

ACKNOWLEDGEMENTS

Praise and gratitude to God for His blessings in accomplished this thesis entitled “ENHANCING ANTIOXIDANT ACTIVITY OF OKARA THROUGH *Rhizopus oryzae* BASED SOLID STATE FERMENTATION” that was written as partial fulfillment of the academic requirements to obtain *Sarjana Teknologi Pertanian Sastra Satu* Food Technology, Universitas Pelita Harapan.

The author realized without the guidance, help, prayers, and supports from many parties, this thesis will not be completed in its time. Therefore, the author would like to express gratitude and appreciation to those parties, including:

1. Eric Jobilong, Ph.D., as the Dean of Faculty of Science and Technology
2. Dela Rosa S.Si., M.M, M.Sc.Apt. as the Vice Dean of Faculty of Science and Technology
3. Laurence, S.T., M.T., as the Director of Administration Faculty Science and Technology.
4. Ir. W. Donald R. Pokatong, M.Sc., Ph.D., as the Head of Food Technology Study Program UPH, for the support until thesis was completed.
5. Ratna Handayani, M.P. as the Vice Head of Food Technology Study Program for the guidance and assistance during the author's research.
6. Dr.-Ing. Azis Boing Sitanggang S.TP, M.Sc., as supervisor for the time in guiding, teaching, advising, and motivating until this thesis was fully completed.
7. Wenny S.L. Br. Sinaga, M.Si., as Co-Supervisor, and Academic Supervisor for the guidance, time, and motivation during study period and the process of writing this thesis.

8. Dr. Adolf J. N. Parhusip, M.Si., Yuniwaty Halim, M.Sc., Tagor M. Siregar, M.Si., and Nuri Anugrahati, MP., as the Head of Laboratories, where the author conducted the final project.
9. Adzie, Virly, STP, Adhi, Darius, and Yosafat Rudju, for helping the author at laboratories.
10. My beloved family for endless supports and prayers.
11. Caecilia Leenardi as partner for the support and help during thesis period.
12. Franz Fernando, Felicia Wie, Caryn Fidelia Miranda, Willy Williamdy, Antony Japutra, Brian Widjaja, Angeline Vania, Celine Angelia, Margareta Wijaya, Patricia Sani, Yokhebed Fransiska, and Grace Josephine as partners in the same team for support and help.

Author realized that this report still far from perfection and might have some mistakes. Therefore, the author would like to apologize for instance and sincerely accept any suggestions that was given to the author about this report. Author also hopes that this report can be useful for the readers and those who needed. Thank You.

