

DOCTORAL THESIS

Culturing grass carp and grey mullet using food waste incorporated with traditional Chinese medicine, Baker's yeast and enzymes

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**CULTURING GRASS CARP AND GREY MULLET
USING FOOD WASTE INCORPORATED WITH
TRADITIONAL CHINESE MEDICINE, BAKER'S YEAST
AND ENZYMES**

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Abstract

The present study focused on using food wastes and feed supplements, e.g. enzymes (bromelain and papain), baker's yeast and Traditional Chinese Medicines (TCMs) for rearing freshwater fish (grass carp and grey mullet) in Hong Kong. Different types of food wastes, e.g. meats, bones, cereals, fruits and vegetables were collected from local hotels, mixed in different ratios and processed into feed pellets for feeding trials.

The cereal dominant food waste feed (FW A) was more suitable for grass carp and grey mullet, with the best growth performance (e.g. feed conversion ratio (FCR), specific growth rate (SGR)) and higher protein digestibility (in grass carp), compared to FW B and FW C which contained higher proportions of meat products. The NBT (Nitroblue Tetrazolium) activities in blood and plasma protein levels were decreased in the grass carp, cultured with food waste feeds without any supplements, compared to the commercial feed, Jinfeng[®], 613 formulation (Control).

Upgrading FW A by the addition of 1% and 2% mixtures of bromelain and papain significantly increased the feed protein solubility and subsequent to growth (SGR and relative weight gain (RWG)) and feed utilization (e.g. apparent net protein utilization (ANPU), protein efficiency ratio (PER)) in both fish species. The protein and feed utilizations by grass carp were also promoted by the yeast supplements with the optimal dose of 2.5% yeast (*S. cerevisiae*) added to FW A upgraded by enzymes. This showed that yeast could further enhance nutrient utilization contained in feeds after addition of bromelain and papain.

The *in vitro* study on the grass carp's plasma treated with TCM extracts also showed that TCM extracts could stimulate plasma bactericidal activity (on *Aeromonas hydrophila*), possibly through enhancing plasma complement activity. The

formulation with *Radix scutellaria*, *Rhizoma coptidis*, *Herba andrographis* and *Radix sophorae flavescens* in the ratio of 1:1:2:3 was more effective in enhancing plasma bactericidal activity than single TCM extracts. Besides, *R. coptidis* and *R. scutellaria* possessed the strongest antimicrobial activity (*in vitro*) on fish pathogens (such as *A. hydrophila*, *Lactococcus garvieae* and *Vibrio cholerae*) among the 17 tested TCMs. In addition, TCMs were less likely for developing drug resistant pathogens than antibiotics.

Grass carp immunity (NBT activity in blood, plasma bactericidal activity and total immunoglobulin level) was boosted by the addition of TCM formulation and baker's yeast (*S. cerevisiae*). The disease resistance to pathogen (*A. hydrophila*) was also enhanced, with significantly lower mortalities observed in groups feeding with TCM (1 and 2% for 21 to 28 days) and baker's yeast (2.5 and 5% for 28-56 days).

The uses of yeast and TCMs led to positive effects on growth, immunity and disease resistance to pathogens in fish, but the effects (grass carp) were less effectual when both were supplemented in feed. The combined use of both supplements may impair the effects of TCM formulation or yeast in the modulation of gut microflora, and upset the balance of beneficial microbial communities.

The present study demonstrated the feasibility of using feed supplements (TCM and baker's yeast) to enhance fish immunity and enzymes upgraded food waste feeds for rearing fish, for the development of a more sustainable aquaculture in Hong Kong.

Table of Contents

Declaration.....	i
Abstract.....	ii
Acknowledgements.....	iv
Table of Contents.....	v
List of Tables.....	xii
List of Figures.....	xv
Abbreviations and Acronyms.....	xiii

Chapter 1 The necessity of feed alternatives with supplements in current and future aquaculture industry

1.1 Overview of world aquaculture status	1
1.2 Hong Kong Inland Fisheries Status.....	4
1.3 Emerging problems in fast growing aquaculture industry in worldwide and China.....	11
1.3.1 Disease prevalence and abuse of chemicals and antibiotics.....	12
1.3.2 Rising feed materials prices	15
1.4 Using feed supplement as immuno-stimulants.....	17
1.4.1 Herbal supplement: Traditional Chinese Medicine (TCMs)	18
1.4.2 Probiotics: Baker's yeast.....	21
1.5 The necessity of alternative protein sources in fish feed.....	22
1.5.1 Utilization of food waste as fish feed in worldwide.....	22
1.5.2 Using enzyme for enhancing feed conversion in fish feed.....	26
1.6 Potential uses of drug alternatives and food waste as fish feed in Hong Kong aquaculture industry.....	27
1.7 Aims and objectives	30
1.8 Contributions and significance of the present research.....	32

