TABLE OF CONTENTS

	Page
Acknowledgement	iii
Abstract (English)	iv
(Thai)	vi
Contents	viii
List of tables	xi
List of illustrations	xii
Abbreviations and symbols	xiv
CHAPTER 1 Introduction	75
CHAPTER 2 Literature review	3
2.1 Chitin	3
2.1.1 Molecular structure of chitin	4
2.1.2 General properties of chitin	5
2.1.3 Chitin production	6
a) Chemical method	8
b) Biological method	11
2.2 Chitosan	13
2.2.1 Structure of chitosan	13
2.2.2 Physicochemical characteristics of chitosan	14
1) Degree of deacetylation	14 LN U
2) Molecular weight	16
3) Viscosity	Jnn ₁₈ rsity
4) Solubility	19
5) Coagulating ability	20
2.2.3 Chitosan production	21
a) Chemical method	21
b) Biological method	22

	Page
2.2.4 Application of chitosan	24
1) Water treatment and Papermaking	26
Medical and Pharmaceutics	29
Cosmetics and Enzyme technology	32
4) Chitosan membrane and Cell encapsulation	33
5) Agriculture	35
6) Food industry	36
- Antimicrobial action of chitosan	39
2.2.5 Nutritional effect of chitosan in foods	42
2.3 Food Spoilage	43
2.3.1 Food spoilage definition	43
2.3.2 Food spoilage microorganisms	5442
2.3.3 Meat and Meat products	46
- Meat safety and Microbiological guidelines	47
CHAPTER 3 Experiments	52
3.1 Materials and Equipments	52
3.1.1 Bacterial strains	52
3.1.2 Chitosan	52
3.1.3 Minced pork	53
3.1.4 Media and chemical reagents	53
3.1.4.1 Microbiological media and diluent	53
3.1.4.2 Chemical reagents	53
3.1.5 Equipments	54 161
3.2 Methods	55
3.2.1 Bacterial strains and cultivation	ni\55 rsitV
3.2.2 Preparation of chitosan solution	55
3.2.3 Antibacterial effect of chitosan on the growth	r 55 e o
of some food spoilage bacteria in vitro and	
determination of the minimum inhibitory	
concentration (MIC) of chitosan	
3.2.4 Effect of nH on antibacterial activity of chitoson	56

	Page
3.2.5 Effect of temperature on antibacterial activity of chitosan	57
3.2.6 Investigation of antimicrobial activity of chitosan on a mixed culture in vitro	57
3.2.7 The effect of bacterial cell on antibacterial activity of chitosan	57
3.2.8 Effect of chitosan for antimicrobial activity in minced pork	58
CHAPTER 4 Results and Discussions	59
4.1 The antibacterial effect of chitosan on the growth of food spoilage bacteria	59
4.2 The effect of pH on the antibacterial activity of chitosan	65
4.3 The effect of temperature on the antibacterial activity of chitosan	74
4.4 The effect of chitosan on a mixed culture in vitro	75
4.5 The effect of cell population on the antibacterial activity of chitosan	77
4.6 Effect of chitosan on microbial survival and growth in minced pork	83
CHAPTER 5 Conclusions	88
REFERENCES	90
APPENDIX A	
APPENDIX C	\$ 104
	11128
APPENDIX Designs of the Chiang Mai U	ninersity.
APPENDIX F I I I I I I I I I I I I I I I I I I	115 116 e o
CURRICULUM VITAE	

LIST OF TABLES

Table	ं श्रिमाम् ।	Page
Table 1	Chitin and Chitosan yields from shellfish in 2000	7
Table 2	Worldwide market for chitin derived product year 2000	7
Table 3	The consumption of chitosan in the worldwide market	25
Table 4	Rate of adsorption of metal ions by chitosan from different sources	27
Table 5	Dye could be adsorbed by chitosan	28
Table 6	Blood anti-coagulant and LPL (Lipoprotein Lipase)-releasing	30
	activities of some sulfate derivatives of chitosan and chitin	
Table 7	Some chitosan products sold to consumers over the internet.	32
Table 8	Food applications of chitin, chitosan and their derivatives in	37
	the food industry	
Table 9	Guideline for the microbiological quality of ready-to eat	50
	meat products	
Table 10	Alberta Health and Food Microbiological guideline	51
Table 11	Inhibition effect of two molecular weight chitosan on	64
	growth of food spoilage bacteria	
Table 12	Technical chitosan product and impurities	103