Tangerang, February 21th, 2018

HANDY GOSUN

TABLE OF CONTENT

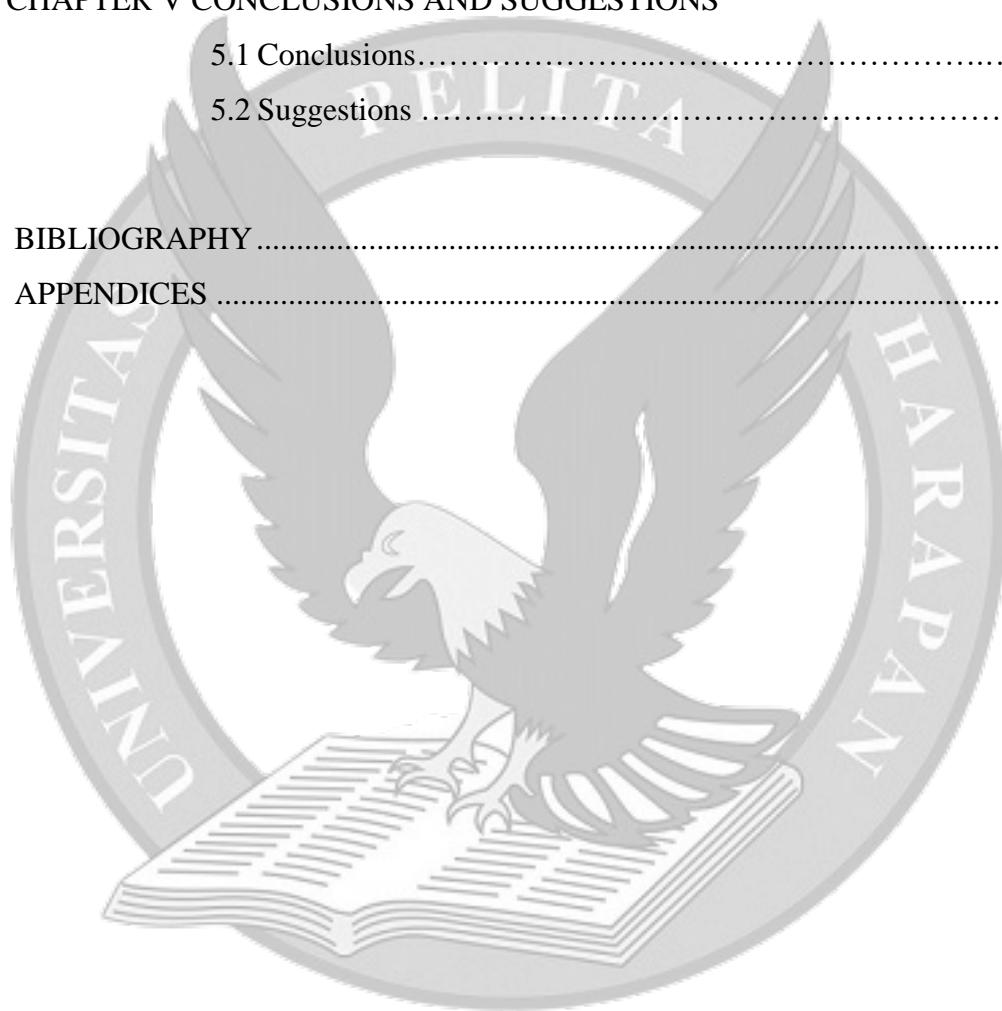
	page
COVER	
APPROVAL LETTER	
STATEMENT OF THESIS AUTHENCITY	
APPROVAL BY THESIS SUPERVISORS	
ABSTRACT	v
ACKNOWLEDGEMENTS	vi
TABLE OF CONTENT	viii
LIST OF FIGURES	xi
LIST OF TABLES	xi
LIST OF APPENDICES	xii
CHAPTER I INTRODUCTION	
1.1 Background	1
1.2 Research Problem.....	2
1.3 Objectives.....	3
1.3.1 General Objectives	3
1.3.2 Specific Objectives.....	3
CHAPTER II LITERATURE REVIEW	
2.1 Okara.....	4
2.2 Solid State Fermentation.....	4
2.3 Antioxidant.....	6
CHAPTER III RESEARCH METHODOLOGY	
3.1 Materials and Equipment.....	8
3.2 Research Method.....	9

3.2.1 Preliminary Research	9
3.2.1.1 Okara Characteristic Analyses	9
3.2.1.2 Growth Profile of <i>R. oryzae</i>	10
3.2.2 Main Research.....	11
3.2.2.1 Effect of Fermentation Times and <i>R. oryzae</i> Concentrations.....	11
3.2.2.2 Effect of Water Activity (A_w)	12
3.3 Experimental Design.....	13
3.3.1 Effect of Fermentation Time and <i>Rhizopus oryzae</i> Concentrations.....	13
3.3.2 Effect of Water Activity (A_w).....	15
3.4 Method of Analysis.....	16
3.4.1 Antioxidant Activity Analysis.....	16
3.4.2 Protein Analysis	17
3.4.3 Amino Nitrogen Content.....	18
3.4.4 Degree of Hydrolysis	18
3.4.5 Protein Digestibility	19
3.4.6 Amino Acid Profile Analysis	19
3.4.7 Particle Size.....	20
3.4.8 Water Activity (A_w).....	20

CHAPTER IV RESULT AND DISCUSSION

4.1 Preliminary Research.....	21
4.1.1 Growth Profile of <i>R. oryzae</i>	21
4.1.2 Characteristic of Dried Okara	23
4.2 Main Research.....	24
4.2.1 Influence of <i>R. oryzae</i> Concentration and Fermentation Time Towards Radical Scavenging Activity (RSA) and Degree of Hydrolysis.....	24
4.2.2 Influence of Water Activity (A_w) towards Radical Scavenging Activity and Degree of Hydrolysis.....	26

