UNIVERSITI PUTRA MALAYSIA

PREPARATION AND CHARACTERIZATION OF CANTALOUPE (Cucumis melo L. reticulatus cv. Glamour) FRUIT POWDER USING FOAM MAT DRYING AND SPRAY DRYING

TAN SUET LI

FSTM 2021 16

PREPARATION AND CHARACTERIZATION OF CANTALOUPE (*Cucumis melo* L. *reticulatus* cv. Glamour) FRUIT POWDER USING FOAM MAT DRYING AND SPRAY DRYING

By

TAN SUET LI

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

July 2020

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Master of Science

PREPARATION AND CHARACTERIZATION OF CANTALOUPE (*Cucumis melo* L. *reticulatus* cv. Glamour) FRUIT POWDER USING FOAM MAT DRYING AND SPRAY DRYING

By

TAN SUET LI

July 2020

Chair : Rabiha Binti Sulaiman, PhD
Faculty : Food Science and Technology

Fresh cantaloupe is highly perishable and has a short shelf life. Therefore, drying is used to preserve the quality of cantaloupe fruit in the form of powder that is stable over a longer storage period. The objectives of this research were (i) to evaluate the effect of Arabic gum concentration on the foam properties, drying curve and physicochemical properties of foam mat dried cantaloupe powder, (ii) to evaluate the effect of Arabic gum concentration on physicochemical properties of spray dried cantaloupe powder, (iii) to determine the storage stability of foam mat dried and spray dried cantaloupe powder at room temperature (25 ± 2 °C, 50-70% RH) and accelerated condition (38 ± 2 °C, 90 ± 2% RH) and (iv) to determine the rheological properties of cake icing incorporated with foam mat dried and spray dried cantaloupe powder. Cantaloupe puree (with pulp) was foam mat dried (FMD) using Arabic gum (AG) at different concentrations (0-15%) in cabinet dryer at 55 °C with 3 mm foam thickness. The results showed that cantaloupe pulp with 10% AG gave better foam properties. Page model fitted well the drying curve of FMD of cantaloupe. FMD cantaloupe powder with 10% AG showed better flowability and lower moisture content, hygroscopicity and cohesiveness. For spray drying, cantaloupe juice (without pulp) was dried with AG concentrations (0-15%) at inlet temperature at 170 °C and outlet temperature at 90 °C. Spray dried (SD) cantaloupe powder produced with 10% AG exhibited the best quality in terms of moisture content, hygroscopicity, hue, water solubility index and total carotenoid content. Therefore, FMD and SD cantaloupe powders with 10% AG were chosen for storage study and application in cake icing. After 6 months of storage, FMD and SD cantaloupe powders were safe to be consumed as the total plate count, yeast and mould and *Bacillus cereus* had less than 4.40 and 3.38 log CFU/ml, respectively. The degradation of carotenoid content of cantaloupe powders followed first order reaction. A rheological test was done on the cake icing incorporated with 10% AG of FMD and SD cantaloupe powder in the temperature range of 15 to 35 °C. Cake icing incorporated with cantaloupe powders fitted the Power law model and the flow behaviour index (n) of the icings were between 0.104 and 0.156 showed no significant difference ($p > 0.05$) with the control sample. The icing incorporated with FMD and SD cantaloupe powder showed higher b* value compared to the control sample. FMD and SD cantaloupe powder can be used as a natural colourant and are suitable for confectionery products such as cake icing. The data in this study is useful in food product development and the use of AG could provide more information in foam mat drying using AG as carrier agent.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains

PENYEDIAAN DAN PENCIRIAN SERBUK TEMBIKAI WANGI (*Cucumis melo* L. *reticulatus* cv. Glamour) DENGAN CARA PENGERINGAN BUIH DAN SEMBURAN

Oleh

TAN SUET LI

Julai 2020

Pengerusi : Rabiha Binti Sulaiman, PhD
Fakulti : Sains dan Teknologi Makanan

Tembikai wangi adalah sumber karotenoid, fenolik, flavonoid, karbohidrat dan mineral yang sangat baik. Tembikai wangi yang segar sangat mudah rosak dan mempunyai jangka hayat yang pendek. Oleh itu, pengeringan digunakan untuk mengekalkan kualiti buah tembikai wangi dalam bentuk serbuk yang stabil dalam tempoh penyimpanan yang lebih lama. Tujuan kajian ini adalah (i) untuk mengenalpasti kesan kepekatan gam arabik terhadap sifat buih, lengkungan pengeringan dan sifat fizikokimia dari serbuk tembikai wangi yang dibuih kering, (ii) untuk mengenalpasti kesan kepekatan gam arabik terhadap sifat fizikokimia dari serbuk tembikai wangi yang disembur kering, (iii) untuk menentukan kestabilan penyimpanan serbuk tembikai wangi yang dibuih dan disembur kering pada suhu bilik (25 ± 2 °C, 50-70% RH) dan keadaan dipercepat (38 ± 2 °C, 90 ± 2% RH) dan (iv) untuk mengkaji sifat reologi aising kek yang dicampur dengan serbuk tembikai wangi yang dibuih dan disembur kering. Puri tembikai wangi (dengan pulpa) dibuih kering dengan pelbagai kepekatan gam arabik (GA) (0-15%) dalam pengeringan kabinet di bawah suhu 55 °C dan ketebalan buih pada 3 mm. Keputusan menunjukkan bahawa pulpa tembikai wangi dengan 10% GA menunjukkan sifat buih yang lebih baik. Model Page didapati sesuai untuk lengkungan pengeringan buih buah tembikai wangi. Serbuk tembikai wangi yang dibuih kering yang dihasilkan dengan 10% GA menunjukkan pengaliran yang baik dan kandungan kelembapan, penyerapan air dan kohesif yang lebih rendah. Bagi pengeringan semburan, jus tembikai wangi (tanpa pulpa) dikeringkan dengan kepekatan GA (0-15%) di bawah suhu udara masuk pada 170°C dan suhu udara keluar pada 90 °C. Dalam pengeringan semburan, serbuk tembikai wangi yang dihasilkan dengan 10% GA mempunyai kualiti yang terbaik dari segi kandungan kelembapan, penyerapan air, warna, kelarutan air dan jumlah kandungan karotenoid. Oleh itu, serbuk tembikai wangi yang dibuih dan disembur kering dengan 10% GA dipilih untuk kajian yang seterusnya dalam penyimpanan dan aising kek.

Selepas 6 bulan penyimpanan, serbuk tembikai wangi yang dibuih dan disembur kering adalah selamat digunakan kerana jumlah bilangan plat, yis dan *Bacillus cereus* mempunyai kurang daripada 4.40 dan 3.38 log CFU/ml, masing-masing. Degradasi kandungan karotenoid pada serbuk tembikai wangi mengikut jenis reaksi terbitan pertama. Ujian reologi bagi aising kek yang dicampurkan dengan 10% GA serbuk tembikai wangi yang dibuih dan disembur kering dijalankan pada suhu 15 hingga 35 °C. Aising yang dicampurkan dengan serbuk tembikai wangi mempamerkan kelakuan reologi mengikut Power law dan indeks kelakuan aliran (n) bagi aising adalah antara 0.104 dan 0.156 menunjukan tiada perbezaan yang signifikan ($p > 0.05$) dengan sample kawalan. Aising yang dicampurkan dengan serbuk tembikai wangi yang dibuih dan disembur kering menunjukkan b* yang lebih tinggi berbanding dengan sample kawalan. Serbuk tembikai yang dibuih dan disembur kering boleh digunakan untuk pewarna yang semula jadi dan sesuai untuk produk gula-gula seperti icing kek. Data dalam kajian in berguna dalam pengembangan produk makanan dan penggunaan GA dapat memberikan lebih banyak maklumat dalam pengeringan dibuih kering menggunakan GA sebagai agen pembawa.

ACKNOWLEDGEMENTS

First of all, I would like to express my sincere gratitude to my supervisor, Assoc Prof. Dr. Rabiha Sulaiman, for her invaluable guidance, advice and constant encouragement throughout the course of my research study. Appreciation and gratitude also go to the members of my supervisory committee, Assoc. Prof. Dr. Yaya Rukayadi and Dr. Nurul Shazini Ramli for their generous advice and support to guide me during my study.

My sincere thanks to the staffs of the Faculty of Food Science and Technology, UPM for providing the research facilities and technical assistance during my study. Special thanks are also extended to my lab mates at Food Processing Lab (Food 5), Faculty Food Science and Technology, UPM, and friends for their assistance and moral support to make my study in UPM a delight and wonderful experience. Special thanks to Mr. Faizal, Alrijal Agronomy Sdn. Bhd. for providing us the fresh cantaloupe fruit.

Last but not least, my deepest appreciation to my beloved family for giving me endless support and encouragement to me. I also wish to express my deepest appreciation to my friends, for their support and encouragement. Special dedication to Mr. Kong Wei Hang, for your faith and care in me. Thank you.

