

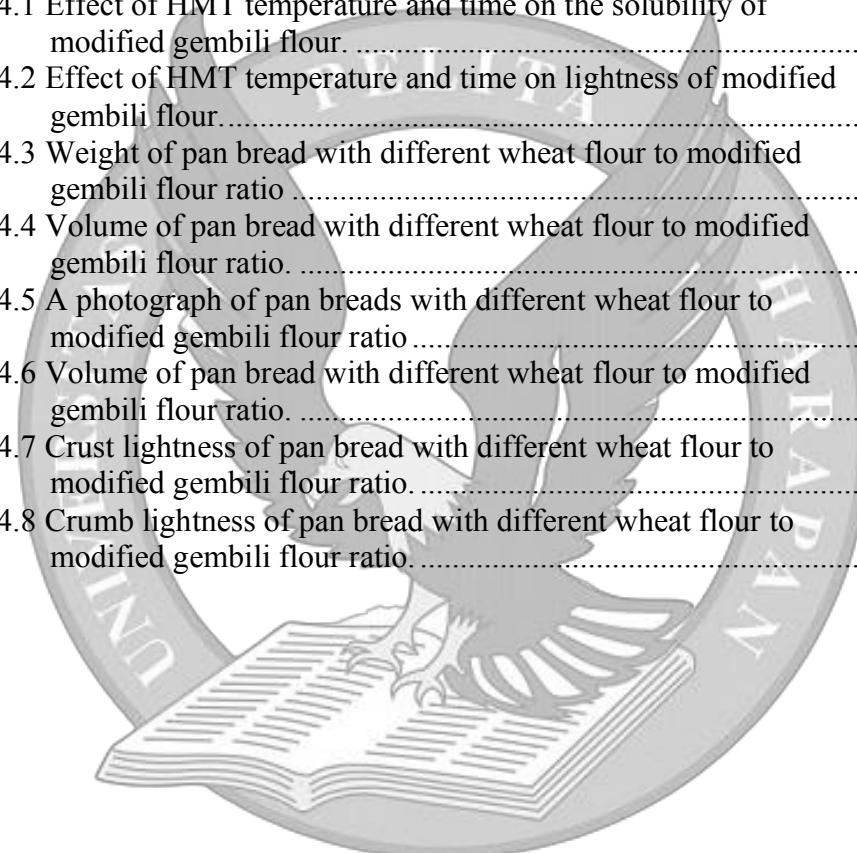
## TABLE OF CONTENTS

	Page
<b>COVER</b>	
FINAL ASSIGNMENT AND UPLOAD AGREEMENT	
APPROVAL BY THESIS SUPERVISOR	
APPROVAL BY THESIS EXAMINATION COMMITTEE	
ABSTRACT .....	v
ACKNOWLEDGEMENTS .....	vi
TABLE OF CONTENTS .....	ix
LIST OF FIGURES .....	xi
LIST OF TABLES .....	xii
LIST OF APPENDICES .....	xiii
<b>CHAPTER I INTRODUCTION</b>	
1.1 Background.....	1
1.2 Research Problem.....	3
1.3 Research Objectives .....	4
1.3.1 General Objectives.....	4
1.3.2 Specific Objectives .....	4
<b>CHAPTER II LITERATURE REVIEW</b>	
2.1 Gembili ( <i>Dioscorea esculenta</i> L.) .....	5
2.1.1 Chemical Composition of Gembili .....	6
2.2 Gembili Flour .....	8
2.3 Starch .....	11
2.3.1 Starch Modification .....	14
2.4 Bread .....	17
2.4.1 Pan Bread .....	18
2.4.2 Straight Dough method .....	20
2.5 Factors Affecting Pan Bread Quality.....	23
<b>CHAPTER III RESEARCH METHODOLOGY</b>	
3.1 Materials and Equipment.....	25
3.2 Research Methodology .....	26
3.2.1 Procedure of Preliminary Stage .....	26
3.2.2 Procedure of Main Research Stage I.....	27
3.2.3 Procedure of Main Research Stage II .....	28
3.3 Experimental Design .....	30
3.3.1 Procedure of Main Research Stage I.....	30
3.3.2 Procedure of Main Research Stage II .....	32
3.4 Analysis Procedures .....	33
3.4.1 Yield .....	33
3.4.2 Swelling Power.....	33
3.4.3 Solubility.....	33
3.4.4 Lightness Analysis .....	34
3.4.5 Total Starch Content .....	34
3.4.6 Amylose Content .....	34

