

DOCTORAL THESIS

Food wastes as feeds incorporated with Chinese herbs and prebiotic fibers on growth and non-specific immunity of grass carp, bighead, mud carp and Nile tilapia

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Abstract

Food waste accounts for about 1/3 of the municipal waste generated in Hong Kong. Using food waste as major ingredients to produce fish feed pellets could ease part of the disposal pressure on the existing landfill sites. The present study focused on the use of food wastes and feed supplements (prebiotic fibres and Chinese herbs) for rearing freshwater fish (grass carp, bighead, mud carp and Nile tilapia) in Hong Kong.

Two isonitrogenous formulations, Food Waste Diet A (FWA), consisted of 53% cereal, 10% fruit and vegetables, 8% bone meal, 4% other food waste, 10% fishmeal, 15% corn meal and Food Waste Diet B (FWB), consisted of 25% meat, 28% cereal, 10% fruit and vegetables, 8% bone meal, 4% other food waste, 10% fishmeal, 15% corn meal were manufactured by Kowloon Biotechnology Ltd, were used as feeds for rearing grass carp, bighead, mud carp and Nile tilapia.

The essential amino acid profiles and proximate compositions (crude protein, crude lipid and total phosphorous) of the two food waste based feed pellets were compared with other common feed items, including Napier grass, rice bran, breads, noodles, soybean dreg (remains of soybean after juicing for soybean milk) and the commercial feed pellets (Jiefeng® 613). Jiefeng® 613, FWA and FWB possessed 5.83%, 5.76% 5.79% (% protein) of lysine, which could satisfy the dietary requirements of both grass carp and Nile tilapia. Results indicated all the fish feed pellets possessed sufficient essential amino acids and suitable proximate compositions (crude lipid, crude protein, crude fibre and non-fibrous carbohydrate) for both grass carp and Nile tilapia.

A field trial was conducted using the three feed pellets (Jiefeng® 613, FWA and FWB) to study their effects on fish growth (grass carp, bighead and mud carp) as well as water quality. FWA that possessing a higher P content (2770 µg/g feed, while control= 967 µg/g feed and FWB= 1942 µg/g feed) favoured the growth of plankton and led to better growth of bighead carp (in terms of length gain, wet weight gain and productivity), while grass carp fed with FWB showed significant better growth (in terms of length gain, wet weight gain, productivity,

feed conversion ratio, specific growth rate and protein efficiency ratio), probably due to the relatively lower amount of carbohydrate (24.2%) and CHO:L ratio (1.83) than Control and FWA. Mud carp grew equally well in ponds fed with the three diets. FWB was subsequently selected for further feeding experiments.

A laboratory feeding trial was conducted to study the effects of feeding grass carp and Nile tilapia with FWB on their growth performance in terms of relative weight gain (RWG), feed conversion ratio (FCR), specific growth rate (SGR) and protein efficiency ratio (PER), and protein digestibility. Both fish fed with FWB showed similar growth performances to groups fed with control diet (Jiefeng® 613), while grass carp showed impaired protein digestibility when compared to group fed with control diet. FWB supplemented with 0.3% of vitamin-mineral premix (VMP) significantly improved the growth performance of both fish species and protein digestibility for grass carp. Results suggested that FWB incorporation with VMP would be necessary as it significantly enhanced growth of the fish.

Four dietary supplements (inulin, mannan-oligosacharride, Huangqi and goji, at the rates of 0.2% or 2%, w/w) were incorporated into FWB for further enhancing fish growth as well as non-specific immunity of grass carp and Nile tilapia. Grass carp fed with 0.2% and 2% inulin, 2% MOS and 0.2% goji, and Nile tilapia fed with 0.2% goji had significantly enhanced growth (RWG, FCR, SGR and PER). Both prebiotic fibres and Chinese herbs boosted the tested non-specific immune parameters (total serum immunoglobulin, serum bactericidal activity and anti-protease activity) of both species. Among all the dietary supplements, 0.2% goji appeared to be the best supplement for both grass carp and Nile tilapia as it significantly enhanced the growth among all experimental diets. Grass carp and Nile tilapia fed with 0.2% showed about 10% and 30% higher RWG, 10% and 30% lower FCR value, respectively, than groups fed with other experimental diets. Moreover, all the tested non-specific immune parameters (total serum immunoglobulin, serum bactericidal activity and anti-protease activity) were significantly enhanced when compared with the groups fed with control diets (Control and FWB without supplementation).

The present study demonstrated the feasibility of using food wastes incorporated with feed

supplements (prebiotic fibres and Chinese herbs) to enhance fish growth and immunity, for the sustainable development of Hong Kong inland aquaculture.

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