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

Rabiha binti Sulaiman, PhD
Associate Professor
Faculty of Food Science and Technology
Universiti Putra Malaysia
(Chairman)

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

Nurul Shazini binti Ramli, PhD
Senior Lecturer
Faculty of Food Science and Technology
Universiti Putra Malaysia
(Member)

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

Date: 14 January 2021

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.: ______Tan Suet LI (GS 49894)__________

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

%	Percentage
°C	Degree celcius
η_{100}	Apparent viscosity
aw	Water activity
a*	Redness or greenness
AC	Accelerated condition
AG	Arabic gum
$AlCl_3$	Aluminium chloride
b*	Yellowness or blueness
CFU/g	Colony forming unit per gram
CFU/ml	Colony forming unit per milliliter
E_a	Activation energy
g	Gram
k	Reaction rate constant
K	Consistency coefficient
kJ/mol	Kilo joule per mol
L*	Lightness
M	Mol
mg GAE/g	Milligran gallic acid per gram
mg RE/g	Milligram rutin per gram
Min	Minute
ml	Millilitre
mm	Millimetre
n	Flow behaviour index

$NaNO_2$	Sodium nitrite
NaOH	Sodium hydroxide
NEB	Non-enzymatic browning
nm	Nanometre
Pa s	Pascal second
QE	Quercetin
RH	Relative humidity
RT	Room temperature
s	Second
$t_{1/2}$	Half-life
TCC	Total carotenoid content
TFC	Total flavonoid content
T_g	Glass transition temperature
TPC	Total phenolic content
ug	Microgram
wt/wt	Weight per weight
h	Hour

CHAPTER 1

INTRODUCTION

1.1 Research background

Cantaloupe (*Cucumis melo* L. *reticulatus* cv. Glamour), is also known as rockmelon or muskmelon, a member of the *Cucurbitaceae* family. Cantaloupe is a round melon with a network of intertwining vines at the outside and contains succulent, sweet, fragrant yellow-orange colour flesh inside. There are several major pigments found in cantaloupe such as carotene and lutein, and few minor pigments such as cryptoxanthin, phytoene, violaxanthin, and zeaxanthin. Cantaloupe produces yellow-orange flesh due to the presence of carotenoids which are the most abundant natural pigments in fruits and vegetables. Carotenoid is a group of phytochemicals that plays a vital role as antioxidant in human which can prevent or repair cells and tissues from oxidative damages and diminish risk for different kinds of cancer, cardiovascular or ophthalmological illness (Stahl & Sies, 2003). Carotenoids intakes are associated with the reduction of breast cancer risk. Cantaloupe is also an excellent source of vitamin C, β-carotene, folic acid, dietary fiber and potassium, which provides many potential health benefits to the consumers (Aune et al., 2012).

Cantaloupe is available year-round in Malaysia. Department of Agriculture (DOA) reported that the cantaloupe production was increased from 3515.1 metric ton to an average of 4452.2 metric ton from 2014 to 2017 (DOA, 2017). Cantaloupe has a high commercial value and is much accepted by the consumer because of its special taste and high nutritional characteristic. However, the fruit is highly perishable and its postharvest shelf life is limited to about 2 weeks. During the seasonal period, large amounts of cantaloupe fruits were produced and led to quality degradation such as excessive softening and flavor deterioration. Moreover, the presence of high amounts of water and sugar in cantaloupe fruit susceptible to spoilage by yeasts, moulds and bacteria (Tournas et al., 2006). In order to overcome these problems, drying is one of the processes can be used to preserve the product, inhibit or slow down microbial growth and product degradation in order to prolong its product shelf life (Hardy & Jideani, 2017). Fruit powder is easier to carry and store as it cuts down the volume and the shelf life of the fruit powder is longer. Fruit powder is usually used as ready to drink fruit powder and consumed straightly as revitalizing drink after dissolving in water. It can also use as an ingredient in beverage, soup, jelly, pudding, cake, and ice cream.

There are few drying techniques that are available to produce fruit powders such as convective drying, freeze drying, spray drying, foam mat drying, microwave drying and vacuum drying. However, Karam et al. (2016) reported that every type of drying technique has its strengths and weaknesses. The physicochemical properties of the fruit powder are varied according to the drying techniques and conditions. Among the different drying techniques, the most frequent and widely used by the industry is spray drying (Phisut, 2012); as it provides rapid drying through continuous operation. However, the high temperature (can be more than 200 °C) used in spray drying might cause oxidative degradation to the thermal sensitive compounds (Anwar & Kunz, 2011; Shishir & Chen, 2017). In addition, spray drying of fruit juice is not easy due to the existence of low molecular weight sugar and organic acid contents in the fruit juice. During drying, the low molecular weight of sugar and organic acid will remain as syrup or stick on the drier chamber wall. Thus, appropriate setting of drying parameters such as inlet temperature, outlet temperature, feed flow rate, air drying speed and types of carrier agent and its concentration are important to produce high quality of spray dried powder (Chegini et al., 2008). To ease the process, high molecular weight of substances, for instance, maltodextrin, Arabic gum, tapioca starch and whey protein are utilized as carrier agents in spray drying of fruit juice to increase the glass transition temperature and reduce the stickiness of the powder (Darniadi et al., 2018; Yousefi et al., 2011). Thus, a less hygroscopic and excellent flowability powder can be produced. Besides, Arabic gum has high solubility and low viscosity properties that speeds up the spray drying process (Tonon et al., 2011).

Hardy and Jideani (2017) revealed that the drying of fruit pulp in foam mat drying is the simplest, cheapest and convenient technique to produce fruit powder. There are three simple steps in foam mat drying: (i) adding foaming agent or stabilizer to the feed solution followed by a whipping process to produce stable foam, (ii) drying the thin layer foamed liquid, and (iii) grinding the dried flakes to get fine powder (Raharitsifa & Ratti, 2010; Shaari et al., 2018). When comparing to the non-foamed sample in similar sort of dryer and conditions, the advantages of utilization of foam mat drying are lower dehydration temperature and shorter dehydration period (Widyastuti & Srianta, 2011). Foaming agents commonly used in foam mat drying are protein, gum and various emulsifiers. Stable foam is important to enable a high speed of drying and produce desirable characteristic of dry product, for example good rehydration properties and high retention of volatiles compounds (Wilson et al., 2012).

Cantaloupe fruit was chosen in this study as the cantaloupe producer from Jeram and Kuala Selangor approached us and requested for cantaloupe-based product which can have longer shelf life. Since there is lack of information on the effect of carrier agent concentration on qualitative and quantitative indicators of foam mat dried and spray dried cantaloupe powder, storage stability of the cantaloupe powder and rheological properties of its food application such as in cake icing. Research on the effect of Arabic gum concentration and drying methods on physicochemical properties of cantaloupe powder contributes a nutritious and accessible cantaloupe fruit powder to all society.

1.2 Problem statement

Cantaloupe fruit is seasonal fruit with short shelf life. During harvest time, a large amount of cantaloupe is produced, and consequently quality degradation of the fruit has happened. To develop a long shelf stable cantaloupe product, drying method is one of the greatest choices in post-harvest technology. However, cantaloupe fruit has high sugar content and low glass transition temperature and it also contains heat sensitive bioactive compounds which are not stable for thermal processing. Among various drying treatments, foam mat drying is one of the most suitable methods to dehydrate any heat sensitive and sticky products as foam mat drying can be carried out at lower temperature and shorter time compared to conventional hot air drying method. Spray drying is also used to produce heat sensitive product as its drying time is very short (~5 s). Moreover, choosing a suitable Arabic gum concentration is crucial in foam mat drying and spray drying since it can affect the overall final quality of the fruit powder. In addition, there is lack of previous study on (i) the effect of Arabic gum concentration on cantaloupe powder using foam mat drying methods, (ii) the effect of storage condition on the cantaloupe powder and (iii) the food application of cantaloupe powder in confectionery. Therefore, in this study, cantaloupe powder could help in developing a healthy and indulgent confectionery product such as cake icing to all society especially dessert lover.

1.3 Objectives

The research aims to produce high quality cantaloupe powder using foam mat drying and spray drying methods with suitable concentration of Arabic gum. To achieve the aim, several objectives were stated as follows:

a) To evaluate the drying curve, foam properties and physicochemical properties of foam mat dried cantaloupe powder produced using different concentration of Arabic gum

b) To evaluate the physicochemical properties of spray dried cantaloupe powder produced using different concentrations of Arabic gum

c) To determine the effect of storage conditions on physicochemical properties and microbiological analyses of foam mat dried and spray dried cantaloupe powders

d) To evaluate the effect of temperature on the rheological properties of cake icing incorporated with foam mat dried and spray dried cantaloupe powders

1.4 Scope and limitation of research

This study was conducted to produce foam mat dried and spray dried cantaloupe powders using four various Arabic gum concentrations. Understanding the physicochemical properties and microbiological analyses of cantaloupe powder on storage condition is important for food engineer to calculate the shelf life of the product and aids the food producer and consumers to choose the suitable conditions for storage. The originality of this study is lack of previous study have been done on (i) foam mat drying using various Arabic gum concentration as drying aid, (ii) storage stability of foam mat dried and spray dried cantaloupe powder and (iii) application of cantaloupe powder on cake icing. The limitation of this study is the finding from this research is specific for the selected drying methods and conditions for *Cucumis melo* L. *reticulatus* cv. Glamour fruit.

REFERENCES

Abbasi, E., & Azizpour, M. (2016). Evaluation of physicochemical properties of foam mat dried sour cherry powder. *LWT-Food Science and Technology*, *68*, 105-110.

Adhikari, B., Howes, T., Bhandari, B. R., Yamamoto, S., & Truong, V. (2002). Application of a simplified method based on regular regime approach to determine the effective moisture diffusivity of mixture of low molecular weight sugars and maltodextrin during desorption. *Journal of Food Engineering*, *54*(2), 157-165.

Adiba, B. D., Salem, B., Nabil, S., & Abdelhakim, M. (2011). Preliminary characterization of food tablets from date (*Phoenix dactylifera* L.) and spirulina (*Spirulina* sp.) powders. *Powder Technology*, *208*(3), 725-730.

Ajuru, M. G., & Okoli, B. E. (2013). The morphological characterization of the melon species in the family Cucurbitaceae Juss., and their utilization in Nigeria. *International Journal of Modern Botany*, *3*(2), 15-19.

Alvarez, M. D., Fernández, C., & Canet, W. (2004). Rheological behaviour of fresh and frozen potato puree in steady and dynamic shear at different temperatures. *European Food Research and Technology*, *218*(6), 544-553.

Amandikwa, C., & Chinyere, E. (2012). Proximate and functional properties of open air, solar and oven dried cocoyam flour. *International Journal of Agriculture and Rural Development*, *15*(2), 988-994.

Amchova, P., Kotolova, H., & Ruda-Kucerova, J. (2015). Health safety issues of synthetic food colorants. *Regulatory Toxicology and Pharmacology*, *73*(3), 914-922.

Anwar, S. H., & Kunz, B. (2011). The influence of drying methods on the stabilization of fish oil microcapsules: Comparison of spray granulation, spray drying, and freeze drying. *Journal of Food Engineering*, *105*(2), 367–378.

AOAC. (2005). Official methods of analysis of AOAC International. 18th edition. Gaithersburg, Maryland. Method no. 940.31 and 950.46: Association of Analytical Communities.

