



**INCORPORATION OF ENZYMATICALLY TREATED STABILISED RICE
BRAN IN
BUTTER COOKIES:
A STUDY ON PHYSICAL, TEXTURAL AND RHEOLOGICAL PROPERTIES**

by

SOON YONG QI

A dissertation submitted in partial fulfillment 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



**PUSAT PENGAJIAN TEKNOLOGI
INDUSTRI UNIVERSITI SAINS
MALAYSIA**

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

Nama penyelia: Dr. Norazatul Hanim Mohd Rozalli

Bahagian: Teknologi Makanan

Saya telah menyemak semua pembedulan/pindaan yang dilaksanakan oleh
Encik/Puan/Cik Soon Yong Qi

mengenai disertasinya sebagaimana yang dipersetujui oleh Panel Pemeriksa di *Viva Voce*-nya.

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

Sekian, terima kasih.

azatul

(Tandatangan dan cop)

DR. NORAZATUL HANIM MOHD ROZALLI
Senior Lecturer
Food Technology Division
School of Industrial Technology
Universiti Sains Malaysia,
11800 USM, Penang, Malaysia.

22/8/2021

Tarikh

June 2021

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.

SOON YONG QI

JUNE 2021

ACKNOWLEDGEMENTS

I am grateful that along the way of completing my final year project, there were a lot of help given to me. First of all, I would like to thank my final year project supervisor, Dr. Norazatul Hanim. She was very patient and helpful all the way by giving me a lot of suggestion and guidance in my final year project. I sincerely thanks her for all the help given to me.

Besides, I would also like to thank School of Industrial Technology for providing all the equipment and apparatus that were needed in my final year project. Moreover, I would like to thank lab assistants (Encik Rahim and Encik Ghoni) that had helped me during my lab work.

Last but not least, I would like to thank my dearest family for their full support all the way, my senior (Hui Yi) for her sharing and guidance, my close friends for their helps and encouragement to complete final year project during this pandemic.

TABLE OF CONTENTS

| | Page |
|-------------------------------------------------------------------------------------------|-------------|
| ACKNOWLEDGEMENTS | iii |
| TABLE OF CONTENTS | iv |
| LIST OF TABLES | vi |
| LIST OF FIGURES | vii |
| LIST OF ABBREVIATION | viii |
| ABSTRAK | ix |
| ABSTRACT | xi |
| CHAPTER 1 INTRODUCTION1 | |
| 1.1 Research background | 1 |
| 1.2 Problem statements | 2 |
| 1.3 Objectives | 3 |
| CHAPTER 2 LITERATURE REVIEW | |
| 2.1 Rice bran | 4 |
| 2.2 Method used for stabilising rice bran in previous studies | 5 |
| 2.3 Effect of different stabilisation method used on properties of rice bran | 5 |
| 2.4 Enzyme papain | 9 |
| 2.5 Percentage of stabilised rice bran incorporated in baking product in previous studies | 10 |
| 2.6 Cookie dough rheology and properties of cookies | 12 |
| 2.7 Analysis of cookie doughs and cookies used in previous studies | 12 |
| 2.7.1 Rheological analysis on cookie doughs | 12 |
| 2.7.2 Texture profile analysis of cookie doughs | 14 |
| 2.7.3 Physical analysis of cookies | 14 |
| 2.7.4 Texture analysis of cookies | 15 |
| CHAPTER 3 MATERIALS AND METHODS | |
| 3.1 Materials | 16 |

| | |
|-------------------------------------------------------------------------------------------------------|----|
| 3.2 Experimental design | 16 |
| 3.3 Stabilisation of rice bran | 17 |
| 3.4 Enzyme treatment on rice bran | 17 |
| 3.5 Preparation of butter cookies supplemented with enzymatically treated stabilised rice bran (ESRB) | 18 |
| 3.6 Rheological analysis of cookie dough | 19 |
| 3.7 Texture profile analysis (TPA) of cookie dough | 19 |
| 3.8 Physical analysis of cookies | 20 |
| 3.9 Texture analysis of cookies | 21 |
| 3.10 Statistical analysis | 21 |
| CHAPTER 4 RESULTS AND DISCUSSION | |
| 4.1 Rheological analysis and texture profile analysis of cookie dough | 22 |
| 4.1.1 Dynamic oscillatory test | 22 |
| 4.1.2 Texture profile analysis (TPA) of cookie doughs | 27 |
| 4.2 Physical analysis of cookies | 29 |
| 4.2.1 Spread ratio | 29 |
| 4.2.2 Density | 30 |
| 4.2.3 Colour analysis | 31 |
| 4.3 Texture analysis of cookies | 32 |
| 4.3.1 Three-point bending test | 32 |
| CHAPTER 5 CONCLUSION AND RECOMMENDATIONS | |
| 5.1 Conclusion | 34 |
| 5.2 Recommendations | 34 |
| REFERENCES | 35 |

LIST OF TABLES

| Table Caption | Page |
|------------------------------------------------------------------------------------------------------|-------------|
| 2.1 Review on percentage of stabilised rice bran incorporated in baking product in previous studies. | 10 |
| 3.1 Formulation of butter cookies | 18 |
| 4.1 Mean values of diameter, height and spread ratio of cookies | 30 |
| 4.2 Mean values of weight, volume and density of cookies | 31 |
| 4.3 Mean values of L*, a*, b* colour values of cookies. | 32 |
| 4.4 Mean of hardness and fracturability of cookies. | 33 |

