

## ACKNOWLEDGEMENTS

The foremost gratitude is to Jesus Christ only that the author is able to complete this thesis report entitled “UTILIZATION OF RAMBUTAN (*NEPHELIUM LAPPACEUM* L.) PEEL AND ITS EXTRACT TO INHIBIT ALCOHOLIC FERMENTATION OF SUGAR PALM (*ARENCA PINNATA* MERR.) SAP FOR SUGAR PRODUCTION”. This thesis is written as the partial fulfillment of the academic requirements to obtain the degree of *Sarjana Teknologi Pertanian Strata Satu*, Food Technology Department, Faculty of Science and Technology, Universitas Pelita Harapan, Tangerang.

Supports from many parties during the period is indispensable; therefore, deserve a gratitude. The author would like to give the highest appreciation to:

1. Ir. W. Donald R. Pokatong, M.Sc., Ph.D., as the main supervisor who has given assistance, guidance, advices, insights, and knowledge from the time this project started to its completion.
2. Ms. Yuniwaty Halim, MSc, as the co-supervisor who has been willing to guide, help, motivate, and support the author during the time of the project.
3. Ms. Julia Ratna Wijaya, MAppSc as the Head of Food Technology Department who has given the opportunity to the author to conduct this research.
4. Mr. Jeremia Manuel Halim, MP, Ms. Ratna Handayani, MP, Mrs. Nathania, MEng, Dr. Adolf J. N. Parhusip and Ir. Melanie Cornelia, MT as the Heads of Quality Control, Research, Food Processing, Microbiology and Chemistry Laboratories, respectively.

5. Ms. Meri Situmorang, Mr. Hendra, Ms. Rachel, Mr. Yosafat, Mr. Adzie and Mr. Darius for the help and information during the work in the laboratories.
6. Dearest parents, David Bambang Purwohadi and Lea Ariaty, for being the most wonderful and supportive persons for the author during the project completion.
7. Fellow friends under supervision of the same main supervisor, Alexandra Casie, Bella Agatha, and Devina Subowo, for the invaluable efforts and memorable moments along the way to complete this thesis.
8. Grace Sheila Jonatan, Irene Astria, and Margaretha Manuella as seniors who have shared the experiences regarding the research.
9. Mr. Julian and Mr. Yani who has helped to provide the needed samples for this research.
10. Jessica Dwikarya, Bella Kumalasari, Cosmas Andi Wiraatmadja, Robertus Hudi, Sherlyn Fierliani, and all the dearest friends in UPH Choir, for the support and care for the author.
11. Santira Putri, Angeline Nita, Frisca Aprillia, Alice Pratiwi, Sheila Sarayar and all friends in RnD Abbalove Serpong, for unending prayers and motivation.
12. Mr. Benny for the help regarding transportation means during this thesis.
13. All friends in Food Technology Department for the help and support for the author.
14. All lecturers and staffs in UPH Food Technology Department for the help given to the author during the research.
15. All friends, family, and colleagues who are not enlisted one by one, but have contributed to the completion of this thesis report.

Author realizes that there are still much room for improvement in this thesis report. Hence, any critics and suggestions to further refine the work will be gladly welcomed. To end with, may this report be a useful and informative one for readers.

Karawaci, February, 2015

Author



# TABLE OF CONTENTS

	page
<b>COVER</b>	
<b>STATEMENT OF AUTHENTICITY</b>	
<b>APPROVAL BY THESIS SUPERVISORS</b>	
<b>APPROVAL BY EXAM COMMITTEE</b>	
<b>ABSTRACT</b> .....	v
<b>ACKNOWLEDGEMENTS</b> .....	vi
<b>TABLE OF CONTENTS</b> .....	ix
<b>LIST OF FIGURES</b> .....	xii
<b>LIST OF TABLES</b> .....	xiii
<b>LIST OF APPENDICES</b> .....	xiv
<b>CHAPTER I INTRODUCTION</b>	
1.1 Background .....	1
1.2. Research Problem.....	3
1.3 Objectives .....	4
1.3.1 General Objectives .....	4
1.3.2 Specific Objectives.....	4
<b>CHAPTER II LITERATURE REVIEW</b>	
2.1 Rambutan .....	5
2.1.1 Rambutan Peel.....	6
2.2 Sugar Palm.....	8
2.2.1 Sugar Palm Sap.....	9
2.2.2 Production of Palm Sugar.....	11
2.2.3 Microbiology of, and Fermentation in Palm Sap.....	12
2.2.3.1 Microbiology of Palm Sap .....	12

2.2.3.2 Fermentation in Palm Sap .....	15
2.3 Fermentation Inhibitor .....	17
2.4 Extraction.....	18
2.4.1 Maceration .....	18
2.4.2 Percolation .....	19
2.4.3 Soxhlet Extraction.....	19