Archaina, D., Vasile, F., Jiménez-Guzmán, J., Alamilla-Beltrán, L., & Schebor, C. (2019). Physical and functional properties of roselle (*Hibiscus sabdariffa* L.) extract spray dried with maltodextrin-gum arabic mixtures. *Journal of Food Processing and Preservation*, *43*(9), e14065.

Aruna, R., Kumar, K. V. P., & Jayamma, P. (2017). Standardization and proximate analysis of muskmelon jam. *International Journal of Agricultural Science and Research*, *7*(5), 329-344.

Asokapandian, S., Venkatachalam, S., Swamy, G. J., & Kuppusamy, K. (2016). Optimization of foaming properties and foam mat drying of muskmelon using soy protein. *Journal of Food Process Engineering*, *39*(6), 692-701.

Aune, D., Chan, D. S. M., Vieira, A. R., Navarro Rosenblatt, D. A., Vieira, R., Greenwood, D. C., & Norat, T. (2012). Fruits, vegetables and breast cancer risk: A systematic review and meta-analysis of prospective studies. *Breast Cancer Research and Treatment*, *134*(2), 479–493.

Auisakchaiyoung, T., & Rojanakorn, T. (2015). Effect of foam-mat drying conditions on quality of dried Gac fruit (*Momordica cochinchinensis*) aril. *International Food Research Journal*, *22*(5), 2025-2031.

Ayadi, A., Mechlouch, R. F., Bessaoud, C., Bennour, H., & Debouba, M. (2014). Effect of microwave and solar drying methods on the physico-chemical properties of kiwifruit. *Journal of Agricultural Technology*, *10*(4), 365-379.

Azeez, L., Adebisi, S. A., Oyedeji, A. O., Adetoro, R. O., & Tijani, K. O. (2017). Bioactive compounds' contents, drying kinetics and mathematical modelling of tomato slices influenced by drying temperatures and time. *Journal of the Saudi Society of Agricultural Sciences*, *18*(2), 120-126.

Azizpour, M., Mohebbi, M., & Khodaparast, M. H. H. (2016). Effects of foam-mat drying temperature on physico-chemical and microstructural properties of shrimp powder. *Innovative Food Science & Emerging Technologies*, 34, 122-126.

Azizpour, M., Mohebbi, M., Khodaparast, M. H. H., & Varidi, M. (2013). Foam-mat drying of shrimp: characterization and drying kinetics of foam. *Agricultural Engineering International: CIGR Journal*, *15*(3), 159-165.

Bag, S. K., Srivastav, P. P., & Mishra, H. N. (2011). Optimization of process parameters for foaming of bael (*Aegle marmelos* L.) fruit pulp. *Food and Bioprocess Technology*, *4*(8), 1450-1458.

Bakar, J., Ee, S. C., Muhammad, K., Hashim, D. M., & Adzahan, N. (2013). Spray-drying optimization for red pitaya peel (Hylocereus polyrhizus). *Food and Bioprocess Technology*, *6*(5), 1332-1342.

Barbosa, M. I. M. J., Borsarelli, C. D., & Mercadante, A. Z. (2005). Light stability of spray-dried bixin encapsulated with different edible polysaccharide preparations. *Food Research International*, *38*(8-9), 989-994.

Benelli, L., Souza, C. R., & Oliveira, W. P. (2013). Quality changes during spouted bed drying of Pepper-Rosmarin extract. *The Canadian Journal of Chemical Engineering*, *91*(11), 1837-1846.

Bhusari, S. N., Muzaffar, K., & Kumar, P. (2014). Effect of carrier agents on physical and microstructural properties of spray dried tamarind pulp powder. *Powder Technology*, *266*, 354-364.

Biswas, N., Cheow, Y. L., Tan, C. P., & Siow, L. F. (2017). Physical, rheological and sensorial properties, and bloom formation of dark chocolate made with cocoa butter substitute (CBS). *LWT-Food Science and Technology*, *82*, 420-428.

Breda, C. A., Sanjinez-Argandoña, E. J., & de AC Correia, C. (2012). Shelf life of powdered Campomanesia adamantium pulp in controlled environments. *Food Chemistry*, *135*(4), 2960-2964.

Caliskan, G., & Dirim, S. N. (2016). The effect of different drying processes and the amounts of maltodextrin addition on the powder properties of sumac extract powders. *Powder Technology*, *287*, 308-314.

Camacho, M. M., Martinez-Navarrete, N., & Chiralt, A. (2005). Rheological characterization of experimental dairy creams formulated with locust bean gum (LBG) and λ-carrageenan combinations. *International Dairy Journal*, *15*(3), 243-248.

Caparino, O. A., Nindo, C. I., Tang, J., Sablani, S. S., Chew, B. P., Mathison, B. D., Fellman, J. K., & Powers, J. R. (2017). Physical and chemical stability of Refractance Window®–dried mango (*Philippine 'Carabao'var.*) powder during storage. *Drying Technology*, *35*(1), 25-37.

Carmona, P. A. O., Garcia, L. C., de Aquino Ribeiro, J. A., Valadares, L. F., de Figueiredo Marçal, A., de França, L. F., & Mendonça, S. (2018). Effect of solids content and spray-drying operating conditions on the carotenoids microencapsulation from pressed palm fiber oil extracted with supercritical CO_2. *Food and Bioprocess Technology*, *11*(9), 1703-1718.

Caro, Y., Anamale, L., Fouillaud, M., Laurent, P., Petit, T., & Dufosse, L. (2012). Natural hydroxyanthraquinoid pigments as potent food grade colorants: an overview. *Natural Products and Bioprospecting*, *2*(5), 174-193.

Carvalho, M. J., Perez-Palacios, T., & Ruiz-Carrascal, J. (2017). Physico-chemical and sensory characteristics of freeze-dried and air-dehydrated yogurt foam. *LWT-Food Science and Technology, 80*, 328-334.

Chang, L. S., Karim, R., Abdulkarim, S. M., Yusof, Y. A., & Ghazali, H. M. (2018). Storage stability, color kinetics and morphology of spray-dried soursop (*Annona muricata* L.) powder: effect of anticaking agents. *International Journal of FoodPproperties*, *21*(1), 1937-1954.

Chauhan, A. K., & Patil, V. (2013). Effect of packaging material on storage ability of mango milk powder and the quality of reconstituted mango milk drink. *Powder Technology*, *239*, 86-93.

Chavan, R., Kumar, A., Basu, S., Nema, P. K., & Nalawade, T. (2015). Whey based tomato soup powder: rheological and color properties. *International Journal of Agricultural Science and Research*, *1*, 301-314.

Chegini, G. R., Khazaei, J., Ghobadian, B., & Goudarzi, A. M. (2008). Prediction of process and product parameters in an orange juice spray dryer using artificial neural networks. *Journal of Food Engineering*, *84*(4), 534–543.

Chen, L. (2015). Emulsifiers as food texture modifiers. In Modifying Food Texture. Woodhead Publishing, 27-49.

Chenlo, F., Moreira, R., & Silva, C. (2011). Steady-shear flow of semidilute guar gum solutions with sucrose, glucose and sodium chloride at different temperatures. *Journal of Food Engineering*, *107*(2), 234-240.

Chranioti, C., Nikoloudaki, A., & Tzia, C. (2015). Saffron and beetroot extracts encapsulated in maltodextrin, gum Arabic, modified starch and chitosan: Incorporation in a chewing gum system. *Carbohydrate Polymers*, *127*, 252-263.

Chuah, T. G., Ling, H. L., Chin, N. L., Choong, T. S., & Fakhru'l-Razi, A. (2008). Effects of temperatures on rheological behavior of dragon fruit (*Hylocereus* sp.) juice. *International Journal of Food Engineering*, *4*(7), 1-28.

Colle, I. J., Lemmens, L., Knockaert, G., Van Loey, A., & Hendrickx, M. (2016). Carotene degradation and isomerization during thermal processing: A Review on the kinetic aspects. *Critical Reviews in Food Science and Nutrition, 56*(11), 1844-1855.

Costa, S. S., Machado, B. A. S., Martin, A. R., Bagnara, F., Ragadalli, S. A., & Alves, A. R. C. (2015). Drying by spray drying in the food industry: micro-encapsulation, process parameters and main carriers used. *African Journal of Food Science*, *9*(9), 462-470.

Coultate, T., & Blackburn, R. S. (2018). Food colorants: their past, present and future. *Coloration Technology*, *134*(3), 165-186.

Darniadi, S., Ho, P., & Murray, B. S. (2018). Comparison of blueberry powder produced via foam-mat freeze-drying versus spray-drying: evaluation of foam and powder properties. *Journal of the Science of Food and Agriculture, 98*(5), 2002-2010.

Dauqan, E., & Abdullah, A. (2013). Utilization of gum arabic for industries and human health. *American Journal of Applied Sciences*, 10(10), 1270-1279.

Daza, L. D., Fujita, A., Fávaro-Trindade, C. S., Rodrigues-Ract, J. N., Granato, D., & Genovese, M. I. (2016). Effect of spray drying conditions on the physical properties of Cagaita (*Eugenia dysenterica* DC.) fruit extracts. *Food and Bioproducts Processing, 97*, 20-29.

de Carvalho Tavares, I. M., Sumere, B. R., Gómez-Alonso, S., Gomes, E., Hermosín-Gutiérrez, I., Da-Silva, R., & Lago-Vanzela, E. S. (2019). Storage stability of the phenolic compounds, color and antioxidant activity of jambolan juice powder obtained by foam mat drying. *Food Research International*, 128, 108750.

de Castilhos, M. B. M., Betiol, L. F. L., de Carvalho, G. R., & Telis-Romero, J. (2018). Experimental study of physical and rheological properties of grape juice using different temperatures and concentrations. Part II: Merlot. *Food Research International*, *105*, 905-912.

de Melo, M. L. S., Narain, N., & Bora, P. S. (2000). Characterisation of some nutritional constituents of melon (*Cucumis melo* hybrid AF-522) seeds. *Food Chemistry*, *68*(4), 411-414.

de Souza, V. B., Fujita, A., Thomazini, M., da Silva, E. R., Lucon Jr, J. F., Genovese, M. I., & Favaro-Trindade, C. S. (2014). Functional properties and stability of spray-dried pigments from Bordo grape (*Vitis labrusca*) winemaking pomace. *Food Chemistry*, *164*, 380-386.

