

ACKNOWLEDGEMENTS

Praise the Lord, Jesus Christ, for His blessings given unto the Author upon completion of this final project report “EFFECT OF MODIFIED CASSAVA FLOUR (MOCAF) SUBSTITUTION ON PEARL OYSTER MUSHROOM (*Pleurotus ostreatus*) CRACKER CHARACTERISTICS”. This final project report compilation is made as one of the requirements for obtaining bachelor degree in Food Technology Universitas Pelita Harapan.

The Author realizes that both of the final project and the report could not be completed without the assistance, prayers, supports, and guidance from many parties. Therefore, the Author feels it is supposed to deliver gratitude to those who give their supports, both directly and indirectly, starting from planning, conducting, until the compilation of final project report, including:

- 1) Prof. Dr. L. Broto S. Kardono, as final project supervisor who has been guiding and supporting the Author starting from preparation of the final project, completion of final project proposal, implementation of final project, until the completion of final project report.
- 2) Ms. Julia Ratna Wijaya, MAppSc., as Head of Food Technology Department and final project co-supervisor who have been guiding and supporting the Author throughout the preparation of final project, completion of final project proposal, implementation of final project, until the compilation of final project report.

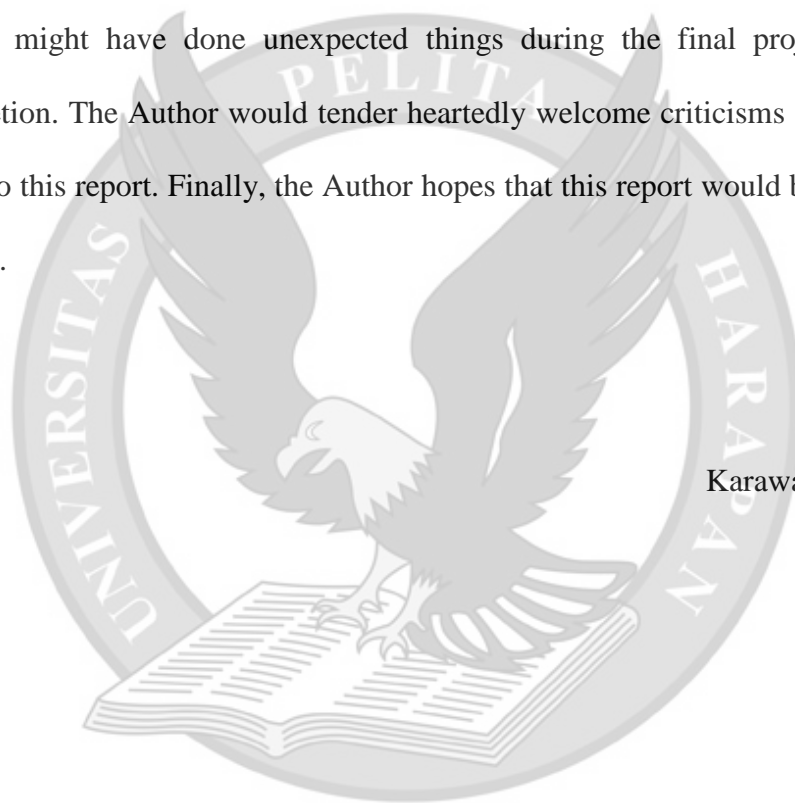
- 3) Ms. Nathania, Mr. Jeremia Manuel, and Ms. Ratna Handayani, as the Head of Food Processing, Quality control, and Research laboratories for the permission given to the Author to use the laboratory during research.
- 4) Mr. Adzie, Mr. Donny, Mr. Hendra, Ms. Merry, Mr. Darius, and Mr. Yosafat, as the laboratory assistants of Food Processing Lab, Quality Control Lab, Chemistry Lab, and Microbiology Lab for the help and support given to the Author during research.
- 5) Beloved Mother (Gina Theresia Trenggono), brother (Wily Budisaputra), sisters (Riyani Syukur Wiharsa and Julisa Pujianti Wiharso), and all family for the unending helps, prayers, and supports.
- 6) Stephanie Maria Theresia, Kevie Aditya, Amelia Amaris, Aprilia Tedja, and Novita Watimena for abundance support, assistance, and prayer as one team under same supervisor (The Broto's Team).
- 7) Yuliana, Shianny CH. Hudiono, Caroline Gunawan, and Phebe Nathania as wonderful friends who have supported and prayed for the Author during implementation of final project and report completion.
- 8) Nathalia M.S, Ruth Debora, Allen Igles, Vania Tjahjadi, Safira Yessica, and all friends who have worked together in Food Processing Technology Laboratory and Quality Control Laboratory who have supported and helped the Author during final project research.
- 9) Anggrayni Yulianita Capah, Andreas Tjoa, Isaura Petrina, Eunike Reviane, Wennie, and all seniors who have helped and prayed for the Author during implementation of final project research and making of final report.

