

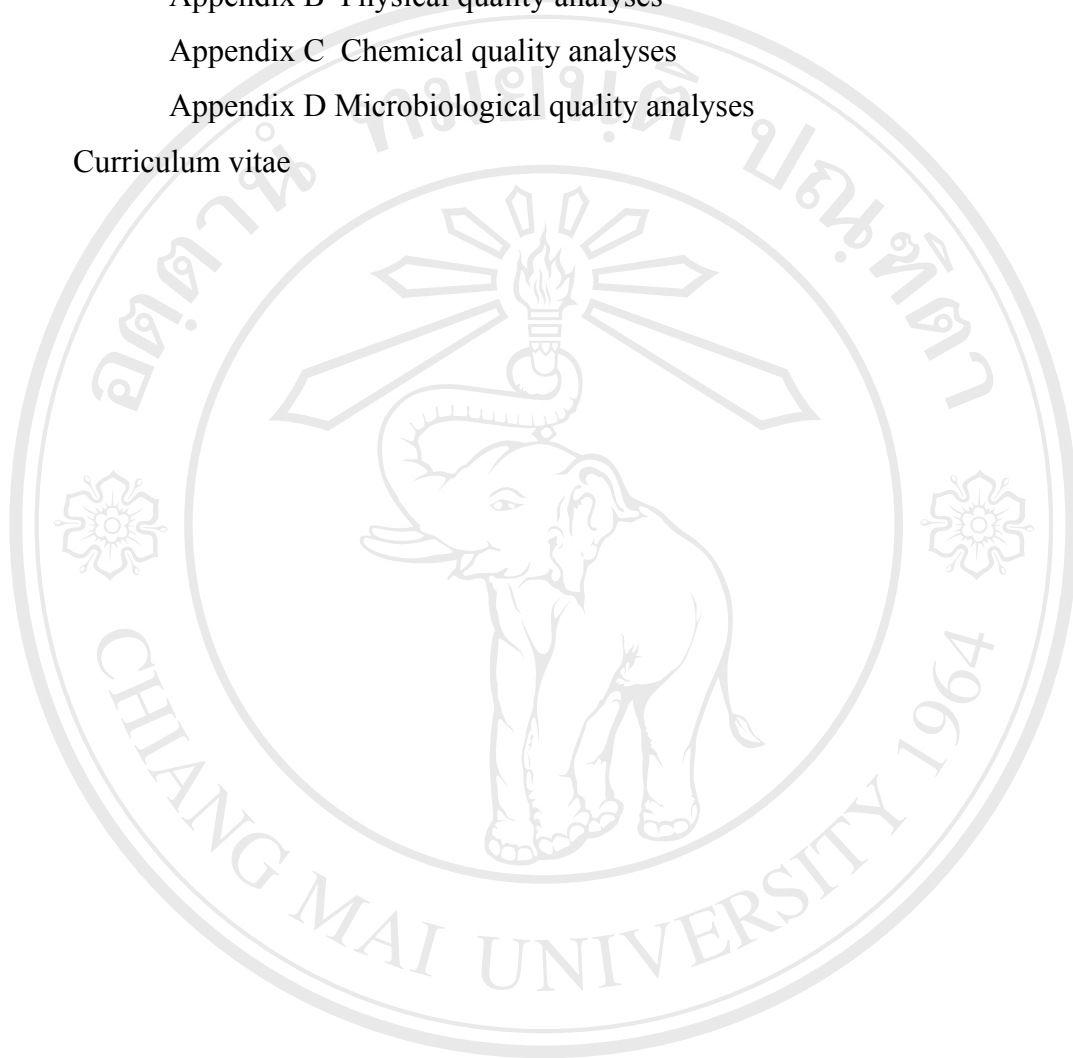
TABLE OF CONTENTS

	Page
Acknowledgements	iii
Abstract Thai	iv
Abstract English	vi
List of tables	xii
List of figures	xiv
Chapter 1 Introduction	1
1.1 Principles, theory, and rationale	1
1.2 Purpose of the study	2
1.3 Education / Application Advantages	3
1.4 Scope of study	3
Chapter 2 Literature review	4
2.1 Corn	4
2.1.1 Types of corn	4
2.1.2 Sweet corn	4
2.1.3 Chemical composition of sweet corn	6
2.1.4 Utilization of sweet corn	7
2.2 Foam	7
2.2.1 Foam formation	9
2.2.2 Stability of foam	11
2.2.3 Disproportionation	13
2.2.4 Drainage	14
2.2.5 Foam breaking	15
2.3 Drying Theory	16
2.4 Foam-mat drying	19
2.4.1 Foaming agent	21
2.4.1.1 Function of surfactants	21
2.4.1.2 Glyceryl monostearate (GMS)	23

	Page
2.4.1.3 Methocel	23
2.4.2 Development of the foam-mat process	24
2.4.3 Maltodextrin	28
2.4.3.1 Production	29
2.4.3.2 Compositional characteristics	31
2.4.3.3 Physicochemical characteristics	31
2.4.3.4 Mechanism of network formation of maltodextrin gels	33
2.4.3.5 Food application of maltodextrin	33
2.5 Instant powder	36
Chapter 3 Methodology	39
3.1 Materials	39
3.1.1 Raw material	39
3.1.2 Chemical	39
3.1.3 Packaging	39
3.2 Equipment	39
3.2.1 Equipment for producing corn milk powder	39
3.2.2 Equipment for analysis	40
3.2.3 Statistical analysis hardware and software	40
3.3 Method	40
3.3.1 The quality of corn milk	40
3.3.2 A production of corn milk powders by foam-mat drying	41
3.2.2.1 A study of suitable foaming agent, sugar and maltodextrin concentrations to produce a stable foam	41
3.2.2.2 A study on suitable amount of foaming agents	43
3.2.2.3 A Study of suitable temperature and time of drying condition in a production of corn milk	