Dehghannya, J., Pourahmad, M., Ghanbarzadeh, B., & Ghaffari, H. (2018). Heat and mass transfer modeling during foam-mat drying of lime juice as affected by different ovalbumin concentrations. *Journal of Food Rngineering*, *238*, 164-177.

Dehghannya, J., Pourahmad, M., Ghanbarzadeh, B., & Ghaffari, H. (2019). A multivariable approach for intensification of foam-mat drying process: Empirical and three-dimensional numerical analyses. *Chemical Engineering and Processing-Process Intensification*, *135*, 22-41.

Dhaliwal, M. S. (2017). *Handbook of vegetable crops: Chapter 5 Cucurbits* (3rd ed.). Delhi: Kalyani Publisher

Deepa C. K. & Krishnaprabha V. (2014). Development and nutrient, antioxidant and microbial analysis of muskmelon and whey water and probiotic incorporated squash. *International Journal of Current Microbiology and Applied Sciences, 3*(5), 267-271.

Desai, K. G. H., & Jin Park, H. (2005). Recent developments in microencapsulation of food ingredients. *Drying Technology*, *23*(7), 1361-1394.

Deshmukh, P. S., Manjunatha, S. S., & Raju, P. S. (2015). Rheological behaviour of enzyme clarified sapota (Achras sapota L) juice at different concentration and temperatures. *Journal of Food Science and Technology*, *52*(4), 1896-1910.

Dianat, M., Taghizadeh, M., Shahidi, F., & Razavi, S. M. A. (2017). The flow properties of honey–malt spread. *Food Science and Technology International*, *23*(5), 415-425.

Dias, J., Almeida, M., Adikevičius, D., Andzevičius, P., & Alvarenga, N. (2016). Impact of olive oil usage on physical properties of chocolate fillings. *Grasas y aceites*, *67*(3), e145.

DOA, (2017). Fruit crops statistic. Department of Agriculture Malaysia, Putrajaya, Malaysia.

Du, J., Ge, Z. Z., Xu, Z., Zou, B., Zhang, Y., & Li, C. M. (2014). Comparison of the efficiency of five different drying carriers on the spray drying of persimmon pulp powders. *Drying Technology*, *32*(10), 1157-1166.

Dutta, D., Dutta, A., Raychaudhuri, U., & Chakraborty, R. (2006). Rheological characteristics and thermal degradation kinetics of beta-carotene in pumpkin puree. *Journal of Food Engineering*, *76*(4), 538-546.

Edris, A. E., Kalemba, D., Adamiec, J., & Piątkowski, M. (2016). Microencapsulation of *Nigella sativa oleoresin* by spray drying for food and nutraceutical applications. *Food Chemistry*, *204*, 326-333.

Ee, S. C., Jamilah, B., Muhammad, K., Hashim, D. M., & Adzahan, N. (2014). Physico-chemical properties of spray-dried red pitaya (*Hylocereus polyrhizus*) peel powder during storage. *International Food Research Journal*, *21*(1), 155-160.

Ekpong, A., Phomkong, W., & Onsaard, E. (2016). The effects of maltodextrin as a drying aid and drying temperature on production of tamarind powder and consumer acceptance of the powder. *International Food Research Journal*, *23*(1), 300-308.

Esteras, C., Rambla, J. L., Sánchez, G., López-Gresa, M. P., González-Mas, M. C., Fernández-Trujillo, J. P., Bellés, J. M. & Picó, M. B. (2018). Fruit flesh volatile and carotenoid profile analysis within the *Cucumis melo* L. species reveals unexploited variability for future genetic breeding. *Journal of the Science of Food and Agriculture*, *98*(10), 3915-3925.

Evaranuz E. Ö. (2015). Dehydration of vegetables. In Y. H. Hui & E. Ö. Evranuz (Ed.), *Handbook of Vegetable Preservation and Processing* (pp. 175-200). Florida: CRC press.

Falade, K. O., & Okocha, J. O. (2012). Foam-mat drying of plantain and cooking banana (*Musa* spp.). *Food and Bioprocess Technology*, *5*(4), 1173-1180.

Farahmandfar, R., Asnaashari, M., Salahi, M. R., & Rad, T. K. (2017). Effects of basil seed gum, Cress seed gum and Quince seed gum on the physical, textural and rheological properties of whipped cream. *International Journal of Biological Macromolecules*, *98*, 820-828.

Fang, Z., & Bhandari, B. (2012). Comparing the efficiency of protein and maltodextrin on spray drying of bayberry juice. *Food Research International*, *48*(2), 478-483.

FAMA (2020). Kualiti rockmelon berpandukan Malaysian Stantard MS 1325:2012. Retrieved from http://www.fama.gov.my/documents/20143/0/rock+melon+red.pdf/3f831fc5-993a-3348-82dc-e6d7fa128cdf

Fávaro-Trindade, C. S., Santana, A. D. S., Monterrey-Quintero, E. S., Trindade, M. A., & Netto, F. M. (2010). The use of spray drying technology to reduce bitter taste of casein hydrolysate. *Food Hydrocolloids*, *24*(4), 336-340.

Fazaeli, M., Emam-Djomeh, Z., Ashtari, A. K., & Omid, M. (2012). Effect of spray drying conditions and feed composition on the physical properties of black mulberry juice powder. *Food and Bioproducts Processing*, *90*(4), 667-675.

Febrianto, A., Kumalaningsih, S., & Aswari, A. W. (2012). Process engineering of drying milk powder with foam mat drying method. *Journal Basic Applied Scientific Research, 2*(4), 3588-3592.

Feketea, G., & Tsabouri, S. (2017). Common food colorants and allergic reactions in children: Myth or reality?. *Food Chemistry*, *230*, 578-588.

Ferrari, C. C., Marconi Germer, S. P., Alvim, I. D., & de Aguirre, J. M. (2013). Storage stability of spray-dried blackberry powder produced with maltodextrin or gum arabic. *Drying Technology, 31(*4), 470-478.

Ferreira, J. E. M., & Rodriguez-Amaya, D. B. (2008). Degradation of Lycopene and β-carotene in model systems and in lyophilized guava during ambient storage: kinetics, structure, and matrix effects. *Journal of Food Science*, *73*(8), C589-C594.

Finney, J., Buffo, R., & Reineccius, G. A. (2002). Effects of type of atomization and processing temperatures on the physical properties and stability of spray-dried flavors. *Journal of Food Science*, *67*(3), 1108-1114.

Franco, T. S., Perussello, C. A., Ellendersen, L. N., & Masson, M. L. (2016). Effects of foam mat drying on physicochemical and microstructural properties of yacon juice powder. *LWT-Food Science and Technology*, *66*, 503-513.

Gallo, L., Llabot, J. M., Allemandi, D., Bucalá, V., & Piña, J. (2011). Influence of spray-drying operating conditions on Rhamnus purshiana (*Cáscara sagrada*) extract powder physical properties. *Powder Technology*, *208*(1), 205-214.

González, F., García-Martínez, E., del Mar Camacho, M., & Martínez-Navarrete, N. (2019). Stability of the physical properties, bioactive compounds and antioxidant capacity of spray-dried grapefruit powder. *Food Bioscience, 28,* 74-82.

Goula A. M. (2016). Implications of non-equilibrium state glass transitions in spray-dried sugar-rich foods. In B. R. Bhandari & Y. H. Roos (Eds.), *Non-equilibrium states and glass transitions in foods: processing effects and product-specific implications* (pp. 253-277). Cambridge: Woodhead Publishing.

Goula, A. M., Adamopoulos, K. G., Chatzitakis, P. C., & Nikas, V. A. (2006). Prediction of lycopene degradation during a drying process of tomato pulp. *Journal of Food Engineering*, *74*(1), 37-46.

Grabowski, J. A., Truong, V. D., & Daubert, C. R. (2006). Spray-drying of amylase hydrolyzed sweetpotato puree and physicochemical properties of powder. *Journal of Food Science*, *71*(5), E209-E217.

Hardy, Z., & Jideani, V. A. (2017). Foam-mat drying technology: A review. *Critical Reviews in Food Science and Nutrition*, *57*(12), 2560–2572.

Hardy, Z., & Jideani, V. A. (2019). Functional characteristics and microbiological viability of foam-mat dried Bambara groundnut (Vigna subterranea) yogurt from reconstituted Bambara groundnut milk powder. *Food Science & Nutrition*, 1-11.

Harrynanan, L., & Sankat, C. K. (2013). Product quality attributes of foam-mat dried pumpkin powder. *In III International Conference on Postharvest and Quality Management of Horticultural Products of Interest for Tropical Regions*, 1047, 323-330.

Hartel, R. W., Joachim, H., & Hofberger, R. (2018). Fondants and Creams. In *Confectionery Science and Technology* (pp. 245-272). Switzerland: Springer.

Hastaoğlu, E., Can, Ö. P., & Vural, H. (2018). The Effects of Colorants Used in Hotel Kitchens in Terms of Child Health. *European Journal of Science and Technology*, (14), 10-16.

Health Protection Agency. (2009) Guidelines for Assessing the Microbiological Safety of Ready-to-Eat Foods. London: Health Protection Agency.

Heigl, D., & Franz, G. (2003). Stability testing on typical flavonoid containing herbal drugs. *Die Pharmazie-An International Journal of Pharmaceutical Sciences*, *58*(12), 881-885.

Hendorson, S. M. & Pabis S. (1961). Grain Drying Theory (I) Temperature Effect on Drying Coefficient. *Journal of Agricultural Engineering Research*, *6*(3), 169-174.

Henríquez, C., Córdova, A., Lutz, M., & Saavedra, J. (2013). Storage stability test of apple peel powder using two packaging materials: High-density polyethylene and metalized films of high barrier. *Industrial Crops and Products*, *45*, 121-127.

Horuz, E., Altan, A., & Maskan, M. (2012). Spray drying and process optimization of unclarified pomegranate (*Punica granatum)* juice. *Drying Technology*, *30*(7), 787-798.