4.2.3 Comparison between Unfermented and Fermented Okara	29
4.2.4 Radical Scavenging Activity between Tofu, Tempeh and Fermented Okara.....	30
CHAPTER V CONCLUSIONS AND SUGGESTIONS	
5.1 Conclusions.....	32
5.2 Suggestions	32
BIBLIOGRAPHY	33
APPENDICES	38

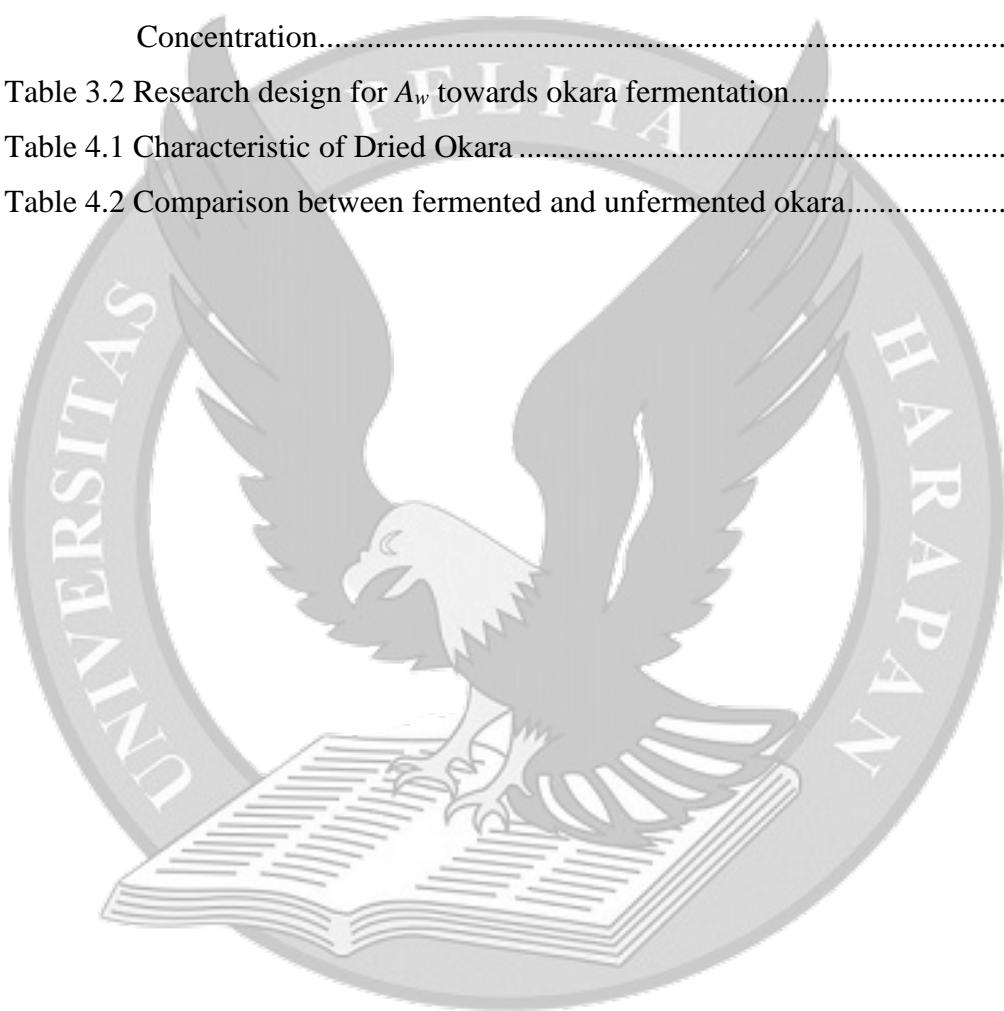


LIST OF FIGURES

	page
Figure 3.1 Experimental diagram for okara analysis	10
Figure 3.2 Experimental Flow Diagram of <i>R. oryzae</i> Growth Curve	11
Figure 3.3 Experimental Flow Diagram of Influence of <i>R. oryzae</i> concentration and fermentation times	12
Figure 3.4 Procedure of Okara Solid State Fermentation with Different Water Activity (A_w).....	13
Figure 4.1 Growth Profile of <i>R. oryzae</i> in 25°C.....	21
Figure 4.2 Growth Profile of <i>R. oryzae</i> in 30°C.....	22
Figure 4.3 Growth Profile of <i>R. oryzae</i> in 37°C.....	22
Figure 4.4 Influence of <i>R. oryzae</i> initial concentration and fermentation towards radical scavenging activity $A_w = 0.913$; T = 30°C	25
Figure 4.5 Influence of <i>R. oryzae</i> initial concentration and fermentation towards degree of hyrdolysis $A_w = 0.913$; T = 30°C	26
Figure 4.6 Influence of water activity (A_w) towards degree of hydrolysis, fermentation condition: t = 96 h; T = 30°C	27
Figure 4.7 Influence of water activity (A_w) towards degree of hydrolysis, fermentation condition: t = 96 h; T = 30°C	27
Figure 4.8 Amino acids profile comparison between unfermented and fermented okara.....	28
Figure 4.9 Comparison radical scavenging activity between tofu, tempeh, and fermented okara.....	31

LIST OF TABLES

	page
Table 2.1 Amino acid composition of soybean curd residue (mg/g)	4
Table 3.1 Experimental Design for <i>R. oryzae</i> Fermentation Time and Concentration.....	15
Table 3.2 Research design for A_w towards okara fermentation.....	16
Table 4.1 Characteristic of Dried Okara	23