10) Mira, Endah, Elviana, Sisi, and Reinita as lovely juniors that has supported and helped the Author during research.

11) All members of family Food Technology 2009 that has assisted the Author during research and final project completion.

12) All friends and close relatives who are not yet mentioned but have also supported the Author during final project and final project report completion.

The Author realizes that this report is not completely perfect, and that the Author might have done unexpected things during the final project and report completion. The Author would tender heartedly welcome criticisms and suggestions given to this report. Finally, the Author hopes that this report would be useful for the readers.



Karawaci, March 2013

Author

TABLE OF CONTENTS

| | page |
|--|-------|
| TITLE PAGE | |
| STATEMENT OF THESIS AUTHENTICITY | |
| APPROVAL BY THESIS SUPERVISORS | |
| APPROVAL BY THESIS EXAMINATION COMMITTEE | |
| ABSTRACT | v |
| ACKNOWLEDGEMENTS | vi |
| TABLE OF CONTENTS | ix |
| LIST OF TABLES | xiii |
| LIST OF FIGURES | xv |
| LIST OF APPENDICES | xviii |
| | |
| CHAPTER I INTRODUCTION | |
| 1.1. Background | 1 |
| 1.2. Research Problem | 2 |
| 1.3. Objectives | 3 |
| 1.3.1. General Objective | 3 |
| 1.3.2. Specific Objectives | 3 |
| | |
| CHAPTER II LITERATURE REVIEW | |
| 2.1. Pearl Oyster Mushroom (<i>Pleurotus ostreatus</i>) | 4 |
| 2.1.1. Taxonomy and Description | 4 |
| 2.1.2. Pearl Oyster Mushroom Nutritional Content | 5 |
| 2.2. Crackers | 9 |
| 2.2.1. Cracker Definition | 9 |
| 2.2.2. Crackers Ingredients | 9 |
| 2.2.3. Crackers Processing | 15 |
| 2.3. Modified Cassava Flour (MOCAF) | 17 |
| 2.3.1. Modified Cassava Flour (MOCAF) Description and Properties | 17 |

| | |
|--|----|
| 2.3.2. Production Process of Modified Cassava Flour (MOCAF)..... | 20 |
| 2.4. A Brief Overview of Protein..... | 21 |
| 2.5. Dietary Fiber | 24 |
| 2.6. Calcium | 25 |

