



DEVELOPMENT OF STARCH-BASED IMITATION CHEESE SPREAD

by

LOW ZHI YU

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

June 2021



**PUSAT PENGAJIAN TEKNOLOGI INDUSTRI
UNIVERSITI SAINS MALAYSIA**

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

Nama penyelia: Associate Professor Dr. Cheng Lai Hoong

Bahagian: Teknologi Makanan

Saya telah menyemak semua pembetulan/pindaan yang dilaksanakan oleh ~~Enik/Puan~~/Cik Low Zhi Yu mengenai disertasinya sebagaimana yang dipersetujui oleh Panel Pemeriksa di *Viva Voce*-nya.

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

Sekian, terima kasih.

DR. CHENG LAI HOONG
(ASSOCIATE PROFESSOR)
FOOD TECHNOLOGY DIVISION
SCHOOL OF INDUSTRIAL TECHNOLOGY
UNIVERSITI SAINS MALAYSIA
11800 USM, PENANG, MALAYSIA.

18/8/2021

(Tandatangan dan cop)

(Tarikh)

DECLARATION BY AUTHOR

This dissertation is composed of my original work and contains no material previously published or written by another person except where due reference has been made in the text. The content of my dissertation is the result of work I have carried out since the commencement of my research project and 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.



LOW ZHI YU

JUNE 2021

ACKNOWLEDGEMENTS

I would like to thank all the people who contributed in some way to the work described in this thesis. First and foremost, I would like to express my sincere gratitude to my supervisor, Associate Professor Dr. Cheng Lai Hoong for her patience and friendly guidance to keep me on the right path throughout my final year project. I am extremely thankful to her as I have benefited greatly from her wealth of knowledge and indebted for her precious time in reviewing my works for improvements in my study.

I would also like to take this opportunity to express gratitude to all the laboratory assistants in the School of Industrial Technology, Cik Norita Abdul Kadir, En. Abdul Rahim Md Sari, En. Abdul Ghoni Ruslan and En. Mohamad Firdaus Mohd Adnan for their kind guidance and expertise are given along the study.

I would also like to express my heartfelt gratitude to my dear family whose constant love and support keep me motivated and confident. Last but not least, deepest thanks to all my friends for their continuous encouragement, understanding and support throughout the entire thesis process and every day.

LOW ZHI YU

JUNE 2021

TABLE OF CONTENTS

	Page
ACKNOWLEDGEMENTS	iv
TABLE OF CONTENTS	v
LIST OF TABLES	viii
LIST OF FIGURES	ix
LIST OF ABBREVIATION	x
ABSTRAK	xi
ABSTRACT	xii
CHAPTER 1 INTRODUCTION	
1.1 Research background	1
1.2 Problem statements	4
1.3 Objectives	4
CHAPTER 2 LITERATURE REVIEW	
2.1 Cheese spread	5
2.2 Imitation cheese	6
2.2.1 Category of imitation cheese	6
2.2.1a Dairy imitation cheese	6
2.2.1b Partial dairy imitation cheese	7
2.2.1c Non-dairy imitation cheese	7
2.3 Starch-based imitation cheese spread	8
2.4 Composition of starch-based imitation cheese spread	10
2.4.1 Nutritional yeast	10
2.4.2 Coconut oil	11
2.4.3 Tapioca starch	13

2.4.4 Glycerol monostearate (GMS)	15
2.5 Role of emulsifier on properties of starch-based imitation cheese spread	17
CHAPTER 3 MATERIALS AND METHODS	
3.1 Materials	19
3.2 Experimental design	19
3.3 Samples preparation	20
3.4 Physicochemical and rheological analyses of starch-based imitation cheese spread	22
3.4.1 Proximate composition analysis	22
3.4.2 Colour measurement	22
3.4.3 Oil separation analysis	23
3.4.4 Frequency sweep test	23
3.4.5 Spreadability test	24
3.5 Statistical analysis	24
CHAPTER 4 RESULTS AND DISCUSSION	
4.1 Physicochemical and rheological analyses of starch-based imitation cheese spread	25
4.1.1 Proximate composition	25
4.1.2 Colour attributes	27
4.1.3 Oil separation	29
4.1.4 Frequency sweep test	30
4.1.5 Spreadability	36
CHAPTER 5 CONCLUSIONS AND RECOMMENDATIONS	
5.1 Conclusion	39
5.2 Recommendations	40