3.4.7 Amylopectin Content .....	35
3.4.8 Weight and Volume .....	35
3.4.9 Texture .....	35
3.4.10 Proximate Analysis .....	36
3.4.11 Sensory Tests .....	38
<b>CHAPTER IV RESULTS AND DISCUSSION</b>	
4.1 Taxonomical Identity of Gembili .....	40
4.2 Yield and Chemical Composition of Unmodified Gembili Flour .....	40
4.3 Effect of HMT Temperature and Time on Physical Characteristics of Gembili Flour .....	41
4.3.1 Swelling Power of Modified Gembili Flour .....	41
4.3.2 Solubility of Modified Gembili Flour .....	42
4.3.3 Lightness of Modified Gembili Flour .....	44
4.4 Selected HMT Temperature and Time based on the Swelling Power and Solubility of Modified Gembili Flour .....	45
4.5 Chemical Composition of Untreated and Selected Modified Gembili Flour .....	46
4.6 Effect of Wheat Flour to Selected Modified Gembili Flour Ratio on Physical Properties of Pan Bread .....	48
4.6.1 Weight .....	48
4.6.2 Volume .....	50
4.6.3 Hardness .....	52
4.6.4 Crust Lightness .....	54
4.6.5 Crumb Lightness .....	56
4.7 Effect of Ratio of Wheat Flour to Modified Gembili Flour on Organoleptic Properties of Pan Bread .....	57
4.7.1 Scoring Values .....	57
4.7.2 Hedonic Values .....	60
4.8 Selected Pan Bread Formulation based on Physical and Organoleptic Properties .....	62
4.9 Chemical Composition of Selected Pan Bread .....	62
<b>CHAPTER V CONCLUSIONS AND SUGGESTIONS</b>	
5.1 Conclusions .....	65
5.2 Suggestions .....	66
<b>BIBLIOGRAPHY .....</b>	<b>67</b>
<b>APPENDICES .....</b>	<b>77</b>