Igual, M., Ramires, S., Mosquera, L. H., & Martínez-Navarrete, N. (2014). Optimization of spray drying conditions for lulo (*Solanum quitoense* L.) pulp. *Powder Technology*, *256*, 233-238.

İncedayi, B., Tamer, C. E., Sinir, G. Ö., Suna, S., & Çopur, Ö. U. (2016). Impact of different drying parameters on color, β-carotene, antioxidant activity and minerals of apricot (*Prunus armeniaca* L.). *Food Science and Technology*, *36*(1), 171-178.

Ismail, H. I., Chan, K. W., Mariod, A. A., & Ismail, M. (2010). Phenolic content and antioxidant activity of cantaloupe (*Cucumis melo*) methanolic extracts. *Food Chemistry*, *119*(2), 643-647.

Jafari, S. M., Mahdavi-Khazaei, K., & Hemmati-Kakhki, A. (2016). Microencapsulation of saffron petal anthocyanins with cress seed gum compared with Arabic gum through freeze drying. *Carbohydrate Polymers*, *140*, 20-25.

Jahromi, S. H. R., Yazdi, F. T., Karimi, M., Mortazavi, S. A., Davoodi, M. G., Pourfarzad, A., & Sourki, A. H. (2012). Application of glazing for bread quality improvement. *Food and Bioprocess Technology*, *5*(6), 2381-2391.

Jakubczyk, E., Gondek, E., & Tambor, K. (2011). Characteristics of selected functional properties of apple powders obtained by foam mat drying method. In P. S. Taoukis, N. G. Stoforos, V. T. Karathanos, & G. D. Saravacos (Eds.), *Food process engineering in a changing world.* Proceedings of the 11th International Congress on Engineering and Food, May 22-26, 2011, Athens, Greece (pp. 1385-1386). Athens: Cosmosware.

Jaya, S., & Das, H. (2004). Effect of maltodextrin, glycerol monostearate and tricalcium phosphate on vacuum dried mango powder properties. *Journal of Food Engineering*, *63*(2), 125-134.

Jinapong, N., Suphantharika, M., & Jamnong, P. (2008). Production of instant soymilk powders by ultrafiltration, spray drying and fluidized bed agglomeration. *Journal of Food Engineering*, *84*(2), 194-205.

Jittanit, W., Chantara-In, M., Deying, T., & Ratanavong, W. (2011). Production of tamarind powder by drum dryer using maltodextrin and Arabic gum as adjuncts. *Songklanakarin Journal of Science & Technology*, *33*(1), 33-41.

Jun-xia, X., Hai-yan, Y., & Jian, Y. (2011). Microencapsulation of sweet orange oil by complex coacervation with soybean protein isolate/gum Arabic. *Food Chemistry*, *125*(4), 1267-1272.

Kadam, D. M., Rai, D. R., Patil, R. T., Wilson, R. A., Kaur, S., & Kumar, R. (2011). Quality of fresh and stored foam mat dried Mandarin powder. *International Journal of Food Science & Technology*, *46*(4), 793-799.

Kadam, D. M., Wilson, R. A., Kaur, V., Chadha, S., Kaushik, P., Kaur, S., Patil R. T. & Rai, D. R. (2012). Physicochemical and microbial quality evaluation of foam-mat-dried pineapple powder. *International journal of food science & technology*, *47*(8), 1654-1659.

Kandasamy, P., Varadharaju, N., Kalemullah, S., & Moitra, R. (2012). Preparation of papaya powder under foam-mat drying technique using egg albumin as foaming agent. *International journal of Bio-resource and Stress Management*, *3*(3), 324-331.

Kang, Y. R., Lee, Y. K., Kim, Y. J., & Chang, Y. H. (2019). Characterization and storage stability of chlorophylls microencapsulated in different combination of gum Arabic and maltodextrin. *Food chemistry*, *272*, 337-346.

Karam, M. C., Petit, J., Zimmer, D., Baudelaire Djantou, E., & Scher, J. (2016). Effects of drying and grinding in production of fruit and vegetable powders: A review. *Journal of Food Engineering*, *188*, 32–49.

Karim, A., & Law, C. L. (2017). *Intermittent and nonstationary drying technologies: Principles and Applications*. CRC Press.

Karim, A. A., & Wai, C. C. (1999). Characteristics of foam prepared from starfruit (*Averrhoa carambola* L.) puree by using methyl cellulose. *Food Hydrocolloids*, *13*(3), 203-210.

Kaushal, M., Sharma, P. C., & Sharma, R. (2013). Formulation and acceptability of foam mat dried seabuckthorn (*Hippophae salicifolia*) leather. *Journal of Food Science and Technology*, *50*(1), 78-85.

Kaya, A., & Sözer, N. (2005). Rheological behaviour of sour pomegranate juice concentrates (*Punica granatum* L.). *International Journal of Food Science & Technology*, *40*(2), 223-227.

Kermiche, F., Boulekbache–Makhlouf, L., Félix, M., Harkat-Madouri, L., Remini, H., Madani, K., & Romero, A. (2018). Effects of the incorporation of cantaloupe pulp in yogurt: Physicochemical, phytochemical and rheological properties. *Food Science and Technology International*, *24*(7), 585-597.

Khamjae, T., & Rojanakorn, T. (2018). Foam-mat drying of passion fruit aril. *International Food Research Journal*, *25*(1), 204-212.

Khoo, H. E., Ismail, A., Mohd-Esa, N., & Idris, S. (2008). Carotenoid content of underutilized tropical fruits. *Plant Foods for Human Nutrition*, *63*(4), 170-175.

Koh, P. C., Noranizan, M. A., Hanani, Z. A. N., Karim, R., & Rosli, S. Z. (2017). Application of edible coatings and repetitive pulsed light for shelf life extension of fresh-cut cantaloupe (*Cucumis melo* L. reticulatus cv. Glamour). *Postharvest Biology and Technology*, *129*, 64-78.

Koh, P. C., Noranizan, M. A., Karim, R., & Hanani, Z. A. N. (2016). Repetitive pulsed light treatment at certain interval on fresh-cut cantaloupe (*Cucumis melo* L. *reticulatus* cv. Glamour). *Innovative Food Science & Emerging Technologies, 36,* 92-103.

Krasaekoopt, W., & Bhatia, S. (2012). Production of yogurt powder using foam-mat drying. *AU Journal of Technology*, *15*(3), 166-171.

Krishnan, S., Bhosale, R., & Singhal, R. S. (2005). Microencapsulation of cardamom oleoresin: Evaluation of blends of gum arabic, maltodextrin and a modified starch as wall materials. *Carbohydrate Polymers*, *61*(1), 95-102.

Krokida, M. K., Maroulis, Z. B., & Saravacos, G. D. (2001). Rheological properties of fluid fruit and vegetable puree products: compilation of literature data. *International Journal of Food Properties*, *4*(2), 179-200.

Kulkarni, A. S., & Joshi, D. C. (2014). Influence of storage temperature on chemical and microbial quality of carotene rich pumpkin powder. *International Journal of Agriculture, Environment & Biotechnology*, 7(Special issue), 421-426.

Lago, C. C., & Noreña, C. P. Z. (2017). Thermodynamic and kinetics study of phenolics degradation and color of yacon (*Smallanthus sonchifolius*) microparticles under accelerated storage conditions. *Journal of Food Science and Technology*, *54*(13), 4197-4204.

Largo Avila, E., Cortes Rodríguez, M., Velásquez, C., & José, H. (2015). Influence of maltodextrin and spray drying process conditions on sugarcane juice powder quality. *Revista Facultad Nacional de Agronomía Medellín*, *68*(1), 7509-7520.

Lee, H. Y., Chai, L. C., Tang, S. Y., Jinap, S., Ghazali, F. M., Nakaguchi, Y., Nishibuchi M. & Son, R. (2009). Application of MPN-PCR in biosafety of

Bacillus cereus s.l. for ready-to-eat cereals. *Food Control, 20*(11), 1068-1071.

Lemmens, L., De Vleeschouwer, K., Moelants, K. R., Colle, I. J., Van Loey, A. M., & Hendrickx, M. E. (2010). β-Carotene isomerization kinetics during thermal treatments of carrot puree. *Journal of Agricultural and Food Chemistry*, *58*(11), 6816-6824.

León-Martínez, F. M., Mendez-Lagunas, L. L., & Rodriguez-Ramirez, J. (2010). Spray drying of nopal mucilage (*Opuntia ficus-indica*): effects on powder properties and characterization. *Carbohydrate Polymers*, *81*(4), 864-870.

Lewis, W. K. (1921). The rate of drying of solid materials. *Industrial & Engineering Chemistry*, *13*(5), 427-432.

Lim, T. K., (2012). *Edible medicinal and non-medicinal plants. Volume 2, Fruits: Cucumis melo (Reticulatus Group)*. New York: Springer Science & Business Media.

Lin, C. H., & Chen, B. H. (2005). Stability of carotenoids in tomato juice during storage. *Food Chemistry*, *90*(4), 837-846.

Liu, F., Cao, X., Wang, H., & Liao, X. (2010). Changes of tomato powder qualities during storage. *Powder Technology*, *204*(1), 159-166.

Lobo, V., Patil, A., Phatak, A., & Chandra, N. (2010). Free radicals, antioxidants and functional foods: Impact on human health. *Pharmacognosy reviews*, *4*(8), 118-126.

Long, Z., Zhao, M., Sun-Waterhouse, D., Lin, Q., & Zhao, Q. (2016). Effects of sterilization conditions and milk protein composition on the rheological and whipping properties of whipping cream. *Food Hydrocolloids*, *52*, 11-18.

López-Vargas, J. H., Fernández-López, J., Pérez-Álvarez, J. A., & Viuda-Martos, M. (2013). Chemical, physico-chemical, technological, antibacterial and antioxidant properties of dietary fiber powder obtained from yellow passion fruit (*Passiflora edulis* var. *flavicarpa*) co-products. *Food Research International*, *51*(2), 756-763.

Luan, F., Delannay, I., & Staub, J. E. (2008). Chinese melon (*Cucumis melo* L.) diversity analyses provide strategies for germplasm curation, genetic improvement, and evidentiary support of domestication patterns. *Euphytica*, *164*(2), 445-461.