Chapter 2 Using food wastes as fish feed ingredients for grass carp (*Ctenopharyngodon idellus*) and grey mullet (*Mugil cephalus*) cultivation

2.1 Introduction	35
2.2 Materials and Methods	39
2.2.1 Food waste fish feed preparation	39
2.2.2 Feed digestibility of different food wastes formulations in grass carp	41
2.2.3 Feed conversion of different food wastes formulations in grey mullet	46
2.2.4 Fish growth performance parameters.....	48
2.2.5 Chemical analysis on fish carcass and feed.....	49
2.2.6 Statistical analysis.....	52
2.3 Results.....	52
2.3.1 Results of feed digestibility of different food waste formulations in grass carp.....	52
2.3.1.1 Feed digestibility of different food wastes formulations and growth performance of grass carp	52
2.3.1.2 Carcass composition of grass carp fed with different food waste formulations.....	56
2.3.2 Results of feed conversion of different food waste formulations in grey mullet.....	56
2.3.2.1 Growth performance of grey mullet fed with different food waste formulations	56
2.3.2.2 Carcass composition of grey mullet fed with different food waste formulations.....	56
2.4 Discussion.....	59
2.4.1 Growth of grass carp and grey mullet fed with different food waste feeds.....	59
2.4.2 Utilizations of different food waste feeds by grass carp and grey mullet.....	61
2.5 Conclusion.....	66

Chapter 3 Upgrading food wastes by means of bromelain and papain to enhance growth and immunity of grass carp (*Ctenopharyngodon idellus*) and grey mullet (*Mugil cephalus*)

3.1 Introduction	68
3.2 Materials and Methods.....	71
3.2.1 Effects of food wastes formulation upgraded by papain and bromelain on grass carp growth performance	71
3.2.2 Effects of food wastes upgraded by papain and bromelain on grey mullet growth performance.....	75
3.2.3 Fish growth performance parameters.....	75
3.2.4 Fish immunological parameters.....	76
3.2.5 Statistical analyses.....	77
3.3 Results.....	78
3.3.1. Results of grass carp feeding trial with different food waste feeds upgraded by papain and bromelain.....	78
3.3.1.1 Grass carp growth performance fed with different food waste feeds upgraded by papain and bromelain.....	79
3.3.1.2 Grass carp carcass composition fed with different food waste feeds upgraded by papain and bromelain.....	78
3.3.1.3 Grass carp immunological parameters.....	79
3.3.2. Results of grey mullet feeding trial with different food waste feeds upgraded by papain and bromelain.....	82
3.3.2.1 Grey mullet growth performance fed with different food waste feeds upgraded by papain and bromelain.....	82
3.3.2.2 Grey mullet carcass composition fed with different food waste feeds upgraded by papain and bromelain.....	83
3.3.2.3 Grey mullet immunological parameters.....	83
3.4. Discussion.....	89
3.4.1 Growth of grass carp and grey mullet fed with food waste supplemented with bromelain and papain mixture.....	89
3.4.2 Utilizations of food waste supplemented with bromelain and papain mixture.....	92
3.4.3 Hematological parameters of fish fed with food waste supplemented with enzyme mixture.....	93

3.5 Conclusion.....	95
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Chapter 4 Adding baker’s yeast to food waste to enhance growth performance and immunity of grass carp (*Ctenopharyngodon idellus*)

4.1 Introduction.....	97
4.2 Materials and Methods.....	99
4.2.1 Experimental setup and fish feed preparation.....	99
4.2.2 Feeding experiment design.....	100
4.2.3 Fish immunological and growth parameters.....	102
4.2.4 <i>A. hydrophila</i> injection to grass carp.....	103
4.2.5 Statistical analysis.....	103
4.3 Results.....	103
4.3.1 Feeding trial with yeast supplement incorporated in different feeds...103	
4.3.1.1 Growth performance of grass carp.....	103
4.3.1.2 Carcass composition of grass carp.....	104
4.3.1.3 Hematological parameters of grass carp fed with different feeds.....	106
4.3.1.4 Disease resistance to <i>Aeromonas hydrophila</i> of grass carp...110	
4.4 Discussion.....	110
4.4.1 Growth and feed utilizations of grass carp fed with baker’s yeast supplemented feed.....	110
4.4.2 Immunity of grass carp fed with baker’s yeast supplemented feed.....	113
4.4.3 Fish disease resistance to <i>A. hydrophila</i>	114
4.5 Conclusion.....	116

Chapter 5 The antimicrobial activity of Traditional Chinese Medicines (TCMs), a potential drug alternative on dealing with fish pathogens

5.1 Introduction.....	118
5.2 Methods and Materials	122
5.2.1 Antimicrobial activity of boiled aqueous extracts of 17 TCMs.....	122
5.2.2 Antimicrobial activity of selected aqueous and organic TCMs extracts.....	125
5.2.3 Checkerboard method for the combined effect of <i>C. phellodendri</i> , <i>R. scutellaria</i> , <i>R. coptidis</i> and <i>F. forsythiae</i>	126