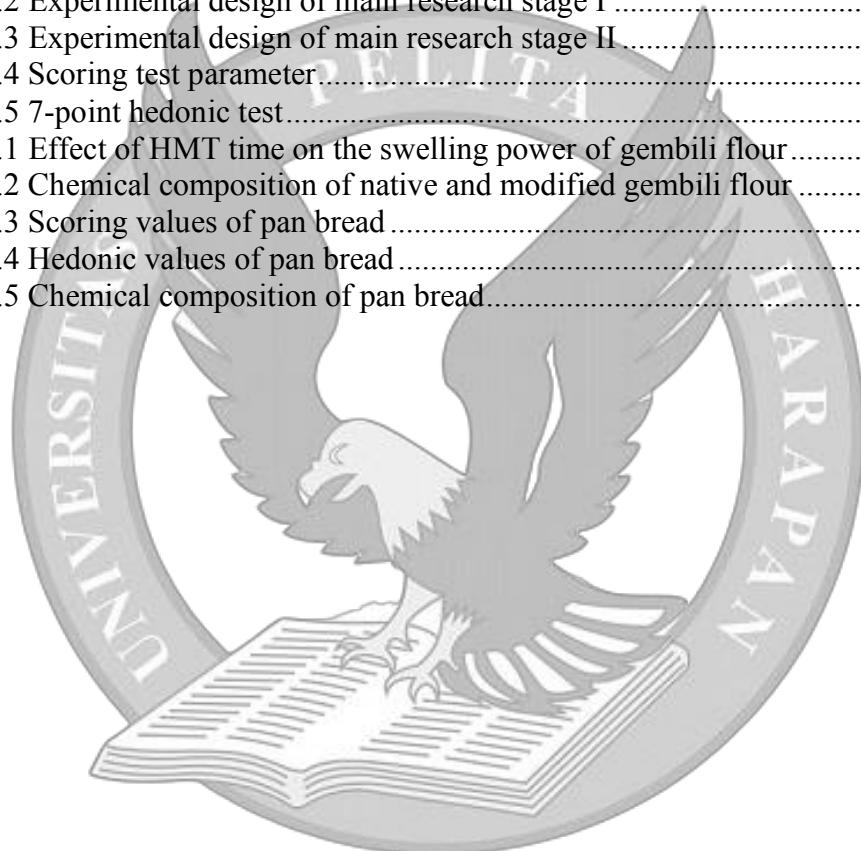
## LIST OF FIGURES

	Page
Figure 2.1 Gembili plant (a) and gembili tuber (b) .....	6
Figure 2.2 Structures of amylose and amylopectin .....	11
Figure 2.3 Illustration of polymer chain rearrangement during HMT .....	16
Figure 2.4 Pan bread .....	18
Figure 2.5 Straight-dough method of making pan bread .....	23
Figure 3.1 Flow chart of gembili flour production .....	26
Figure 3.2 Flow chart of HMT gembili flour production .....	27
Figure 3.3 Flow chart of straight-dough method for pan bread production....	29
Figure 4.1 Effect of HMT temperature and time on the solubility of modified gembili flour. ....	43
Figure 4.2 Effect of HMT temperature and time on lightness of modified gembili flour.....	44
Figure 4.3 Weight of pan bread with different wheat flour to modified gembili flour ratio .....	49
Figure 4.4 Volume of pan bread with different wheat flour to modified gembili flour ratio. ....	50
Figure 4.5 A photograph of pan breads with different wheat flour to modified gembili flour ratio .....	51
Figure 4.6 Volume of pan bread with different wheat flour to modified gembili flour ratio. ....	53
Figure 4.7 Crust lightness of pan bread with different wheat flour to modified gembili flour ratio. ....	55
Figure 4.8 Crumb lightness of pan bread with different wheat flour to modified gembili flour ratio. ....	57



## LIST OF TABLES

	Page
Table 2.1 Composition of Gembili Tuber .....	7
Table 2.2 Composition of gembili flour.....	10
Table 2.3 Chemical composition of pan bread.....	18
Table 2.4 Quality parameter of pan bread.....	19
Table 3.1 Ingredients and formulation of pan bread .....	28
Table 3.2 Experimental design of main research stage I .....	30
Table 3.3 Experimental design of main research stage II .....	32
Table 3.4 Scoring test parameter.....	39
Table 3.5 7-point hedonic test.....	39
Table 4.1 Effect of HMT time on the swelling power of gembili flour.....	42
Table 4.2 Chemical composition of native and modified gembili flour .....	46
Table 4.3 Scoring values of pan bread .....	57
Table 4.4 Hedonic values of pan bread .....	60
Table 4.5 Chemical composition of pan bread.....	63



## LIST OF APPENDICES

	Page
Appendix A Taxonomical Identity of Gembili ( <i>Dioscorea esculenta</i> L.) Gembili Identification Result.....	A-1
Appendix B Physical Characteristics of Modified Gembili Flour	
Swelling Power of Modified Gembili Flour .....	B-1
Statistical Analysis of Swelling Power of Modified Gembili Flour ...	B-7
Solubility of Modified Gembili Flour .....	B-8
Statistical Analysis of Solubility of Modified Gembili Flour .....	B-14
Lightness of Modified Gembili Flour .....	B-16
Statistical Analysis of Lightness of Modified Gembili Flour .....	B-18
Appendix C Chemical Composition of Selected Modified Gembili Flour	
Moisture Content of Modified Gembili Flour.....	C-1
Statistical Analysis Results for Moisture Content of Modified Gembili Flour .....	C-6
Protein Content of Modified Gembili Flour .....	C-7
Statistical Analysis Results for Protein Content of Modified Gembili Flour .....	C-9
Fat Content of Modified Gembili Flour of Modified Gembili Flour ..	C-10
Statistical Analysis Results for Fat Content.....	C-12
Ash Content of Modified Gembili Flour .....	C-13
Statistical Analysis Results for Ash Content of Modified Gembili Flour.....	C-15
Carbohydrate Content of Modified Gembili Flour .....	C-15
Statistical Analysis Results for Carbohydrate Content of Modified Gembili Flour .....	C-16
Starch Content of Modified Gembili Flour .....	C-19
Amylose Content of Modified Gembili Flour.....	C-20
Amylopectin Content of Modified Gembili Flour .....	C-21
Statistical Analysis Results for Starch Content of Modified Gembili Flour.....	C-22
Statistical Analysis Results for Amylose Content of Modified Gembili Flour .....	C-22
Statistical Analysis Results for Amylopectin Content of Modified Gembili Flour .....	C-23
Appendix D Physical Properties of Pan Bread	
Weight of pan bread.....	D-1
Statistical Analysis Results for Weight of Pan Bread.....	D-2
Volume of pan bread.....	D-3
Statistical Analysis Results for Volume of Pan Bread.....	D-4
Hardness of Pan Bread .....	D-5
Statistical Analysis Results for Hardness of Pan Bread.....	D-6
Crust Lightness of Pan Bread.....	D-7