ลิขสิทธิมหาวิทยาลัยเชียงใหม่ Copyright[©] by Chiang Mai University All rights reserved

LIST OF ILLUSTRATIONS

Figure	างมยนด	Page
Figure 1	Structure of chitin	4
Figure 2	The crystallographic models of α -chitin (A) and β -chitin (B)	5
Figure 3	Chitin manufacturing process	10
Figure 4	Total bioconversion process	12
Figure 5	Structure of chitosan	13
Figure 6	IR spectra of Chitin (A) and Chitosan (B)	15
Figure 7	¹³ C NMR spectra of chitin (A) and chitosan (B) by CP-MA	16
Figure 8	Chitosan manufacturing process	23
Figure 9	Scanning electron photomicrograph of A. actinomycetemcomitans	41
	cell after treatment with the chitooligosaccharides for 30 min	
Figure 10	Transmission electron photomicrograph of	41//
	A. actinomycetemcomitans cell after treatment with	
	the chitooligosaccharides for 30 min	
Figure 11	Inhibition effects of chitosan Mw 150,000 Da (A) and	61
	chitosan Mw 400,000 Da (B) on growth of food spoilage	
	bacteria	
Figure 12	The effect of pH on the antibacterial activity of chitosan	67
	0.01% (w/v), pH 6.0 against M. luteus	
Figure 13	The effect of pH on the antibacterial activity of chitosan	71
	0.01% (w/v), pH 6.0 against B. cereus	
Figure 14	The inhibitory effect of chitosan 0.01% (w/v), pH 6.0	76
	on mixed culture of M. luteus and B. cereus	
	after 24 hr incubation at 37°C	
Figure 15	The effect of cell population on antibacterial activity of	78
	chitosan 0.01% (w/v) against M. luteus at 37°C for 24 hr	

Figure 16	The effect of cell population on antibacterial activity of	Page 81
	chitosan 0.01% (w/v) against B. cereus at 37°C for 24 hr	
Figure 17	Viable cell counts in minced pork stored at 4°C for 10 days.	86
Figure 18	The growth rate of E. coli	108
Figure 19	The growth rate of En. aerogenes and Ps. fluorescens	109
Figure 20	The growth rate of S. marcescen and M. luteus	110
Figure 21	The growth rate of B. cereus and L. plantarum	0 111
Figure 22	Standard graph of B. cereus at OD600 and OD660	113
Figure 23	Standard graph of M. luteus at OD600 and OD660	114
	Colonies of seven food spoilage bacteria tested	116
	after 24 hr incubation	

ลิขสิทธิ์มหาวิทยาลัยเชียงใหม่ Copyright[©] by Chiang Mai University _ All rights reserved

ABBREVIATIONS AND SYMBOLS

cm ²	Centi square centimeter
CFU	Colony forming unit
Da	Dalton
°C	Degree Celsius
DD	Degree of deacetylation
g	Gram
hr	Hour
kg	Kilogram
L [강화 근	Litre
μm	Micrometer
MDa	Milli dalton
mg	Milligram
ml	Millilitre
mm	Millimeter
min	Minute
M	Molarity
Mw	Molecular weight
nm	Nanometer
N Salanguko	Normolity Onticel density
OD CT O CT I I O AD I I I	Optical density
" Convright by	Percent ang Mai University
1ь Соруна	round
spp. A righ	Species reserved
US\$	US dollar
w/v .	Weight by volume
w/w	Weight by weight