CHAPTER III RESEARCH METHODOLOGY

| | |
|---|----|
| 3.1. Materials and Equipments..... | 28 |
| 3.2. Research Procedures | 29 |
| 3.2.1. Preliminary Research | 29 |
| 3.2.2. Main Research | 31 |
| 3.3. Analyses..... | 35 |
| 3.3.1. Yield (AOAC, 1995)..... | 35 |
| 3.3.2. Moisture Content (AOAC, 1995) | 35 |
| 3.3.3. Ash Content (AOAC, 1995; SNI 01-3751-2006) | 36 |
| 3.3.4. Protein Content (AOAC, 1995) | 36 |
| 3.3.5. Fat Content (AOAC 963.15, 2005)..... | 37 |
| 3.3.6. Carbohydrate Content (AOAC, 1984)..... | 37 |
| 3.3.7. Starch Content (SNI 01-2891-1992)..... | 38 |
| 3.3.8. Amylose Content (AOAC, 1984) | 39 |
| 3.3.9. Soluble and Insoluble Fiber Determination (AOAC 991.43, 1994) | 40 |
| 3.3.10. Calcium Content (AOAC 985.35, 2005) | 42 |
| 3.3.11. Starch Gelatinization Characteristic Test (Wennie, 2006) | 43 |
| 3.3.12. Crackers volume expansion measurement (modification from Yu <i>et al.</i> , 1981 and Widowati, 1987)..... | 44 |
| 3.3.13. Texture Analysis of Crackers (Miyatani, 2008; Noorakmar <i>et al.</i> , 2012)..... | 44 |
| 3.3.14. Colorimetric method using Chromameter (Nielsen, 2010) | 45 |
| 3.3.15. Organoleptic Test (Meilgaard <i>et al.</i> , 2003)..... | 45 |
| 3.4. Experimental Design..... | 46 |
| 3.4.1. Effect of Processing Type and Concentration of Pearl Oyster Mushroom on Mushroom Cracker Characteristics..... | 46 |
| 3.4.2. Effect of MOCAF Substitution on Cracker Characteristics | 48 |

CHAPTER IV RESULTS AND DISCUSSION

| | |
|---|-----|
| 4.1. Preliminary Research Results | 50 |
| 4.1.1. Proximate Analysis of Pearl Oyster Mushroom | 50 |
| 4.1.2. Pearl Oyster Mushroom Puree and Powder Analysis Results | 51 |
| 4.2. Results of Pearl Oyster Mushroom Crackers | 55 |
| 4.2.1. Physical Characteristics of Pearl Oyster Mushroom Crackers | 55 |
| 4.2.2. Chemical Characteristic of Pearl Oyster Mushroom Crackers | 63 |
| 4.2.3. Scoring Test Results of Pearl Oyster Mushroom Crackers | 66 |
| 4.2.4. Hedonic Test Results of Pearl Oyster Mushroom Crackers | 75 |
| 4.2.5. Determination of Best Pearl Oyster Mushroom Cracker Formulation | 81 |
| 4.2.6. Proximate Analysis Results of Best Pearl Oyster Mushroom Crackers | 82 |
| 4.2.7. Dietary Fiber Analysis Results of Best Pearl Oyster Mushroom Crackers | 85 |
| 4.3. Results of MOCAF Substituted Pearl Oyster Mushroom Crackers..... | 86 |
| 4.3.1. Proximate, Starch Content, and Calcium Analysis of MOCAF | 87 |
| 4.3.2. Dietary Fiber Content of MOCAF | 89 |
| 4.3.3. Gelatinization Characteristic of MOCAF and Tapioca Flour | 89 |
| 4.3.4. Physical Characteristics of MOCAF Substituted Pearl Oyster Mushroom Crackers | 92 |
| 4.3.5. Chemical Characteristic of MOCAF Substituted Pearl Oyster Mushroom Crackers | 99 |
| 4.3.6. Scoring Test Results of MOCAF Substituted Pearl Oyster Mushroom Crackers | 100 |
| 4.3.7. Hedonic Test Results of MOCAF Substituted Pearl Oyster Mushroom Crackers | 104 |
| 4.3.8. Determination of Best MOCAF Substituted Mushroom Cracker Formulation | 108 |
| 4.3.9. Proximate Analysis Results of Best MOCAF Substituted Pearl Oyster Mushroom Crackers | 109 |

