

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.

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