Maietti, A., Tedeschi, P., Stagno, C., Bordiga, M., Travaglia, F., Locatelli, M., Arlorio, A., & Brandolini, V. (2012). Analytical traceability of melon (*Cucumis melo* var *reticulatus*): proximate composition, bioactive compounds, and antioxidant capacity in relation to cultivar, plant physiology state, and seasonal variability. *Journal of Food Science*, *77*(6), C646- C652.

Manjunatha, S. S., & Raju, P. S. (2015). Rheological characteristics of reconstituted spray dried beetroot (*Beta vulgaris* L.) juice powder at different solid content, temperatures and carrier materials. *International Food Research Journal*, *22*(6), 2333-2345.

Mariod, A. A. (2018). Functional properties of gum arabic. In A. A. Mariod (Ed.), *Gum Arabic: Structure, Properties, Application and Economics* (pp. 283-293). UK: Academic Press.

Mason, H. S. (2009). Phenolase complex. *Advances in Enzymology and Related Areas of Molecular Biology*, *183*, 105-173.

Mauriello, G., De Prisco, A., Di Prisco, G., La Storia, A., & Caprio, E. (2017). Microbial characterization of bee pollen from the Vesuvius area collected by using three different traps. *PloS one*, *12*(9), e0183208.

Mckenna, B. M., & Lyng, J. G. (2013). Principles of food viscosity analysis. In *Instrumental Assessment of Food Sensory Quality* (pp. 129-162). UK: Woodhead Publishing.

Medeiros, A. K. D. O. C., de Carvalho Gomes, C., de Araújo Amaral, M. L. Q., de Medeiros, L. D. G., Medeiros, I., Porto, D. L., Aragão A.F.S., & Passos, T. S. (2019). Nanoencapsulation improved water solubility and color stability of carotenoids extracted from Cantaloupe melon (*Cucumis melo* L.). *Food Chemistry*, *270*, 562-572.

Methakhup, S., Chiewchan, N., & Devahastin, S. (2005). Effects of drying methods and conditions on drying kinetics and quality of Indian gooseberry flake. *LWT-Food Science and Technology*, *38*(6), 579-587.

Meza, B. E., Peralta, J. M., & Zorrilla, S. E. (2015). Rheological properties of a commercial food glaze material and their effect on the film thickness obtained by dip coating. *Journal of Food Process Engineering*, *38*(5), 510-516.

Meza, B. E., Peralta, J. M., & Zorrilla, S. E. (2016). Rheological characterization of full-fat and low-fat glaze materials for foods. *Journal of Food Engineering*, *171*, 57-66.

Michalska, A., Wojdyło, A., Lech, K., Łysiak, G. P., & Figiel, A. (2016). Physicochemical properties of whole fruit plum powders obtained using different drying technologies. *Food Chemistry*, *207*, 223-232.

Mishra, P., Mishra, S., & Mahanta, C. L. (2014). Effect of maltodextrin concentration and inlet temperature during spray drying on physicochemical and antioxidant properties of amla (*Emblica officinalis*) juice powder. *Food and Bioproducts Processing*, *92*(3), 252-258.

Mishra, P., Brahma, A., & Seth, D. (2017). Physicochemical, functionality and storage stability of hog plum (*Spondia pinnata*) juice powder produced by spray drying. *Journal of Food Science and Technology*, *54*(5), 1052-1061.

Mohamed, I. O., & Hassan, E. (2016). Time-dependent and time-independent rheological characterization of date syrup. *Journal of Food Research*, *5*(2), 13-22.

Mohammed, N. K., Tan, C. P., Manap, Y. A., Alhelli, A. M., & Hussin, A. S. M. (2017). Process conditions of spray drying microencapsulation of *Nigella sativa* oil. *Powder Technology*, *315*, 1-14.

Molina, R., Clemente, E., Scapim, M. R. D. S., & Vagula, J. M. (2014). Physical evaluation and hygroscopic behavior of dragon fruit (*Hylocereus undatus*) lyophilized pulp powder. *Drying Technology*, *32*(16), 2005-2011.

Moraes, I. C., Fasolin, L. H., Cunha, R. L. D., & Menegalli, F. C. (2011). Dynamic and steady: shear rheological properties of xanthan and guar gums dispersed in yellow passion fruit pulp (Passiflora edulis f. flavicarpa). *Brazilian Journal of Chemical Engineering*, *28*(3), 483-494.

Moser, P., Telis, V. R. N., de Andrade Neves, N., García-Romero, E., Gómez-Alonso, S., & Hermosín-Gutiérrez, I. (2017). Storage stability of phenolic compounds in powdered BRS Violeta grape juice microencapsulated with protein and maltodextrin blends. *Food Chemistry*, *214*, 308-318.

Mrmošanin, J. M., Pavlović, A. N., Veljković, J. N., Mitić, S. S., Tošić, S. B., & Mitić, M. N. (2014). Effect of storage temperature and thermal processing on catechins, procyanidins and total flavonoids stability in commercially available cocoa powders. *Facta Universitatis, Series Physics, Chemistry and Technology*, *13*(1), 39-49.

Murdock, D. H. (2002). *Encyclopedia of foods: a guide to healthy nutrition.* San Diego, California: Academic Press.

Muzaffar, K., & Kumar, P. (2017). Quality assessment and shelf life prediction of spray dried tamarind pulp powder in accelerated environment using two different packaging materials. *Journal of Food Measurement and Characterization*, *11*(1), 265-271.

Naknaen, P., & Itthisoponkul, T. (2015). Characteristics of cantaloupe jams as affected by substitution of sucrose with xylitol. *International Journal of Fruit Science*, *15*(4), 442-455.

Narsing Rao, G., Prabhakara Rao, P. G., Balaswamy, K., & Rao, D. G. (2011). Preparation of instant tomato pickle mix and evaluation of its storage stability. *International Food Research Journal*, *18*(2) 589-593.

NSW Food Authority. 2009. Microbiological quality guide for ready-to-eat foods: A guide to interpreting microbiological results. NSW/FA/CP028/0906 (pp. 1-9).

Nwoke, O. O., Ojike, O. O., Onwualu, A. P., & Okonkwo, W. I. (2011). Development and Evaluation of a Solar Powered Rice Packaging

Machine. *Agricultural Engineering International: CIGR Journal. Manuscript*, *13*(1), 1-7.

Oberoi, D. P. S., & Sogi, D. S. (2015). Effect of drying methods and maltodextrin concentration on pigment content of watermelon juice powder. *Journal of Food Engineering*, *165*, 172-178.

Oliveira, R. A., De Carvalho, M. L., Nutti, R. M., De Carvalho, L. J., & Fukuda, W. G. (2010). Assessment and degradation study of total carotenoid and ß-carotene in bitter yellow cassava (*Manihot esculenta Crantz*) varieties. *African Journal of Food Science*, *4*(4), 148-155.

Oliveira, C. F., Gurak, P. D., Cladera-Olivera, F., & Marczak, L. D. F. (2016). Evaluation of physicochemical, technological and morphological characteristics of powdered yellow passion fruit peel. *International Food Research Journal*, *23*(4), 1653-1662.

Onishi, T., Umemura, S., Yanagawa, M., Matsumura, M., Sasaki, Y., Ogasawara, T., & Ooshima, T. (2008). Remineralization effects of gum arabic on caries-like enamel lesions. *Archives of Oral Biology*, *53*(3), 257-260.

Ozcelik, M., Ambros, S., Heigl, A., Dachmann, E., & Kulozik, U. (2019). Impact of hydrocolloid addition and microwave processing condition on drying behavior of foamed raspberry puree. *Journal of Food Engineering*, *240*, 83-98.

Patel, R. P., Patel, M. P., & Suthar, A. M. (2009). Spray drying technology: an overview. *Indian Journal of Science and Technology*, *2*(10), 44-47.

Patil, V., Chauhan, A. K., & Singh, R. P. (2014). Optimization of the spray-drying process for developing guava powder using response surface methodology. *Powder Technology*, *253*, 230-236.

Pereira, D. C. D. S., Beres, C., Gomes, F. D. S., Tonon, R. V., & Cabral, L. M. (2019). Spray drying of juçara pulp aiming to obtain a "pure" powdered pulp without using carrier agents. *Drying Technology*, 1-11.

Phimolsiripol, Y. & Suppakul, P. (2016) Techniques in shelf life evaluation of food products. *Reference Module in Food Science,* 1, 1–8.

Phisut, N. (2012). Spray drying technique of fruit juice powder. *International Food Research Journal*, *19*(4), 1297–1306.

Phisut, N., Rattanawedee, M., & Aekkasak, K. (2013). Effect of osmotic dehydration process on the physical, chemical and sensory properties of osmo-dried cantaloupe. *International Food Research Journal*, *20*(1), 189-196.

Phoungchandang, S., & Sertwasana, A. (2010). Spray-drying of ginger juice and physicochemical properties of ginger powders. *Science Asia*, *36*(1), 40-45.

Plants, F. T. F. (1988). *Traditional food plants: A resource book for promoting the exploitation and consumption of food plants in arid, semi-arid, and sub-humid lands of Eastern Africa*: *Cucumis melo*. Rome: FAO.

Prabakaran, M., Lee, J. H., Ahmad, A., Kim, S. H., Woo, K. S., Kim, M. J., & Chung, I. M. (2018). Effect of storage time and temperature on phenolic compounds of soybean (*Glycine max* L.) flour. *Molecules*, *23*(9), 2269.

Pua, C. K., Hamid, N. S. A., Rusul, G., & Rahman, R. A. (2007). Production of drum-dried jackfruit (Artocarpus heterophyllus) powder with different concentration of soy lecithin and gum arabic. *Journal of Food Engineering*, *78*(2), 630-636.

Pua, C. K., Hamid, N. S. A., Tan, C. P., Mirhosseini, H., Rahman, R. A., & Rusul, G. (2008). Storage stability of jackfruit (*Artocarpus heterophyllus*) powder packaged in aluminium laminated polyethylene and metallized co-extruded biaxially oriented polypropylene during storage. *Journal of Food Engineering*, *89*(4), 419-428.