4.3.10. Dietary Fiber and Calcium Content Analysis of Best
MOCAF Substituted Pearl Oyster Mushroom Crackers..... 111

CHAPTER V CONCLUSIONS AND SUGGESTIONS

5.1. Conclusions..... 113
5.2. Suggestions 114

BIBLIOGRAPHY 115

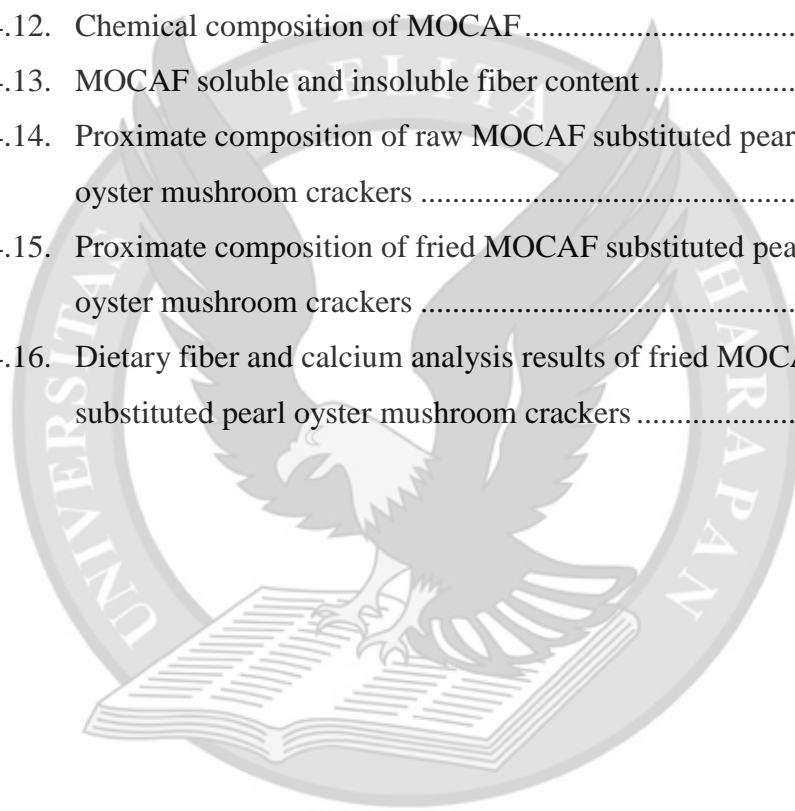
APPENDICES 125



LIST OF TABLES

| | page |
|--|------|
| Table 2.1. Composition of dried <i>P. ostreatus</i> | 8 |
| Table 2.2. Amino acid content of <i>Pleurotus ostreatus</i> | 8 |
| Table 2.3. Nutritional composition of 100 grams tapioca flour..... | 11 |
| Table 2.4. Composition of pepper..... | 14 |
| Table 2.5. Chemical composition of modified cassava flour (MOCAF)..... | 19 |
| Table 2.6. Essential and non-essential amino acids | 22 |
| Table 2.7. Function of body proteins | 23 |
| Table 3.1. Formulation of crackers with treatment of different processing type and concentration of pearl oyster mushroom | 33 |
| Table 3.2. Formulation of MOCAF substituted pearl oyster mushroom crackers | 35 |
| Table 3.3. Sugar determination based on Luff Schoorl | 39 |
| Table 3.4. Conversion table for hue angle | 45 |
| Table 3.5. Sample description- pearl oyster mushroom processing type and concentration | 47 |
| Table 3.6. Sample description- MOCAF substitution..... | 49 |
| Table 4.1. Proximate analysis results of pearl oyster mushroom..... | 50 |
| Table 4.2. Yield, moisture content, and color of pearl oyster mushroom puree and powder | 52 |
| Table 4.3. Proximate analysis results of fresh pearl oyster mushroom and pearl oyster mushroom puree and powder | 54 |
| Table 4.4. Soluble and insoluble fiber analysis results of pearl oyster mushroom puree and powder | 55 |
| Table 4.5. Effect of pearl oyster mushroom processing type on fried crackers taste scoring value..... | 71 |
| Table 4.6. Effect of pearl oyster mushroom concentration on fried crackers taste scoring value..... | 71 |