	Page
powders by foam-mat drying	45
Chapter 4 Results and discussion	47
4.1 The composition of corn milk	47
4.2 A study on appropriate foaming agent, sugar and maltodextrin concentrations to produce a stable foam	50
4.2.1 The effect of foaming agents on foam formation and stability	51
4.2.1.1 Glyceryl monostearate (GMS)	51
4.2.1.2 Methocel	55
4.2.1.3 A combination of GMS and methocel ratio (1:1)	56
4.2.2 Effect of maltodextrin on the foam formation and stability	57
4.2.3 Effect of sugar on the foam formation and stability	59
4.2.4 Effect of whipping time on foam formation	60
4.2.4.1 Glyceryl monostearate (GMS)	60
4.2.4.2 A mixture of GMS and methocel at a ratio of 1:1	62
4.2.5 Effect of whipping temperature on foam formation	63
4.3 A Study on the suitable amount of foaming agent in production of corn milk powder by foam-mat drying	65
4.3.1 The properties of foam	66
4.3.2 The quality of corn milk powder	69
4.3.3 Hygroscopic characteristics	77
4.4 A study of the suitable time and temperature of drying processes in the production of corn milk powders by foam-mat drying	79
4.4.1 Drying processing time	79
4.4.2 The properties of corn milk powders	82
4.4.3 Hygroscopic characteristics	87
Chapter 5 Conclusion	91
References	94
Appendix	100
Appendix A Pictures	101

	Page
Appendix B Physical quality analyses	104
Appendix C Chemical quality analyses	107
Appendix D Microbiological quality analyses	119
Curriculum vitae	122



ลิขสิทธิ์มหาวิทยาลัยเชียงใหม่
Copyright © by Chiang Mai University
All rights reserved

LIST OF TABLES

Tables	Page
4.1 Analyses of raw sweet corn and corn milks	47
4.2 Effect of GMS, sugar and maltodextrin on the physical characteristics of foam formation and its stability during drying	52
4.3 Effect of methocel, sugar and maltodextrin on the physical characteristics of foam formation and its stability during drying	53
4.4 Effect of GMS : methocel (1:1), sugar and maltodextrin on the physical characteristics of foam formation and its stability during drying	54
4.5 Different amounts of foaming agents added into corn milk	66
4.6 The properties of foam made from different levels and types of foaming agents	67
4.7 The color of corn milk powder and reconstituted corn milk made by 2 % GMS concentration and 5 % concentration of GMS and methocel (1:1)	71
4.8 The solubility, dispersibility and rehydration characteristics of corn milk powder made by 2% concentration of GMS and 5 % concentration of GMS and methocel (1:1)	72
4.9 The chemical and microbiological properties and the yield of corn milk powder made by 2 % concentration of GMS and 5 % concentration of GMS and methocel (1:1)	75

Tables	Page
4.10 Moisture contents (%) of corn milk powders drying at 60, 70 and 80 °C	80
4.11 Color of corn milk powders and reconstituted corn milks made by 63 g (31.5 %w/w) of GMS and methocel (1:1) concentration and dried at 60 and 70 °C	85
4.12 Physical, chemical and microbiological qualities of corn milk powders made by a 63 g(31.5 %w/w) of GMS and methocel (1:1) and dried at 60 and 70 °C	86
B.1 Invert sugar table	118

LIST OF FIGURES

Figures	Page
2.1 Deformation of gas bubble subject to extensional flow by the surrounding liquid	11
2.2 A gas bubble at an orifice	11
2.3 Sketch of three liquid films meeting at Plateau border with radius of curvature	11
2.4 A disturbance of a liquid film in the form of a symmetric wave	13
2.5 Wetting of a solid particle at the air-water interface	13
2.6 Theoretical rates of disproportionation for carbon dioxide and nitrogen at 20 °C and 1 atmosphere pressure	14
2.7 Schematic representation of process of regeneration	15
2.8 Schematic representation of consecutive stages whereby a spreading particle cause local film thinning ultimately leading to film collapse	16
2.9 One type of cabinet or tray drier	19
2.10 Mode of adsorption of various surfactants at oil-water or air-water interface	22
2.11 Structure of methyl cellulose	24
4.1 Effect of whipping time on foam density of corn milk made by different concentrations of GMS as a foaming agent.	61
4.2 Effect of whipping time on foam density of corn milk made by different concentrations of GMS and methocel (1:1) as a foaming agent.	63
4.3 Effect of whipping temperature on foam density of corn milk prepared using GMS	65

Figures	Page
4.4 Effect of whipping temperature on foam density of corn milk prepared using 5 % concentration of GMS and methocel (1:1)	65
4.5 Hygroscopic characteristics of corn milk powders made by 2 % GMS and 5% GMS and methocel (1:1)	78
4.6 Drying curves at 60 and 70 ⁰ C for corn milk powders produced by foam-mat drying	82
4.7 Hygroscopic characteristics of corn milk powders from 5 % concentration of GMS and methocel (1:1) and dried at 60 ⁰ C for 90 to 120 min and at 70 ⁰ C for 60 to 90 min	89
A.1 Corn milk	101
A.2 Stable foam and unstable foam	101
A.3 Foam before drying, stable foam after drying and foam collapsed during drying	102
A.4 Corn milk powder produced from stable foam	102
A.5 Corn milk powders prepared by 2 % concentration of GMS and 5 % concentration of GMS and methocel (1:1)	103
A.6 Reconstituted corn milks prepared by 2 % concentration of GMS and 5 % concentration of GMS and methocel (1:1)	103
C.1 β -carotene standard curve	114
C.2 Vitamin C standard curve	116