Qadri, O. S., Srivastava, A. K., & Yousuf, B. (2020). Trends in foam mat drying of foods: Special emphasis on hybrid foam mat drying technology. *Critical Reviews in Food Science and Nutrition*, *60*(10), 1667-1676.

Raharitsifa, N., & Ratti, C. (2010). Foam-mat freeze-drying of apple juice part 2: Stability of dry products during storage. *Journal of Food Process Engineering*, *33*(s1), 341–364.

Raharitsifa, N., Genovese, D. B., & Ratti, C. (2006). Characterization of apple juice foams for foam-mat drying prepared with egg white protein and methylcellulose. *Journal of Food Science*, *71*(3), E142-E151.

Ramzi, M., Kashaninejad, M., Salehi, F., Sadeghi Mahoonak, A. R., & Razavi, M. A. (2017). Rheological and physicochemical properties of honeys as a function of temperature, concentration and moisture content. *Journal of Food Biosciences and Technology*, *7*(2), 35-48.

Rao, M. A. (2014). Introduction: Food rheology and structure. In *Rheology of Fluid, Semisolid, and Solid Foods* (pp. 1-26). Boston: Springer.

Ray, S., Raychaudhuri, U., & Chakraborty, R. (2016). An overview of encapsulation of active compounds used in food products by drying technology. *Food Bioscience*, *13*, 76-83.

Razmkhah, S., Tan, C. P., Long, K., & Nyam, K. L. (2013). Quality changes and antioxidant properties of microencapsulated kenaf (*Hibiscus cannabinus* L.) seed oil during accelerated storage. *Journal of the American Oil Chemists' Society*, *90*(12), 1859-1867.

Reis, F. R. (2014). Introduction to low pressure processes. In F. R. Reis, *Vacuum drying for extending food shelf-life* (pp. 1-6). New York: Springer.

Risson, T. (2012). Eating it too:'The icing on the (birthday) cake'. *Australasian Journal of Popular Culture*, *2*(1), 57-78.

Robin, A. L., & Sankhla, D. (2013). European legislative framework controlling the use of food additives. In M. Saltmarsh (Ed.), *Essential guide to food additives* (4^{th} ed., pp. 44-62). UK: RSC Publishing.

Roongruangsri, W., & Bronlund, J. E. (2016). Effect of air-drying temperature on physico-chemical, powder properties and sorption characteristics of pumpkin powders. *International Food Research Journal*, *23*(3), 962-972.

Rosenquist, H., Smidt, L., Andersen, S. R., Jensen, G. B., & Wilcks, A. (2005). Occurrence and significance of Bacillus cereus and Bacillus thuringiensis in ready-to-eat food. *FEMS microbiology letters*, *250*(1), 129-136.

Sagar, V. R., & Kumar, P. S. (2010). Recent advances in drying and dehydration of fruits and vegetables: a review. *Journal of Food Science and Technology*, *47*(1), 15-26.

Saikia, S., Mahnot, N. K., & Mahanta, C. L. (2015). Effect of spray drying of four fruit juices on physicochemical, phytochemical and antioxidant properties. *Journal of Food Processing and Preservation*, *39*(6), 1656-1664.

Salahi, M. R., Mohebbi, M., & Taghizadeh, M. (2017). Development of cantaloupe (*Cucumis melo*) pulp powder using foam-mat drying method: Effects of drying conditions on microstructural of mat and physicochemical properties of powder. *Drying Technology*, *35*(15), 1897-1908.

Salahi, M. R., Mohebbi, M., & Taghizadeh, M. (2015). Foam-Mat Drying of Cantaloupe (*Cucumis melo*): Optimization of Foaming Parameters and Investigating Drying Characteristics. *Journal of Food Processing and Preservation*, *39*(6), 1798-1808.

Samborska, K., Langa, E., & Bakier, S. (2015). Changes in the physical properties of honey powder during storage. *International Journal of Food Science & Technology*, *50*(6), 1359-1365.

Sangamithra, A., Sivakumar, V., Kannan, K., & John, S. G. (2015a). Foam-mat drying of muskmelon. *International Journal of Food Engineering*, *11*(1), 127-137.

Sangamithra, A., Venkatachalam, S., John, S. G., & Kuppuswamy, K. (2015b). Foam mat drying of food materials: A review. *Journal of Food Processing and preservation, 6*(39), 3165-3174.

Santhalakshmy, S., Bosco, S. J. D., Francis, S., & Sabeena, M. (2015). Effect of inlet temperature on physicochemical properties of spray-dried jamun fruit juice powder. *Powder Technology*, *274*, 37-43.

Santana, A. A., Cano-Higuita, D. M., De Oliveira, R. A., & Telis, V. R. (2016). Influence of different combinations of wall materials on the microencapsulation of jussara pulp (*Euterpe edulis*) by spray drying. *Food Chemistry*, *212*, 1-9.

Santos, D., Maurício, A. C., Sencadas, V., Santos, J. D., Fernandes, M. H., & Gomes, P. S. (2017). Spray Drying: An Overview. In R. Pignatello (Ed), *Biomaterials-Physics and Chemistry-New Edition* (pp. 9-35). London: IntechOpen.

Sarsavadia, P. N., Sawhney, R. L., Pangavhane, D. R., & Singh, S. P. (1999). Drying behaviour of brined onion slices. *Journal of Food Engineering*, *40*(3), 219-226.

Schuck, P., Dolivet, A., & Jeantet, R. (2012). *Analytical methods for food and dairy powders*. West Sussex: Wiley.

Seerangurayar, T., Manickavasagan, A., Al-Ismaili, A. M., & Al-Mulla, Y. A. (2018). Effect of carrier agents on physicochemical properties of foam-mat freeze-dried date powder. *DryingTechnology*, *36*(11), 1292-1303.

Shaari, N. A., Sulaiman, R., Rahman, R. A., & Bakar, J. (2018). Production of pineapple fruit (Ananas comosus) powder using foam mat drying: Effect of whipping time and egg albumen concentration. *Journal of Food Processing and Preservation*, *42*(2), e13467.

Shafeek, M. R., Shaheen, A. M., El-Samad, E. A., Rizk, F. A., & El-Al, F. S. A. (2015). Response of growth, yield and fruit quality of cantaloupe plants (*Cucumis melo* L.) to organic and mineral fertilization. *Middle East J. Applied. Sci*, *5*, 76-82.

Shakerardekani, A., Karim, R., Ghazali, H. M., & Chin, N. L. (2013). The effect of monoglyceride addition on the rheological properties of pistachio spread. *Journal of the American Oil Chemists' Society*, *90*(10), 1517-1521.

Shamsudin, R., Ling, C. S., Adzahan, N. M., & Daud, W. R. W. (2013). Rheological properties of ultraviolet-irradiated and thermally pasteurized Yankee pineapple juice. *Journal of Food Engineering*, *116*(2), 548-553.

Sharma, M., Kadam, D. M., Chadha, S., Wilson, R. A., & Gupta, R. K. (2013). Influence of particle size on physical and sensory attributes of mango pulp powder. *International Agrophysics*, *27*(3), 323-328.

Shi, Q., Fang, Z., & Bhandari, B. (2013). Effect of addition of whey protein isolate on spray-drying behavior of honey with maltodextrin as a carrier material. *Drying Technology*, *31*(13-14), 1681-1692.

Shishir, M. R. I., & Chen, W. (2017). Trends of spray drying: A critical review on drying of fruit and vegetable juices. *Trends in Food Science and Technology*, *65*, 49–67.

Sidik, N. J., Hashim, S. N., Mohamad, Y. S., & Abdullah, S. (2012). Effects of natural and synthetic cytokinin hormone on shoot regeneration of rockmelon (*Cucumis melo*) Glamour cv. by using nodal explants. *ISBELA 2012 - IEEE Symposium on Business, Engineering and Industrial Applications*, 719-723.

Singh, B., & Hathan, B. S. (2017). Effect of different packaging materials on the storage study of beetroot powder. *Asian Journal of Dairy & Food Research*, *36*(1), 58-62.

Solval, K. M., Sundararajan, S., Alfaro, L., & Sathivel, S. (2012). Development of cantaloupe (*Cucumis melo*) juice powders using spray drying technology. *LWT-Food Science and Technology*, *46*(1), 287-293.

Song, J., Wang, X., Li, D., & Liu, C. (2017). Degradation kinetics of carotenoids and visual colour in pumpkin (*Cucurbita maxima* L.) slices during microwave-vacuum drying. *International Journal of Food Properties*, *20*(1), S632-S643.

Soysal, Ç. & Söylemez, Z. (2005). Kinetics and inactivation of carrot peroxidase by heat treatment. *Journal of Food Engineering*, *68*(3), 349-356.

Stahl, W., & Sies, H. (2003). Antioxidant activity of carotenoids. *Molecular Aspects of Medicine*, *24*(6), 345–351.

Suhag, Y., & Nanda, V. (2017). Degradation kinetics of ascorbic acid in encapsulated spray-dried honey powder packaged in aluminium laminated polyethylene and high-density polyethylene. *International Journal of Food Properties*, *20*(3), 645-653.

Suhag, Y., Nayik, G. A., & Nanda, V. (2016). Effect of gum arabic concentration and inlet temperature during spray drying on physical and antioxidant properties of honey powder. *Journal of Food Measurement and Characterization*, *10*(2), 350-356.

Sun, Y., Zheng, X., Xu, X., Liu, C., Li, Q., & Zhang, Q. (2012). Drying properties and parameters of blue honeysuckles pulp under foam assisted microwave drying conditions. *International Journal of Food Engineering*, *8*(2), 1-21.

Tan, S., Kha, T., Parks, S., Stathopoulos, C., & Roach, P. (2015). Optimising the encapsulation of an aqueous bitter melon extract by spray-drying. *Foods*, *4*(3), 400-419.

Tang, J., & Yang, T. (2004). Dehydrated vegetables: principles and systems. In Y. H. Hui, S. Ghazala, D. M. Graham, K. D. Murrell, W. K. Nip (Ed.), *Handbook of vegetable preservation and processing* (pp. 335-372). New York: Marcel Dekker.

Tang, Y. C., & Chen, B. H. (2000). Pigment change of freeze-dried carotenoid powder during storage. *Food Chemistry*, *69*(1), 11-17.