LIST OF TABLES

Table Caption	Page
3.1 Abbreviation of starch-based imitation cheese spread formulations	20
3.2 Formulations of starch-based imitation cheese spread	20
4.1 Proximate composition of starch-based imitation cheese spread samples studied	26
4.2 Colour attributes of starch-based imitation cheese spread samples and commercial cheese spread products	28
4.3 Oil separation results of starch-based imitation cheese spread under ambient and chiller temperature storage	30
4.4 Effect of frequency sweep test on the Power Law fitting Eq. (3.1) and Eq. (3.2) of the starch-based imitation cheese spread samples with different GMS concentration and commercial cheese spread products	35
4.5 Spreadability results of starch-based imitation cheese spread samples and commercial cheese spread products	37

LIST OF FIGURES

Figure Caption	Page
3.1 Flow diagram of starch-based imitation cheese spread preparation	21
4.1 Dynamic frequency sweep moduli (G' , G'') on starch-based imitation cheese spread samples, F1 – F5 with different GMS concentration: (A) 0.0%, (B) 2.5%, (C) 5.0%, (D) 7.5%, (E) 10.0%, respectively; and commercial cheese spread products: (F) PA and (G) PB	32
4.2 Loss tangent ($\tan \delta$) as a function of frequency for starch-based imitation cheese spread samples with different GMS concentration: F1 (0.0%), F2 (2.5%), F3 (5.0%), F4 (7.5%), F5 (10.0%); and commercial cheese spread products, PA and PB	34

LIST OF ABBREVIATION

Abbreviation	Caption
ANOVA	Analysis of Variance
AOAC	Association of Official Analytical Chemists
F1	Starch-based imitation cheese spread formulated with 0.0% of glycerol monostearate
F2	Starch-based imitation cheese spread formulated with 2.5% of glycerol monostearate
F3	Starch-based imitation cheese spread formulated with 5.0% of glycerol monostearate
F4	Starch-based imitation cheese spread formulated with 7.5% of glycerol monostearate
F5	Starch-based imitation cheese spread formulated with 10.0% of glycerol monostearate
g	gram
GMS	Glycerol monostearate
G'	storage modulus
G''	loss modulus
Hz	hertz
kg	kilogram
min	minute
mL	milliliter
mm	millimeter
mm/s	millimeters per second
PA	Commercial cheese spread product A
PB	Commercial cheese spread product B
Pa	Pascal
rpm	revolutions per minute
tan δ	loss tangent

PERKEMBANGAN KEJU TIRUAN MEREBAK BERASASKAN KANJI

ABSTRAK

Tujuan kajian ini adalah untuk menghasilkan keju tiruan merebak berasaskan kanji sebagai alternatif bagi menggantikan setera tenusunya. Kesan peratusan berat gliserol monostearat (GMS) yang berlainan (0.0%, 2.5%, 5.0%, 7.5% dan 10.0%) dalam keju tiruan merebak berasaskan kanji terhadap sifat fisiko-kimia dan reologi telah dikaji. Sampel yang dihasilkan telah dicari berdasarkan komposisi proksi, warna, pemisahan minyak, tingkah laku viskoelastik dan penyebaran. Perbezaan peratusan berat GMS dalam keju tiruan merebak berasaskan kanji mempunyai kesan yang signifikan ($p < 0.05$) terhadap kandungan kelembapan dan lemak dalam analisis proksi. Hasil kajian menunjukkan bahawa peningkatan jumlah GMS secara signifikan meningkatkan kecerahan dan penurunan kromatik keju tiruan merebak berasaskan kanji yang dihasilkan. Sampel yang mengandungi GMS didapati tetap stabil tanpa pemisahan minyak semasa penyimpanan. Selain itu, tingkah laku seperti pepejal dipaparkan oleh semua sampel kecuali sampel yang dirumus dengan 0.0% GMS. Penemuan menunjukkan bahawa kegunaan GMS mempunyai kesan langsung terhadap tingkah laku viskoelastik keju tiruan merebak berasaskan kanji. Dengan peningkatan peratusan berat GMS sehingga 10.0%, kedua-dua modul penyimpanan (G') dan kerugian (G'') meningkat secara signifikan. Peningkatan kandungan GMS menyebabkan penurunan signifikan ($p < 0.05$) dalam penyebaran keju tiruan merebak berasaskan kanji. Secara keseluruhan, keputusan mendedahkan bahawa mengubahsuai kandungan GMS sahaja tidak mencukupi untuk meniru sifat produk keju merebak berasaskan tenusu, oleh itu, kajian lebih lanjut mengenai faktor-faktor lain diperlukan.