### **CHAPTER III RESEARCH METHODOLOGY**

3.1 Materials and Equipment.....	21
3.2 Research Stages.....	21
3.2.1 Preliminary Research .....	21
3.2.2 Main Research Stage I Procedure.....	23
3.2.3 Main Research Stage II Procedure.....	25
3.3 Experimental Designs.....	26
3.3.1 Preliminary Research .....	26
3.3.2 Main Research Stage I .....	28
3.3.3 Main Research Stage II .....	29
3.4 Methods of Analysis.....	29
3.4.1 Moisture Content by Oven Method .....	29
3.4.2 Extraction Yield .....	30
3.4.3 Total Reducing Sugar.....	30
3.4.4 Total Dissolved Solids .....	32
3.4.5 pH Determination .....	32
3.4.6 Alcohol Content.....	33
3.4.7 Total Titratable Acidity .....	33
3.4.8 Total Plate Count .....	34
3.4.9 Yield of Palm Sugar .....	34

3.4.10 Texture Analysis .....	35
<b>CHAPTER IV RESULTS AND DISCUSSION</b>	
4.1 Taxonomical Verification .....	36
4.2 Result of Concentration Range Determination and Extraction Yield .....	36
4.3 Physicochemical Properties of Palm Sap Added With Rambutan Peel.....	38
4.3.1 pH.....	38
4.3.2 Total Titratable Acidity .....	40
4.3.3 Total Reducing Sugar.....	42
4.3.4 Alcohol Content.....	44
4.3.5 Total Dissolved Solids .....	46
4.4 Microbial Enumeration of Palm Sap Sample.....	47
4.4.1 Total Plate Count .....	47
4.4.2 Yeast Count .....	49
4.5 Production and Evaluation of Palm Sugar .....	51
4.5.1 Reducing Sugar Content.....	51
4.5.2 Moisture Content .....	52
4.5.3 Yield of Brown Sugar .....	53
4.5.4 Visual Appearance .....	54
4.5.5 Texture Analysis.....	55
<b>CHAPTER V CONCLUSION AND SUGGESTIONS</b>	
5.1 Conclusion .....	57
5.2 Suggestions .....	57
<b>BIBLIOGRAPHY.....</b>	<b>59</b>
<b>APPENDICES.....</b>	<b>64</b>

## LIST OF FIGURES

	page
Figure 2.1 Rambutan fruit ( <i>Nephelium lappaceum</i> L.).....	6
Figure 2.2 Inflorescence of sugar palm ( <i>Arenga pinnata</i> ).....	9
Figure 3.1 Flowchart of the application of semi-dried and extract of rambutan peel toward palm sap .....	21
Figure 3.2 Flowchart of palm sugar production .....	22
Figure 4.1 Ethyl acetic extract of rambutan peel.....	34
Figure 4.2 pH of palm sap treated with a) semi-dried, and b) ethyl acetic extract of rambutan peel .....	35
Figure 4.3 Total titratable acidity of palm sap treated with a) semi-dried, and b) ethyl acetic extract of rambutan peel.....	37
Figure 4.4 Total reducing sugar of palm sap treated with a) semi-dried, and b) ethyl acetic extract of rambutan peel .....	40
Figure 4.5 Alcohol content of palm sap treated with a) semi-dried, and b) ethyl acetic extract of rambutan peel.....	41
Figure 4.6 Total dissolved solids of palm sap treated with a) semi-dried, and b) ethyl acetic extract of rambutan peel .....	43
Figure 4.7 Total plate count of palm sap treated with a) semi-dried, and b) ethyl acetic extract of rambutan peel .....	45
Figure 4.8 Total yeast count of palm sap treated with a) semi-dried, and b) ethyl acetic extract of rambutan peel .....	48
Figure 4.9 Palm sugar produced from untreated (control) and treated palm sap .....	51

## LIST OF TABLES

	page
Table 2.1 Chemical composition of <i>Arenga pinnata</i> sap.....	10
Table 2.2 Standard of palm sugar made from <i>A. pinnata</i> sap.....	12
Table 2.3 Total bacterial, and yeasts and moulds count of palm sap .....	14
Table 3.1 Experimental design of preliminary research (fresh peel) .....	24
Table 3.2 Experimental design of preliminary research (dried peel) .....	24
Table 3.3 Experimental design of main research stage I (semi-dried peel).....	26
Table 3.4 Experimental design of main research stage I (rambutan peel extract) .....	26
Table 3.5 Conversion table of Na <sub>2</sub> SO <sub>3</sub> to amount of monosaccharides.....	28
Table 3.6 Temperature corrections of hand refractometer calibrated at 20 °C .....	29
Table 3.7 Specific gravity of water at different temperatures (°C) .....	30
Table 4.1 Total reducing sugar produced from palm sap treated with rambutan peels .....	48
Table 4.2 Moisture content of cooked palm sugar from different treatments of palm sap .....	49
Table 4.3 Yield of brown sugar .....	50
Table 4.4 Result of hardness value of produced brown sugar .....	52



## LIST OF APPENDICES

	page
Appendix A. Taxonomical Verification of Rambutan Species.....	A-1
Appendix B. Preliminary research.....	B-1
Appendix C. Main Research stage I.....	C-1
Appendix D. Main Research stage II.....	D-1