Thuwapanichayanan, R., Prachayawarakorn, S., & Soponronnarit, S. (2012). Effects of foaming agents and foam density on drying characteristics and textural property of banana foams. *LWT-Food Science and Technology*, *47*(2), 348-357.

Tonon, R. V., Grosso, C. R., & Hubinger, M. D. (2011). Influence of emulsion composition and inlet air temperature on the microencapsulation of flaxseed oil by spray drying. *Food Research International*, *44*(1), 282-289.

Tontul, I., & Topuz, A. (2017). Spray-drying of fruit and vegetable juices: Effect of drying conditions on the product yield and physical properties. *Trends in Food Science & Technology*, *63*, 91-102.

Toti, M., Carboni, C., & Botondi, R. (2018). Postharvest gaseous ozone treatment enhances quality parameters and delays softening in cantaloupe melon during storage at 6° C. *Journal of the Science of Food and Agriculture*, *98*(2), 487-494.

Touil, A., Chemkhi, S., & Zagrouba, F. (2014). Moisture diffusivity and shrinkage of fruit and cladode of *opuntia ficus-indica* during infrared drying. *Journal of Food Processing*, *2014* 1-9.

Tournas, V. H., Heeres, J., & Burgess, L. (2006). Moulds and yeasts in fruit salads and fruit juices. *Food Microbiology*, *23*(7), 684–688.

Trang, H. K. (2013). Development of HPLC methods for the determination of water-soluble vitamins in pharmaceuticals and fortified food products. *All Theses*. 1745.

Tuyen, C. K., Nguyen, M. H., & Roach, P. D. (2010). Effects of spray drying conditions on the physicochemical and antioxidant properties of the Gac (*Momordica cochinchinensis*) fruit aril powder. *Journal of Food Engineering*, *98*(3), 385-392.

Tze, N. L., Han, C. P., Yusof, Y. A., Ling, C. N., Talib, R. A., Taip, F. S., & Aziz, M. G. (2012). Physicochemical and nutritional properties of spray-dried pitaya fruit powder as natural colorant. *Food Science and Biotechnology*, *21*(3), 675-682.

Udomkun, P., Nagle, M., Argyropoulos, D., Mahayothee, B., Latif, S., & Müller, J. (2016). Compositional and functional dynamics of dried papaya as affected by storage time and packaging material. *Food Chemistry*, *196*, 712-719.

U.S. Department of Agriculture, U. (2019). National Nutrient Database for Standard Reference, Release 28 (slightly revised). US Department of Agriculture, Agricultural Research Service, USDA Nutrient Data Laboratory, 9040.

Valenzuela, C., & Aguilera, J. M. (2013). Aerated apple leathers: effect of microstructure on drying and mechanical properties. *Drying Technology*, *31*(16), 1951-1959.

Vidović, S. S., Vladić, J. Z., Vaštag, Ž. G., Zeković, Z. P., & Popović, L. M. (2014). Maltodextrin as a carrier of health benefit compounds in Satureja montana dry powder extract obtained by spray drying technique. *Powder Technology*, *258*, 209-215.

Vongsak, B., Sithisarn, P., & Gritsanapan, W. (2013). Bioactive contents and free radical scavenging activity of *Moringa oleifera* leaf extract under different storage conditions. *Industrial Crops and Products, 49*, 419-421.

Widyastuti, T. E. W., & Srianta, I. (2011). Development of functional drink based on foam-mat dried papaya (Carica papaya l.): Optimisation of foam-mat drying process and its formulation. *International Journal of Food, Nutrition and Public Health*, *4*(2), 167–176.

Wilson, R. A., Kadam, D. M., Chadha, S., Grewal, M. K., & Sharma, M. (2014). Evaluation of physical and chemical properties of foam-mat dried mango (*Mangifera indica*) powder during storage. *Journal of Food Processing and Preservation*, *38*(4), 1866-1874.

Wilson, R. A., Kadam, D. M., Chadha, S., & Sharma, M. (2012). Foam Mat Drying Characteristics of Mango Pulp. *International Journal of Food Science and Nutrition Engineering*, *2*(4), 63–69.

Wong, C. W., & Lim, W. T. (2016). Storage stability of spray-dried papaya (*Carica papaya* L.) powder packaged in aluminium laminated polyethylene (ALP) and polyethylene terephthalate (PET). *International Food Research Journal, 23*(5), 1887-1894.

Wulandari, P., Daryono, B. S., & Supriyadi. (2017). The effect of ripening stages on the antioxidant potential of melon (*Cucumis melo* L.) cultivar Hikapel. In *AIP Conference Proceedings* (Vol. 1854, No. 1, p. 020039). AIP Publishing LLC.

Yilmaz, M. S., Şakiyan, Ö., Barutcu Mazi, I., & Mazi, B. G. (2019). Phenolic content and some physical properties of dried broccoli as affected by drying method. *Food Science and Technology International*, *25*(1), 76-88.

Yousefi, S., Emam-Djomeh, Z., & Mousavi, S. M. (2011). Effect of carrier type and spray drying on the physicochemical properties of powdered and reconstituted pomegranate juice (*Punica Granatum* L.). *Journal of Food Science and Technology*, *48*(6), 677–684.

Zea, L. P., Yusof, Y. A., Aziz, M. G., Ling, C. N., & Amin, N. A. M. (2013). Compressibility and dissolution characteristics of mixed fruit tablets made from guava and pitaya fruit powders. *Powder Technology*, *247*, 112-119.

Zhang, J. Y., Liu, S. L., Wang, Y., & Ding, Y. T. (2011). Chemical, microbiological and sensory changes of dried *Acetes chinensis* during accelerated storage. *Food Chemistry*, *127*(1), 159-168.

Zhang, Z., Song, H., Peng, Z., Luo, Q., Ming, J., & Zhao, G. (2012). Characterization of stipe and cap powders of mushroom (*Lentinus edodes*) prepared by different grinding methods. *Journal of Food Engineering*, *109*(3), 406-413.

Zhou, M., Chen, Q., Bi, J., Wang, Y., & Wu, X. (2017). Degradation kinetics of cyanidin 3-O-glucoside and cyanidin 3-O-rutinoside during hot air and vacuum drying in mulberry (*Morus alba* L.) fruit: A comparative study based on solid food system. *Food Chemistry*, *229*, 574-579.

Zotarelli, M. F., da Silva, V. M., Durigon, A., Hubinger, M. D., & Laurindo, J. B. (2017). Production of mango powder by spray drying and cast-tape drying. *Powder T9echnology*, *305*, 447-454.

BIODATA OF STUDENT

Tan Suet Li was born on 21st March, 1993 in Kuantan, Pahang, Malaysia. She acquired her early education at SJKC Semambu (2000-2005), secondary school at SMK Cenderawasih (2006-2010) and pre-university at SMK Tengku Panglima Perang Tengku Muhammad (2011-2012). Subsequently, she continued her studies at Universiti Putra Malaysia in Bachelor of Food Studies (2013-2017) and graduated with first class honours. In September 2017, she enrolled herself as a postgraduate student in Master in Food Technology at Faculty Food Science and Technology, Universiti Putra Malaysia under supervision of Assoc. Prof Dr. Rabiha Sulaiman.

LIST OF PUBLICATIONS

Tan, S. L., & Sulaiman, R. (2019). Color and Rehydration Characteristics of Natural Red Colorant of Foam Mat Dried Hibiscus sabdariffa L. Powder. *International Journal of Fruit Science*, 1-17.

Tan, S. L., Sulaiman, R., Rukayadi, Y., & Ramli, N. S. (2021). Physical, chemical, microbiological properties and shelf life kinetic of spray-dried cantaloupe juice powder during storage. *LWT*, *140*, 110597.

Tan, S. L., Sulaiman, R., Rukayadi, Y., & Ramli, S. (2020). Effect of gum arabic concentrations on foam properties, drying kinetics and physicochemical properties of foam mat drying of cantaloupe. *Food Hydrocolloids*, 106492.

Tan, S. L., Sulaiman, R, Rukayadi, Y, & Ramli, N. S. (2020). Storage stability, carotenoid kinetics and microbiological analyses of foam mat dried cantaloupe powder under different storage conditions. *Food Research International*. Submitted.

Tan, S. L., Sulaiman, R, Rukayadi, Y, & Ramli, N. S. (2020). Physicochemical properties of spray dried cantaloupe powder and rheological behaviour of cake icing. *International Food Research Journal*. Submitted.

Conference

Tan S. L., Sulaiman R., Rukayadi Y., and Ramli N. S. (2019). Rheological Properties of Icing Cake Incorporated with Cantaloupe Powder Produced using Different Drying Methods. 2nd International Food Research Conference (IFRC 2019), 27-29 August, Putrajaya, Malaysia.

UNIVERSITI PUTRA MALAYSIA

STATUS CONFIRMATION FOR THESIS / PROJECT REPORT AND COPYRIGHT

ACADEMIC SESSION : ________________

TITLE OF THESIS / PROJECT REPORT :

____

____

____

NAME OF STUDENT : ____

I acknowledge that the copyright and other intellectual property in the thesis/project report belonged to Universiti Putra Malaysia and I agree to allow this thesis/project report to be placed at the library under the following terms:

1. This thesis/project report is the property of Universiti Putra Malaysia.
2. The library of Universiti Putra Malaysia has the right to make copies for educational purposes only.
3. The library of Universiti Putra Malaysia is allowed to make copies of this thesis for academic exchange.

I declare that this thesis is classified as :

*Please tick (√)

☐	**CONFIDENTIAL**	(Contain confidential information under Official Secret Act 1972).
☐	**RESTRICTED**	(Contains restricted information as specified by the organization/institution where research was done).
☐	**OPEN ACCESS**	I agree that my thesis/project report to be published as hard copy or online open access.

This thesis is submitted for :

☐	**PATENT**	Embargo from_____________ until _____________ (date) (date)

Approved by:

_____________________ _______________________

(Signature of Student) (Signature of Chairman of Supervisory Committee)
New IC No/ Passport No.: Name:

Date : Date :

[Note : If the thesis is CONFIDENTIAL or RESTRICTED, please attach with the letter from the organization/institution with period and reasons for confidentially or restricted.]