

ACKNOWLEDGEMENTS

Praise and gratitude to God for His blessing and His grace that this thesis report entitled “SYNTHESIS OF ZINC OXIDE NANOPARTICLES USING PERICARPS AND SEEDS OF MANGOSTEEN AND EVALUATION OF ITS CHARACTERISTICS AND FREE RADICAL SCAVENGING ACTIVITY” could come to a completion. This thesis report is written as a partial fulfillment of the academic requirements to obtain degree of *Sarjana Teknologi Pertanian Strata Satu* in Food Technology Study Program, Faculty of Science and Technology of Universitas Pelita Harapan, Tangerang.

This thesis report would not be possible and successfully completed without the help, support, prayers and guidance from several parties. In this occasion, expression of sincere gratitude and appreciation are given to:

1. Prof. Dr. Manlian Ronald A. Simanjuntak, ST., MT., D. Min. as the dean of Science and Technology Faculty.
2. Ir. W. Donald R. Pokatong, M.Sc., Ph. D as the head of Food Technology Study Program, for the opportunity to conduct this research and approval of this thesis report.
3. Ir. A. Herry Cahyana, M.Sc, Ph.D, as the main supervisor for the guidance, information, advice and support during the process and completion of thesis report.
4. Yuniwayat Halim, MSc, as the co-supervisor and Head of Quality Control Laboratory, for the help, support, patience and guidance, and opportunity to conduct this research in the laboratory.

5. Dr. Tagor M. Siregar, MSi., Head of Chemistry Laboratory, and Natania, M.Eng, Head of Food Processing Laboratory, as head of examiner and member of examiner respectively for the helpful insight during the thesis period.
6. Dr. Ir. Adolf J.N Parhusip, MSi. as the Head of Microbiology Laboratory respectively for the opportunity to conduct the research.
7. Ms. Virly and Mr. Andra as the lecturer assistant, for the patience, help and guidance during the research in the laboratory.
8. Mr. Adzie, Mr. Darius, Mr. Hendra, and Mr. Yosafat as laboratory assistance for the friendly guidance and help during the research.
9. All lecturers and staff of the UPH Food Technology Department.
10. Beloved parents and sister for help and endless support.
11. Novelia Gunario, Ardelyta Susanti, Claudia Severesia, Lisa Angereni, and Evelyn as thesis partners in one batch who always accompany, support, help and give comfort during laboratory work and thesis completion.
12. Felicia Mirabel, Olivia Virginia, Stella Jessica, Melissa Tanniadi, and Bubble for the support, help, and consolation during thesis work and completion.
13. Fellow classmates of Food Technology Class C 2013 for the information shared together.

It is realized that this report is far from excellence. Critics and suggestions are gladly accepted for better improvement in the future.

Tangerang, May 2017

Author



TABLE OF CONTENTS

	page
COVER	
STATEMENT OF THESIS AUTHENTICITY	
APPROVAL BY THESIS SUPERVISORS	
APPROVAL BY THESIS EXAMINATION COMMITTEE	
ABSTRACT	iv
ACKNOWLEDGEMENTS	vi
TABLE OF CONTENTS	ix
LIST OF TABLES	xii
LIST OF FIGURES	xiii
LIST OF APPENDICES	xv
CHAPTER I INTRODUCTION	
1.1 Background	1
1.2 Research Problem.....	3
1.3 Research Objectives	3
1.3.1 General Objectives	3
1.3.2 Specific Objectives.....	3
CHAPTER II LITERATURE REVIEW	
2.1 Nanoparticles.....	5
2.1.1 Synthesis Mechanism of Nanoparticles	6
2.2 Zinc Oxide Nanoparticles.....	8
2.2.1 Antioxidant Activity of ZnO-NPs	8
2.3 Mangosteen (<i>Garcinia mangostana</i> Linn.)	9
2.4 Extraction	11
2.4.1 Maceration.....	11
2.4.2 Type of Solvents	11
2.5 Calcination	12