| | | |
|-------------|--|-----|
| Table 4.7. | Effect of pearl oyster mushroom processing type on fried crackers texture hedonic score | 79 |
| Table 4.8. | Effect of pearl oyster mushroom concentration on fried crackers texture hedonic score | 79 |
| Table 4.9. | Proximate analysis results of raw pearl oyster mushroom crackers and crackers without pearl oyster mushroom addition | 83 |
| Table 4.10. | Proximate analysis results of fried pearl oyster mushroom crackers and crackers without pearl oyster mushroom addition | 84 |
| Table 4.11. | Dietary fiber analysis result of fried crackers | 85 |
| Table 4.12. | Chemical composition of MOCAF | 88 |
| Table 4.13. | MOCAF soluble and insoluble fiber content | 89 |
| Table 4.14. | Proximate composition of raw MOCAF substituted pearl oyster mushroom crackers | 110 |
| Table 4.15. | Proximate composition of fried MOCAF substituted pearl oyster mushroom crackers | 110 |
| Table 4.16. | Dietary fiber and calcium analysis results of fried MOCAF substituted pearl oyster mushroom crackers | 112 |



LIST OF FIGURES

| | page |
|---|------|
| Figure 2.1. Pearl oyster mushroom | 5 |
| Figure 2.2. Starch granules | 10 |
| Figure 2.3. Steamed crackers dough | 16 |
| Figure 2.4. Structure of amino acid | 22 |
| Figure 3.1. Flowchart of the production of pearl oyster mushroom powder and puree | 30 |
| Figure 3.2. Flowchart of the production of pearl oyster mushroom cracker | 32 |
| Figure 4.1. Effect of interaction between processing type and concentration of pearl oyster mushroom on crackers volume expansion | 56 |
| Figure 4.2. Effect of different pearl oyster mushroom concentration in puree (a) and powder (b) on crackers hardness | 58 |
| Figure 4.3. Effect of interaction between processing type and concentration of pearl oyster mushroom on raw crackers lightness | 59 |
| Figure 4.4. Effect of different pearl oyster mushroom concentration in puree (a) and powder (b) on fried crackers lightness | 60 |
| Figure 4.5. Effect of interaction between processing type and concentration of pearl oyster mushroom on raw crackers hue angle | 61 |
| Figure 4.6. Effect of interaction between processing type and concentration of pearl oyster mushroom on fried crackers hue angle | 63 |
| Figure 4.7. Effect of interaction between processing type and concentration of pearl oyster mushroom on raw crackers moisture content | 65 |

| | | |
|--------------|--|----|
| Figure 4.8. | Effect of interaction between processing type and concentration of pearl oyster mushroom on fried crackers appearance scoring value..... | 67 |
| Figure 4.9. | Effect of interaction between processing type and concentration of pearl oyster mushroom on fried crackers color scoring value | 68 |
| Figure 4.10. | Effect of different pearl oyster mushroom concentration in puree (a) and powder (b) on fried crackers aroma scoring value..... | 70 |
| Figure 4.11. | Effect of different pearl oyster mushroom concentration in puree (a) and powder (b) on fried crackers off flavor scoring value..... | 72 |
| Figure 4.12. | Effect of different pearl oyster mushroom concentration in puree (a) and powder (b) on fried crackers crispiness scoring value..... | 73 |
| Figure 4.13. | Effect of different pearl oyster mushroom concentration in puree (a) and powder (b) on fried crackers appearance hedonic score | 75 |
| Figure 4.14. | Effect of different pearl oyster mushroom concentration in puree (a) and powder (b) on fried crackers color hedonic score | 76 |
| Figure 4.15. | Effect of different pearl oyster mushroom concentration in puree (a) and powder (b) on fried crackers aroma hedonic score | 77 |
| Figure 4.16. | Effect of different pearl oyster mushroom concentration in puree (a) and powder (b) on fried crackers taste hedonic score | 78 |
| Figure 4.17. | Effect of different pearl oyster mushroom concentration in puree (a) and powder (b) on fried crackers overall hedonic score | 81 |
| Figure 4.18. | Starch gelatinization characteristic result..... | 90 |