Table 4.2 Comparison between fermented and unfermented okara.....	29



LIST OF APPENDICES

	page
Appendix A. Growth Profiles of <i>Rhizopus oryzae</i> at 25°C	A-1
Appendix B Growth Profiles of <i>Rhizopus oryzae</i> at 30°C	B-1
Appendix C. Growth Profiles of <i>Rhizopus oryzae</i> at 37°C.....	C-1
Appendix D. Data of Unfermented Okara Characteristics Analyses.....	D-1
Appendix E. Initial concentrations of <i>R.oryzae</i>	E-1
Appendix F. Radical Scavenging Activity of Fermented Okara ($T = 30^\circ\text{C}$; $A_w = 0.913$) at 5000 ppm.....	F-1
Appendix G. Statistical Analyses of Fermented Okara Radical Scavenging Activity..	G-1
Appendix H. Amino nitrogen content of fermented okara at ($T = 30^\circ\text{C}$; $A_w = 0.913$)...H-1	H-1
Appendix I. Protein content of fermented okara at ($T = 30^\circ\text{C}$; $A_w = 0.913$).....I-1	I-1
Appendix J. Degree of hydrolysis of fermented okara at ($T = 30^\circ\text{C}$; $A_w = 0.913$).....J-1	J-1
Appendix K. Statistical Analyses of Fermented Okara Degree of Hydrolysis.....K-1	K-1
Appendix L. Fermented okara (4.74×10^{-3} gDCW/g _{Okara} <i>R.oryzae</i> initial concentration, $A_w = 0.931$, $t = 72$ h; $T = 30^\circ\text{C}$).....L-1	L-1
Appendix M.	

Statistical analysis results of fermented okara (4.74×10^{-3} gDCW/gOkara <i>R.oryzae</i> concentrations; $A_w = 0.913$; $t = 72$ h; $T = 30^\circ\text{C}$) radical scavenging activity and degree of hydrolysis with different water activity (A_w).....	M-1
Appendix N. Unfermented okara particle size.....	N-1
Appendix O. Unfermented okara protein digestibility.....	O-1
Appendix P. Fermented okara protein digestibility.....	P-1
Appendix Q. Verification of soybean taxonomy.....	Q-1
Appendix R. Unfermented okara amino acids profile.....	R-1
Appendix S. Fermented okara amino acids profile.....	S-1
Appendix T. Radical scavenging activity of tofu and tempeh at 5000 ppm.....	T-1