4.3.1 Effect of Calcination towards the Characteristics of Zinc Oxide
Nanoparticles..... 50

CHAPTER V CONCLUSIONS AND SUGGESTIONS

5.1 Conclusions 53
5.2 Suggestions 53

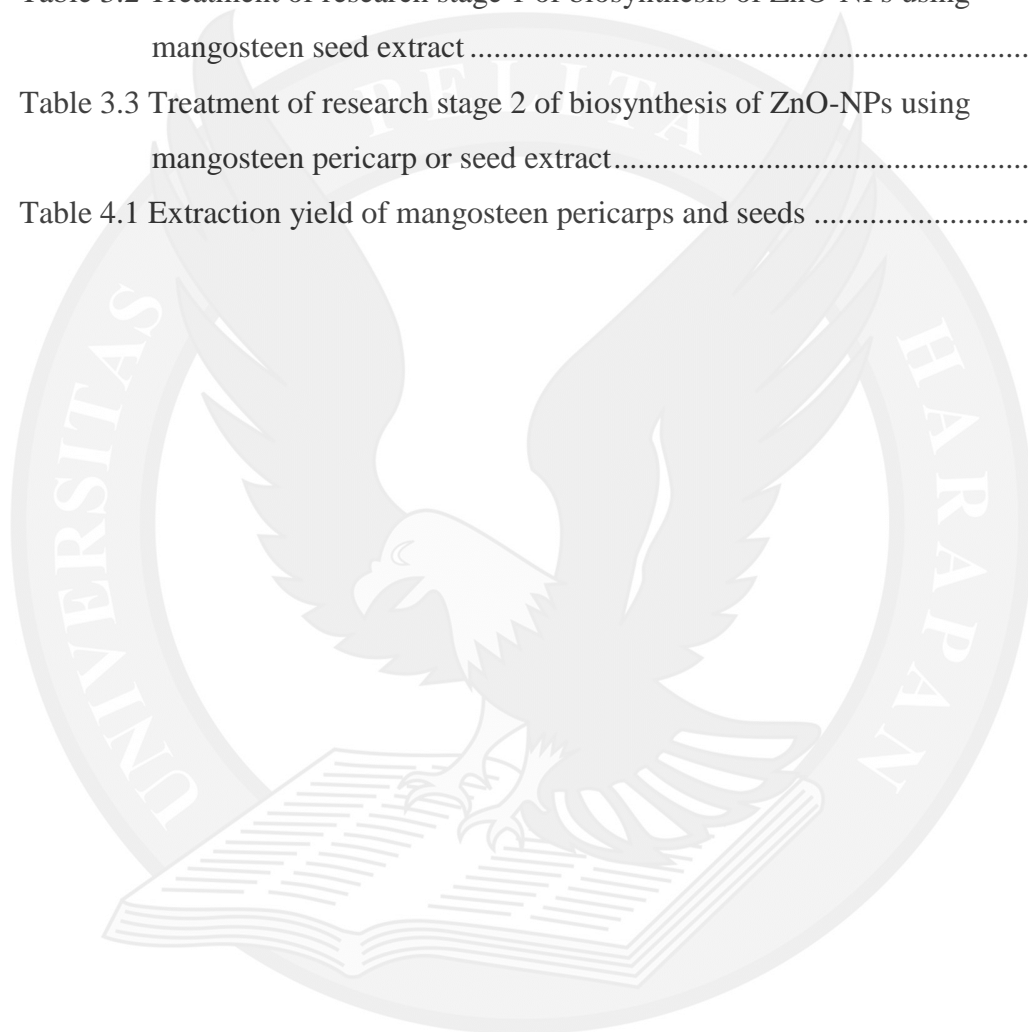
BIBLIOGRAPHY 55

APPENDICES 58



LIST OF TABLES

	page
Table 3.1 Treatment of research stage 1 of biosynthesis of ZnO-NPs using mangosteen pericarp extract	19
Table 3.2 Treatment of research stage 1 of biosynthesis of ZnO-NPs using mangosteen seed extract	20
Table 3.3 Treatment of research stage 2 of biosynthesis of ZnO-NPs using mangosteen pericarp or seed extract.....	23
Table 4.1 Extraction yield of mangosteen pericarps and seeds	29



