microbiology*, 52: 154-158.

Trudeau, K., Dang, K. & Lacroix, M. (2012). Effect of gamma irradiation on the expressed proteins in the foodborne pathogen *Staphylococcus aureus*. *Radiation Physics and Chemistry*, 81(8): 1181–1184.

Velu, S., Abu Bakar, F., Mahyudin, N. A., Saari, N. & Zaman, M. Z (2014). *In vitro* antimicrobial activity of musk lime, key lime and lemon extracts against food related pathogenic and spoilage bacteria,. *International Food Research Journal*, 21(1): 379–386.

Vilgis, T. A. (2013). Texture, taste and aroma: multi-scale materials and the gastrophysics of food. *Flavour*, 2:12.

Vladic, J., Ramic, M., Brindza, J., Vidovic, S., Tomšik, A. & Pavlic, B. (2016). Optimization of ultrasound-assisted extraction of bioactive compounds from wild garlic (*Allium ursinum* L.). *Ultrasonics sonochemistry*, 29: 502–511.

Wakimoto, N., Nishi, J., Sheikh, J., Nataro, J. P., Sarantuya, J. A. V, Iwashita, M., Manago, K. Tokuda, K., Yoshinaga, M. & Kawano, Y. (2004). Quantitative biofilm assay using a microtiter plate to screen for enteroaggregative *Esherichia Coli*. *American Society of Tropical Medicine and Hygiene*, 71(5): 687–690.

Wang, Y. H. & Essenberg, M. (2010). Inhibitor and substrate activities of sesquiterpene olefins toward (+)-δ-cadinene-8-hydroxylase, a cytochrome P450 monooxygenase (CYP706B1). *Phytochemistry*, 71(2010), 1825-1831.

Waters, A. E., Contente-Cuomo, T., Buchhagen, J., Liu, C. M., Watson, L., Pearce, K., Foster, J. T., Bowers, J., Driebe, E. M., Engelthaler, D. M., Keim, P. S. & Price, L. B. (2011). Multidrug-resistant *Staphylococcus aureus* in US meat and poultry. *Clinical Infectious Diseases*, 52(10): 1227–1230.

Weerakkody, N. S., Caffin, N., Turner, M. S. & Dykes, G. A. (2010). In vitro antimicrobial activity of less-utilized spice and herb extracts against selected food-borne bacteria. *Food Control*, 21(10): 1408–1414.

Wei, M-C., Xiao, J. & Yang, Y-C. (2016). Extraction of α-humulene-enriched oil from clove using ultrasound-assisted supercritical carbon dioxide extraction and studies of its fictitious solubility. *Food Chemistry*, 210(2016): 172-181.

Witkowska, A. M., Hickey, D. K., Alonso-Gomez, M. & Wilkinson, M. (2013). Evaluation of antimicrobial activities of commercial herb and spice extracts against selected food-borne bacteria. *Journal of Food Research*, 2(4): 37–54.

World Health Organisation (WHO). (2016). Who's first ever global estimates of foodborne diseases find children under 5 account for almost one third of deaths.

World Health Organisation (WHO). (2007). Food safety and foodborne illness. Fact Sheet. WHO, 2007.

World Health Organisation (WHO). (2005). WHO Traditional Medicine Strategy 2002–2005' WHO/EDM/ TRM/2002.1, 2002.

Wu, C. (2014). An important player in brine shrimp lethality bioassay. The solvent. *Journal of Advanced Pharmaceutical Technology and Research*, 5(1): 57-58.

Xu, G., Wang, Z., Zhao, B., Liu, N., Yang, S., Liu, Y., Wang, J. & Zhou, X. (2016). Saniculamins A and B, two new flavonoids from *Sanicula lamelligera* Hance inhibiting LPS-induced nitric oxide release. *Phytochemistry Letters*, 18: 35-38.

Yan, S. W. & Asmah, R. (2010). Comparison of total phenolic contents and antioxidant activities of turmeric leaf, pandan leaf and torch ginger flower. *International Food Research Journal*, 17: 417–423.

Yang, X., Khan, I. & Kang, S. C. (2015). Antibacterial activities of ethanol extracts of Philippine medicinal plants against multidrug-resistant bacteria. *Pacific Journal of Tropical Medicine*, 8(9): 694–700.

Yang, A-H., H, X., Chen, J-X., He, L-N., Jin, C-H., Wang, L-L., Zhang, F-L. & An, L-J. (2015). Identification and characterization of reactive metabolites in

myristicin-mediated mechanism-based inhibition of CYP1A2. *Chemico-Biological Interactions*, 237(2015).: 133-140.

Yusoff, N. A. H., Noor, N. F. & Rukayadi, Y. (2015). Effects of *Cosmos caudatus* Kunth. (Ulam Raja) extract on microflora in raw chicken meat. *International Journal of Current Microbiology and Applied Sciences*, 2(2): 426–435.

Zaveri, M., Khandhar, A., Patel, S. & Patel, A. (2010). Chemistry and pharmacology of *Piper longum* L. *International Journal of Pharmaceutical Sciences Review and Research*, 5(1): 67–76.