



**PUSAT PENGAJIAN TEKNOLOGI INDUSTRI
UNIVERSITI SAINS MALAYSIA**

**BORANG PENYERAHAN DISERTASI MUTAKHIR
SATU (1) NASKHAH**

Nama penyelia: Professor Dato' Dr Azhar bin Mat Easa

Bahagian: Teknologi Makanan

Saya telah menyemak semua pembetulan /pindaan yang dilaksanakan oleh Encik Mohamad Aiman bin Mohamad Anuar mengenai disertasinya sebagaimana yang dipersetujui oleh Panel Pemeriksa di *Viva Voce*-nya.

2. Saya ingin mengesahkan bahawa saya berpuas hati dengan pembetulan/ pindaan yang dilaksanakan oleh calon.

Sekian, terima kasih.

(Tandatangan/ cop)

9/8/2020

Tarikh



THE DEVELOPMENT OF AERATED DODOL PRODUCT USING FOAM MAT DRYING TECHNOLOGY

by

MOHAMAD AIMAN BIN MOHAMAD ANUAR

A dissertation submitted in partial fulfilment of the requirements for the degree of
Bachelor of Technology (B. Tech) in the field of Food Technology
School of Industrial Technology
Universiti Sains Malaysia

July 2020

DECLARATION BY AUTHOR

This dissertation is composed of my original work and contains no material previously published or written by another author except where due references has been made in the text. The content of my dissertation is the result of work I have carried out since the project was commenced. It does not include a substantial part of work that has been submitted to qualify for the award of any other degree or diploma in any university or other tertiary institution.

MOHAMAD AIMAN MOHAMAD ANUAR

ACKNOWLEDGEMENTS

It has never been an easy journey for all of us. To see my classmates being able to complete their research project in full mode made me feel nothing but happy for them. Nevertheless, I have given my best to conduct my initial research and when the pandemic hits us, I had to put an abrupt end to the ongoing project.

My utmost gratitude to my amazing supervisor, Professor Dato' Dr. Azhar bin Mat Easa for his guidance and his precious time supervising me throughout my research work. Without his ambitious mind, this project would not even exist in the first place.

My heartfelt appreciation goes to my fellow supervisee mate, Rosmiza binti Abd Rahman for always helping me and keeping me on tabs during our project. To my friends and fellow course mates who have been motivating me throughout the journey, I dedicate my deepest gratitude for the thoughts and supports. Thank you for keeping me company while I was in the lab at night.

I am very grateful for the help of lecturers that guided us tirelessly, Dr Cheng, Professor Fazilah, Dr Shariffa, Dr Tan and other lecturers who have been shaping our minds since we first came to the school. Thank you to the lab assistants and all the postgraduate students who have guided me throughout my research work.

To my lovely family, I would have never made it until the end without the tender, loving and care that have been given to me since I was writing my thesis at home. No amount of words could compensate my gratitude towards my only parents and my family. I have given my best and I will always try to be a better person, every day.

TABLE OF CONTENTS

	Page
ACKNOWLEDGEMENTS	iii
TABLE OF CONTENTS	iv
LIST OF FIGURES	vi
LIST OF SYMBOLS	vii
LIST OF ABBREVIATIONS	viii
ASBTRAK	ix
ABSTRACT	xi
CHAPTER 1 INTRODUCTION	
1.1 Research background	1
1.2 Rationale of the study	3
1.3 Objectives	4
CHAPTER 2 LITERATURE REVIEW	
2.1 Drying	5
2.2 Foam mat drying	5
2.3 Foaming agents	7
2.3.1 Egg albumen (EA)	7
2.4 Foam stabilisers	8
2.4.1 Carboxymethyl cellulose (CMC)	9
2.5 Foam structure and formation	10
2.6 Quality characteristics of foam	12
2.6.1 Foam density	13
2.6.2 Foam expansion	13
2.6.3 Foam stability	14

2.7	Quality attributes of foam mat dried products	14
2.8	Textural attributes of foam mat dried products	16
2.9	Dodol	16
2.9.1	Ingredients in dodol	17
CHAPTER 3 DISCUSSION		
3.1	The effect of sugar on EA foam	19
3.2	The effect of starch on EA foam	21
3.3	The effect of lipid on EA foam	23
3.4	Research trials	24
CHAPTER 4 FUTURE PROSPECTS		
4.1	Future research	32
CHAPTER 5 CONCLUSIONS		34
REFERENCES		35