5.2.4	Development of drug resistant fish pathogens exposed to selected aqueous TCM extracts.....	127
5.3	Results.....	128
5.3.1	Antimicrobial activity of boiled aqueous extracts of 17 TCMs.....	128
5.3.2	Antimicrobial activity of aqueous (boiled and non-boiled) and organic extracts of 4 selected TCMs.....	130
5.3.3	Antimicrobial activities of boiled aqueous mixtures of <i>C. phellodendri</i> , <i>R. scutellaria</i> , <i>R. coptidis</i> and <i>F. forsythia</i>	132
5.3.4	Development of drug resistant fish pathogens exposed to selected TCM extracts.....	133
5.4	Discussion.....	137
5.4.1	Antimicrobial activities of boiled aqueous extracts of 17 TCMs.....	137
5.4.2	Antimicrobial activities of organic and aqueous extracts of <i>R. coptidis</i> and <i>R. scutellaria</i> , <i>C. phellodendri</i> and <i>F. forsythia</i>	138
5.4.3	Development of resistant bacteria to single TCMs and antimicrobial activities of mixed TCM extracts	140
5.5	Conclusion.....	143

Chapter 6 Effects of Traditional Chinese Medicines (TCM) on the Immune Response of Grass Carp (*Ctenopharyngodon idellus*)

6.1	Introduction.....	145
6.2	Materials and Methods.....	148
6.2.1	Experimental fish feed preparation.....	149
6.2.2	Identifications of TCMs.....	149
6.2.3	Fish feeding experiment and blood sampling	150
6.2.4	<i>A. hydrophila</i> injection to grass carp.....	152
6.2.5	Immunological parameters analysis.....	152
6.2.6	Field trial in Yuen Long and cost evaluation on the application of TCM feed.....	153
6.2.7	Effects of TCM extracts on plasma bactericidal activity of grass carp against <i>A. hydrophila</i>	155
6.2.8	Statistical analysis.....	156
6.3	Results.....	157
6.3.1	Immune parameters in Grass carp blood feeding with TCM	

formulation.....	157
6.3.2 Fish growth and disease resistance to <i>A. hydrophila</i> in laboratory experiment.....	157
6.3.3 Disease resistance to <i>A. hydrophila</i> in field trial at Yuen Long and cost evaluation on TCM feed application.....	163
6.3.4 <i>In vitro</i> activation on plasma bactericidal activity.....	163
6.4 Discussion.....	169
6.4.1 Haematological parameters of grass carp fed with TCM formulation...	169
6.4.2 Plasma bactericidal activity of grass carp in feeding trial and <i>in vitro</i> study.....	170
6.4.3 Disease resistance to <i>A. hydrophila</i>	173
6.4.4 Cost evaluation of using TCM feed in aquaculture.....	175
6.5 Conclusion.....	176

Chapter 7 Upgrading food waste feed using TCMs, baker’s yeast and enzyme on the immune responses of grass carp (*Ctenopharyngodon idellus*) against *Aeromonas hydrophila*

7.1 Introduction.....	178
7.2 Materials and Methods.....	180
7.2.1 Experimental setup and fish feed preparation.....	180
7.2.2 Feeding trial and sample collections.....	181
7.2.3 <i>A. hydrophila</i> injection to grass carp.....	182
7.2.4 Statistical analysis.....	182
7.3 Results.....	183
7.3.1 Growth performance of grass carp fed with enzymes, baker’s yeast and TCMs as supplements.....	183
7.3.2 Immunity of grass carp fed with enzymes, baker’s yeast and TCMs....	183
7.3.3 Disease resistance to <i>A. hydrophila</i> of grass carp fed with enzymes, baker’s yeast and TCMs	188
7.4 Discussion.....	188
7.4.1 Growth and feed utilization of grass carp fed with enzyme upgraded food waste with baker’s yeast and TCM.....	188

7.4.2 Immunity parameters of grass carp fed with enzyme upgraded food waste with baker's yeast and TCM.....	190
7.4.3 Effects of baker's yeast and TCM on fish disease resistance against <i>A. hydrophila</i>	192
7.5 Conclusion.....	195
 Chapter 8 General Discussion and Major Conclusions	
8.1 Introduction.....	197
8.2 General Discussion.....	198
8.2.1 The effects of adding enzymes in enhancing food waste utilization by fish.....	198
8.2.2 The effects of adding of TCMs and baker's yeast to cope with fish infections.....	205
8.2.3 Concerns on using feed supplements for application in aquaculture	210
8.3 Major conclusions.....	212
8.4 Comments for future studies.....	215
References.....	218
Publication & Conference Presentations.....	245
Curriculum Vitae.....	246