

## CONTENTS

	Page
Acknowledgement	iii
Abstract in Thai	iv
Abstract in English	vi
Contents	viii
List of Tables	xi
List of Figures	xii
List of Abbreviation and Symbols	xiii
<b>CHAPTER 1</b> Introduction	<b>1</b>
1.1    Situation of aquatic production and the using of protein hydrolysates	1
1.2    Purpose of study	4
<b>CHAPTER 2</b> Literature reviews	<b>5</b>
2.1    Fish meal and fish oil as feed components	5
2.2    Opportunities of replacing fishmeal by plant proteins	7
2.3    Challenges associated with replacing fishmeal by plant proteins	9
2.4    Utilization of fishery by-products	10
2.5    Protein hydrolysate	12
2.6    Fish Protein Hydrolysate (FPH)	12
2.6.1    Proximate composition of fish protein hydrolysates	13
2.6.2    Amino acid composition of fish protein hydrolysates	13
2.6.3    Potential applications of FPH in aqua-feed	15
2.7    Lysozyme Activities	16
2.8    Fish meat quality	17
2.9    red-tail catfish	18

	Page
CHAPTER 3 Materials and methods	20
3.1    Materials	20
3.1.1    Feed ingredients	20
3.1.2    Experimental fish	21
3.2    Methods	22
3.2.1    Experimental design	22
3.2.2    Preparation and evaluation of experimental diets	24
3.2.3    Experimental setup	24
3.2.4    Parameters of Growth Performance	25
3.2.5    Water quality	26
3.2.6    Carcass and meat evaluation.	26
3.2.7    Lysozyme analysis	28
3.3    Statistical Analysis	29
CHAPTER 4 Results	30
4.1    Growth performance	30
4.2    Water quality	31
4.3    Carcass quality	32
4.4    Muscle composition	33
4.5    Flesh color analysis	34
4.6    Lysozyme activity	35
CHAPTER 5 Discussion	36
5.1    Growth performance and mortality rate	36
5.2    Carcass quality	38
5.3    Meat Quality	39
5.4    Immune response	40
5.5    Further study	42
CHAPTER 6 Conclusions	43
REFERENCES	45

	Page
APPENDIX	
APPENDIX I	57
APPENDIX II	63
APPENDIX III	66
CURRICULUM VITAE	75



ลิขสิทธิ์มหาวิทยาลัยเชียงใหม่  
Copyright<sup>©</sup> by Chiang Mai University  
All rights reserved

## LIST OF TABLES

	Page
Table 1	7
Table 2	14
Table 3	20
Table 4	21
Table 5	23
Table 6	31
Table 7	32
Table 8	33
Table 9	34
Table 10	34

ลิขสิทธิ์มหาวิทยาลัยเชียงใหม่  
Copyright© by Chiang Mai University  
All rights reserved

## LIST OF FIGURES

	<b>Page</b>
Figure 3.1 Sample of fish protein hydrolysates powder tested	21
Figure 3.2 Mixing experimental diets	22
Figure 3.3 Pelleting machine	24
Figure 3.4 Pelleted experimental diet	24
Figure 3.5 Fish were grown in circle fiber tanks run in a closed water recirculation system	25
Figure 3.6 Weight recording	26
Figure 3.7 Length measurement	26
Figure 3.8 Appearance at end of experiment	27
Figure 3.9 Preparing of fillets	27
Figure 3.10 Carcass appearance	27
Figure 3.11 pH measurement	28
Figure 3.12 Color measurement	28
Figure 3.13 Blood collected by puncture of vena caudalis	29
Figure 4.1 Lysozyme activity with increase FPH in the diet	34

คิมสิกธ์นมหาวิทยาลัยเชียงใหม่  
Copyright<sup>©</sup> by Chiang Mai University  
All rights reserved

## ABBREVIATIONS AND SYMBOLS

### Abbreviations and symbols      Term

-	to
°C	degree centigrade or Celsius
=	equal to
>	less than
<	more than
μ	micron
μg	microgram
μl	microliter
%	percent
/	Per
+	Plus
ADG	Average Daily Gain
ANOVA	analysis of variance
AOAC	Association of Official and Analytical Chemists
CF	crude fiber
F	<i>F</i> -values
FCR	feed conversion ratio
FI	feed intake
FPH	fish protein hydrolysate
SGR	specific growth rate
PER	protein efficiency ratio

**Abbreviations and symbols      Term**

g	gram
g/kg	gram per kilogram
g/L	gram/liter
kg	kilogram
L	liter
Min	minute
mg/ml	milligram/milliliter
SPSS	the Statistical Package for Social Science
$m^3$	cubic



ลิขสิทธิ์มหาวิทยาลัยเชียงใหม่  
Copyright© by Chiang Mai University  
All rights reserved