LIST OF FIGURES

Figure	Caption	Page
2.1	Simple steps of a general foam mat drying process.	6
2.2	Structure of a foam.	11
3.1	The dodol samples from a) 1 h and b) 2 h of cooking.	25
3.2	The mixture on the left was mixed with CMC powder without rehydrating prior to whipping while the mixture on the right was mixed with rehydrated CMC mixture.	26
3.3	The foam mat aerated dodol that has been dried for 6 h in the hot air drier.	27
3.4	The dodol produced from 1 h, 2 h and 3 h of cooking with the lid uncovered.	28
3.5	The whipped mixture was transferred into graduated measuring cylinders for foam analysis. From left; mixture whipped at 4, 8 and 12 min, respectively.	29
3.6	The aerated dodol after 3h, with very little liquid drained at the bottom of the measuring cylinder, with formulation of 5% EA, 0.1% CMC and whipping time of 8 min.	31
3.7	The aerated dodol after 3h, with very little liquid drained at the bottom of the measuring cylinder, with formulation of 5% EA, 0.1% CMC and whipping time of 12 min.	31

LIST OF SYMBOLS

Symbol	Definition
g	Gram
h	Hour
min	Minute
mL	Millilitre
mm	Millimetre
rpm	Revolutions per minute
v	Volume
°C	Degree Celsius
+	Plus
-	Minus
/	Divide
%	Percent

LIST OF ABBREVIATIONS

Abbreviation	Definition
CMC	Carboxymethyl cellulose
EA	Egg albumen
Eq.	Equation
FD	Foam density
FE	Foam expansion
FS	Foam stability
GMS	Glycerol monostearate
GRF	Glutinous rice flour
RSM	Response surface methodology
SPI	Soy protein isolate

PERKEMBANGAN PRODUK DODOL BERUDARA MENGGUNAKAN TEKNOLOGI PENGERINGAN BUSA

ABSTRAK

Pengeringan busa merupakan suatu kaedah pengawetan bahan makanan melalui penyahhidratan. Berbanding dengan pengeringan beku dan pengeringan semburan, pengeringan busa merupakan alternatif yang lebih menjimatkan bagi proses penghasilan serbuk makanan. Bahan makanan cecair akan diubah menjadi busa yang stabil dengan memukul, menggoncang atau membuih dengan bantuan agen pembusa dan agen penstabil busa. Kajian yang telah dilakukan sebelumnya banyak menekankan pada pengeringan ekstrak dan puri buah-buahan dan sayur-sayuran, oleh hal yang demikian kajian ini telah mengkaji kemungkinan untuk membangunkan formulasi dodol berudara menggunakan kaedah pengeringan busa. Dodol adalah makanan pencuci mulut yang melekit dan dihasilkan daripada tepung pulut, santan dan gula. Dalam kajian ini, putih telur dipilih sebagai agen pembusa dengan karboksimetil selulosa sebagai agen penstabil busa. Putih telur adalah agen pembusa yang sesuai menurut kebanyakan kajian, dan dengan bantuan karboksimetil selulosa, busa yang stabil akan terhasil yang mampu mencegah busa runtuh. Sampel dodol telah dimasak dengan menggunakan Thermomix TM5 selama 3 jam. Percubaan untuk menghasilkan dodol berudara telah dibuat dengan menggunakan 5% w/w putih telur dan 0.5% w/w karboksimetil selulosa, dengan tempoh memukul campuran selama 4,8 dan 12 min. Sampel dodol berudara telah dianalisa untuk mengkaji sifat pembusaan termasuk ketumpatan busa, pengembangan busa dan kestabilan busa. Sampel yang dihasilkan stabil kerana jumlah air yang mengalir di dasar silinder penyukat adalah terlalu sedikit. Sampel dodol berudara telah dianalisa untuk beberapa formulasi dan sampel dodol berudara dicapai. Penggunaan agen pembusa berasaskan tumbuh-tumbuhan seperti aquafaba dan isolat protein kedelai mungkin boleh dipertimbangkan untuk

menggantikan agen pembusa sedia ada bagi menghasilkan produk dodol berudara
vegan pada masa akan datang.