LIST OF FIGURES

	page
Figure 2.1 Different types of nanoparticle synthesis from plant resources.....	6
Figure 2.2 Mechanisms of nanoparticle synthesis	7
Figure 2.3 <i>Garcinia mangostana</i> Linn.	10
Figure 2.4 Chemical structure of α -mangostin	10
Figure 3.1 Flow chart of research stage I	17
Figure 3.2 Flow chart of research stage II.....	17
Figure 4.1 The effect of types of solvent to the amount of dry matter of mangosteen pericarps extract	32
Figure 4.2 The effect of types of solvent to the amount of dry matter of mangosteen seeds extract	33
Figure 4.3 The effect of type of sample to the amount of dry matter	34
Figure 4.4 The effect of types of solvent on total phenolic content of mangosteen pericarps extract	35
Figure 4.5 The effect of types of solvent on total phenolic content of mangosteen seeds extract	35
Figure 4.6 The effect of type of sample on total phenolic content	37
Figure 4.7 The effect of types of solvent on the total flavonoids content of mangosteen pericarps extract	38
Figure 4.8 The effect of types of solvent on the total flavonoid content of mangosteen seeds extract	38
Figure 4.9 The effect of type of sample to the total flavonoid content	39
Figure 4.10 The effect of types of solvent to the free radical scavenging activity of mangosteen pericarps extract.....	40
Figure 4.11 The effect of types of solvent to the free radical scavenging activity of mangosteen seeds extract.....	40

Figure 4.12 The effect of type of sample to the free radical scavenging activity of extract	42
Figure 4.13 Reaction mechanism of the formation of ZnO-NPs	42
Figure 4.14 Amount of ZnO-NPs synthesized from mangosteen pericarps extract	44
Figure 4.15 Amount of ZnO-NPs synthesized from mangosteen seeds extract	44
Figure 4.16 The effect of type of sample to the amount of ZnO-NPs	45
Figure 4.17 The effect of types of solvent to the free radical scavenging activity of ZnO-NPs synthesized from mangosteen pericarps extract.....	46
Figure 4.18 The effect of types of solvent to the free radical scavenging activity of ZnO-NPs synthesized from mangosteen seeds extract.....	46
Figure 4.19 The effect of type of sample on the free radical scavenging activity of ZnO-NPs	48
Figure 4.20 Effect of calcination towards the free radical scavenging activity of ZnO-NPs	49
Figure 4.21 SEM morphology of ZnO-NPs treated (a) without calcination; (b) with calcination at 100°C using x200 magnification	51
Figure 4.22 SEM morphology of ZnO-NPs treated (a) without calcination; (b) with calcination at 100°C using x500 magnification	51
Figure 4.23 SEM morphology of ZnO-NPs treated (a) without calcination; (b) with calcination at 100°C using x1500 magnification	51

LIST OF APPENDICES

	page
Appendix A. Result of Identification Test of Mangosteen Fruit.....	A-1
Appendix B. Yield of Mangosteen Pericarps and Seeds Extract	B-1
Appendix C. Dry Matter of Mangosteen Pericarps and Seeds Extract	C-1
Appendix D. Total Phenolic Content of Mangosteen Pericarps and Seeds Extract..	D-1
Appendix E. Total Flavonoid Content of Mangosteen Pericarps and Seeds Extract	E-1
Appendix F. Free Radical Scavenging Activity of Mangosteen Pericarps and Seeds Extract.....	F-1
Appendix G. Yield of Zinc Oxide Nanoparticles Synthesized from Mangosteen Pericarps and Seeds.....	G-1
Appendix H. Free Radical Scavenging Activity of Zinc Oxide Nanoparticles Synthesized from Mangosteen Pericarps and Seeds	H-1
Appendix I. Free Radical Scavenging Activity of Zinc Oxide Nanoparticles Synthesized from Mangosteen Pericarps Extracted with Methanol as the Best Solvent with Different Treatments.....	I-1
Appendix J. Characterization of Zinc Oxide Nanoparticles Treated without Calcination	J-1
Appendix K. Characterization of Zinc Oxide Nanoparticles Treated with Calcination	K-1