LIST OF FIGURES

| Figure Caption | Page |
|-----------------------------------------------------------------------------------------|------|
| 3.1 Experimental design | 16 |
| 4.1 Strain sweep test of cookie dough ESRB 40%. | 24 |
| 4.2 Storage modulus of cookie doughs (ESRB 0%, 10%, 20%, 30%, 40%) | 25 |
| 4.3 Loss modulus of cookie doughs (ESRB 0%, 10%, 20%, 30%, 40%) | 25 |
| 4.4 $\tan \delta$ of cookie doughs (ESRB 0%, 10%, 20%, 30%, 40%) | 26 |
| 4.5 Error bars for storage modulus of cookie doughs (ESRB 0%, 10%, 20%, 30%, 40%) | 26 |
| 4.6 Error bars for loss modulus of cookie doughs (ESRB 0%, 10%, 20%, 30%, 40%) | 27 |
| 4.7 Hardness of cookie doughs (ESRB 0%, 10%, 20%, 30%, 40%) | 28 |
| 4.8 Cohesiveness of cookie doughs (ESRB 0%, 10%, 20%, 30%, 40%) | 29 |
| 4.9 Correlation graph between cohesiveness of cookie doughs and spread ratio of cookies | 29 |
| 4.10 Cookies of different formulations (From the left to the right, ESRB 0% to 40%) | 32 |

LIST OF ABBREVIATION

| Abbreviation | Caption |
|---------------------|--------------------------------------------|
| ANOVA | Analysis of variance |
| ESRB | Enzymatically treated stabilised rice bran |
| FFA | Free fatty acid |
| LVR | Linear viscoelastic region |
| SRB | Stabilised rice bran |

**PENGGABUNGAN DEDAK PADI YANG DIRAWAT OLEH ENZIM DALAM
PEMBUATAN KUKI MENTEGA: KAJIAN TERHADAP CIRI FIZIKAL,
TEKSTUR DAN REOLOGI**

ABSTRAK

Tren masyarakat kini lebih menjurus kepada pengambilan makanan berkhasiat dan suka membeli makanan yang boleh diubah suai berdasarkan keperluan nutrisi individu. Dedak padi yang diautoklaf dan dirawat oleh enzim mempunyai potensi untuk dijadikan ramuan berfungsi disebabkan ia akan memberi faedah berfungsi dan faedah nutrisi yang lebih banyak berbanding dengan dedak padi mentah dan dedak padi yang distabilkan oleh tenaga haba. Objektif kajian ini adalah untuk mengkaji kesan penggabungan dedak padi yang diautoklaf dan dirawat oleh enzim (ESRB) atas sifat fizikal dan reologi doh kuki dan juga kesannya ke atas sifat fizikal dan tekstur kuki. Untuk mencapai objektif ini, analisis reologi (ujian ayunan dinamik) dan analisis profil tekstur telah dijalankan untuk semua rumusan doh kuki, manakala analisis fizikal (warna, ketumpatan dan nisbah pengembangan) dan analisis tekstur (kekerasan dan kebolehan patahan) telah dijalankan untuk semua rumusan cookie. Keputusan analisis menunjukkan bahawa penggabungan ESRB dalam peratusan yang berbeza mempunyai kesan ketara atas reologi, kekerasan dan kesepaduan doh kuki, begitu juga dengan warna dan tekstur kuki. Ciri reologi (modulus elastik dan modulus kelikatan) doh kuki mengalami tren meningkat dari rumusan ESRB 0% sampai ESRB 20%. Dalam analisis profil tekstur, kekerasan doh kuki meningkat dengan ketara, manakala kesepaduan doh kuki menurun dengan ketara apabila peratusan penggabungan ESRB dalam rumusan meningkat. Dalam analisis fizikal, ESRB mempunyai kesan ketara terhadap nilai warna kuki (nilai L^* dan b^*). Akhirnya, peningkatan peratusan ESRB dalam ramuan kuki juga mempunyai kesan ketara terhadap tekstur (kekerasan) kuki. Justeru, ESRB sebanyak 20% boleh digabungkan dalam pembuatan kuki mentega, hal ini disebabkan penggabungan ESRB

lebih daripada 30% akan menghasilkan kuki yang berwarna gelap dan mempengaruhi penampilan kuki.

**INCORPORATION OF ENZYMATICALLY TREATED RICE BRAN IN
BUTTER COOKIES:
A STUDY ON PHYSICAL, TEXTURE AND RHEOLOGICAL PROPERTIES**

ABSTRACT

The trend of people eating healthy food is increasing and they are looking for food that can be modified according to their nutrition needed. Enzymatically treated stabilised rice bran (ESRB) is a potential functional ingredients in baking product as it will provide better functional and nutritional benefits compared to raw rice bran and thermally stabilised rice bran. The objective of this research is to study the effects of enzymatically treated stabilised rice bran incorporation on the physical, textural and rheological quality of butter cookies. To achieve this objective, rheological analysis (dynamic oscillatory test) and texture profile analysis were done on all cookie dough formulations, whereas physical analysis (colour, density and spread ratio) and texture analysis (hardness and fracturability) were done on all cookie formulations (10%, 20% ,30% and 40% of ESRB was used to substitute wheat flour in butter cookies formulation). Results shown that different percentage of ESRB had a significant effect on the rheology, hardness and cohesiveness of dough as well as colour values and texture of cookies. Rheological properties (storage modulus and loss modulus) of cookie doughs had an increasing trend from ESRB 0% to ESRB 20%. In TPA, with increasing percentage of ESRB, hardness of cookie doughs increased significantly, whereas cohesiveness of cookie doughs decreased significantly. In term of physical properties, ESRB had a significant effect on the colour values (L^* and b^*) of cookies. Last but not least, an increasing amount of ESRB incorporated also had significantly increased the hardness of cookies. Therefore, the percentage of up to 20% of ESRB can be added into cookies is suggested as the colour of

cookies formulations higher than ESRB 30% (as shown in Figure 4.10) will be obviously darker than control (ESRB 0%) which yielded cookies with undesirable appearance.