Statistical Analysis Results for Crust Lightness of Pan Bread .....	D-8
Crumb Lightness of Pan Bread .....	D-9
Statistical Analysis Results for Crumb Lightness of Pan Bread .....	D-10

## Appendix E Scoring Test of Pan Bread Partially Substituted with HMT Modified Gembili Flour

Example of Scoring Test Questionnaire .....	E-1
Scoring Test Results for Crust Colour .....	E-2
Average Scoring Test Results for Crust Colour.....	E-4
Statistical Analysis Results for Crust Colour.....	E-4
Scoring Test Results for Crumb Colour.....	E-5
Average Scoring Test Results for Crumb Colour .....	E-7
Statistical Analysis Results for Crumb Colour .....	E-7
Scoring Test Results for Firmness .....	E-8
Average Scoring Test Results for Firmness.....	E-10
Statistical Analysis Results for Firmness.....	E-10
Scoring Test Results for Aroma.....	E-11
Average Scoring Test Results for Aroma .....	E-13
Statistical Analysis Results for Aroma .....	E-13
Scoring Test Results for Taste .....	E-14
Average Scoring Test Results for Taste.....	E-16
Statistical Analysis Results for Taste.....	E-16

## Appendix F Hedonic Test of Pan Bread Partially Substituted with HMT Modified Gembili Flour

Example of Hedonic Test Questionnaire .....	F-1
Hedonic Test Results for Crust Colour .....	F-2
Average Hedonic Test Results for Crust Colour.....	F-4
Statistical Analysis Results for Crust Colour.....	F-4
Hedonic Test Results for Crumb Colour.....	F-5
Average Hedonic Test Results for Crumb Colour .....	F-7
Statistical Analysis Results for Crumb Colour .....	F-7
Hedonic Test Results for Firmness .....	F-8
Average Hedonic Test Results for Firmness.....	F-10
Statistical Analysis Results for Firmness .....	F-10
Hedonic Test Results for Aroma.....	F-11
Average Hedonic Test Results for Aroma .....	F-13
Statistical Analysis Results for Firmness .....	F-13
Hedonic Test Results for Taste .....	F-14
Average Hedonic Test Results for Taste.....	F-16
Statistical Analysis Results for Taste.....	F-16
Hedonic Results for Overall Acceptance .....	F-17
Average Hedonic Test Results for Overall Acceptance.....	F-19
Statistical Analysis Results for Overall Acceptance .....	F-19

## Appendix G Chemical Composition of Pan Bread Partially Substituted with HMT Modified Gembili Flour

Moisture Content of Pan Bread.....	G-1
------------------------------------	-----

Statistical Analysis Results for Moisture Content of Pan Bread .....	G-2
Protein and Fat Analysis of Pan Bread (Replication 1) from External Laboratory .....	G-3
Protein and Fat Analysis of Pan Bread (Replication 2) from External Laboratory .....	G-4
Protein and Fat Analysis of Pan Bread (Replication 3) from External Laboratory .....	G-5
Protein Content of Pan Bread.....	G-6
Statistical Analysis Results for Protein Content of Pan Bread .....	G-7
Fat Content of Pan Bread .....	G-8
Statistical Analysis Results for Fat Content of Pan Bread.....	G-9
Ash Content of Pan Bread.....	G-10
Statistical Analysis Results for Ash Content of Modified Gembili Flour.....	G-11
Carbohydrate Content of Pan Bread .....	G-12
Statistical Analysis Results for Carbohydrate Content of Pan Bread ..	G-13

#### Appendix H Research Documentation

Gembili Tuber .....	H-1
Sliced gembili .....	H-1
Dried gembili slices .....	H-1
Control and HMT gembili flour.....	H-2
Bread dough after intermediate proofing.....	H-2
Bread dough after panning .....	H-3
Bread dough after final proofing.....	H-3
Pan bread after baking.....	H-3
Cross-section of pan bread .....	H-4