| | |
|--|-----|
| Figure 4.19. Effect of MOCAF substitution on volume expansion of pearl oyster mushroom crackers | 93 |
| Figure 4.20. Effect of MOCAF substitution on hardness of pearl oyster mushroom crackers..... | 94 |
| Figure 4.21. Effect of MOCAF substitution on lightness of raw pearl oyster mushroom crackers | 95 |
| Figure 4.22. Effect of MOCAF substitution on lightness of fried pearl oyster mushroom crackers | 96 |
| Figure 4.23. Effect of MOCAF substitution on hue angle of raw pearl oyster mushroom crackers | 97 |
| Figure 4.24. Effect of MOCAF substitution on hue angle of fried pearl oyster mushroom crackers | 98 |
| Figure 4.25. Effect of MOCAF substitution on moisture content of raw pearl oyster mushroom crackers | 99 |
| Figure 4.26. Effect of MOCAF substitution on pearl oyster mushroom crackers appearance scoring value | 100 |
| Figure 4.27. Effect of MOCAF substitution on pearl oyster mushroom crackers color scoring value | 102 |
| Figure 4.28. Effect of MOCAF substitution on pearl oyster mushroom crackers off-flavor scoring value | 103 |
| Figure 4.29. Effect of MOCAF substitution on pearl oyster mushroom crackers texture scoring value | 104 |
| Figure 4.30. Effect of MOCAF substitution on pearl oyster mushroom crackers appearance hedonic score..... | 105 |
| Figure 4.31. Effect of MOCAF substitution on pearl oyster mushroom crackers color hedonic score | 106 |
| Figure 4.32. Effect of MOCAF substitution on pearl oyster mushroom crackers texture hedonic score..... | 107 |
| Figure 4.33. Effect of MOCAF substitution on pearl oyster mushroom crackers overall hedonic score..... | 108 |

LIST OF APPENDICES

| | page |
|---|------|
| Appendix A. Taxonomy result of pearl oyster mushroom | A-1 |
| Appendix B. Proximate Analysis of Fresh Pearl Oyster Mushroom | B-1 |
| Appendix C. Analysis Results of Pearl Oyster Mushroom Puree and Powder | C-1 |
| Appendix D. Soluble and Insoluble Fiber Analysis of Pearl Oyster Mushroom Puree | D-1 |
| Appendix E. Soluble and Insoluble Fiber Analysis of Pearl Oyster Mushroom Powder | E-1 |
| Appendix F. Analysis Results of Pearl Oyster Mushroom Crackers | F-1 |
| Appendix G. Soluble and Insoluble Fiber Analysis of Fried Crackers with 0% Pearl Oyster Mushroom Addition | G-1 |
| Appendix H. Soluble, Insoluble Fiber, and Calcium Content Analysis of Fried Crackers with 10% Pearl Oyster Mushroom Addition | H-1 |
| Appendix I. Proximate Analysis of Modified Cassava Flour | I-1 |
| Appendix J. Starch Gelatinization Characteristic Test of MOCAF | J-1 |
| Appendix K. Analysis Data and Statistical Results of MOCAF Substituted Pearl Oyster Mushroom Crackers | K-1 |
| Appendix L. Starch and Amylose Content Analysis Result of MOCAF | L-1 |
| Appendix M. Dietary Fiber and Calcium Analysis Result of MOCAF | M-1 |
| Appendix N. Dietary Fiber Analysis Result of Fried Pearl Oyster Mushroom Crackers Substituted with MOCAF | N-1 |
| Appendix O. Calcium Content Analysis Result of Fried Pearl Oyster Mushroom Crackers Substituted with MOCAF | O-1 |
| Appendix P. Form of scoring test for main research stage I | P-1 |
| Appendix Q. Form of hedonic test for main research stage I | Q-1 |
| Appendix R. Form of scoring test for main research stage II | R-1 |
| Appendix S. Form of hedonic test for main research stage II | S-1 |
| Appendix T. Picture of resulted crackers | T-1 |