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co-products for fishmeal-free diets of Nile tilapia
Oreochromis niloticus

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博士学位論文内容要旨
Abstract

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論文題目 Title	Studies on the potential application of corn co-products for fishmeal-free diets of Nile tilapia <i>Oreochromis niloticus</i> (ナイルティラピア用無魚粉飼料におけるトウモロコシ副産物の応用に関する研究)		

Several plant based ingredients have been used to replace fish meal in aqua-feed. Corn gluten meal (CGM), corn protein concentrate (CPC), distillers dried grains with soluble (DDGS) and high protein distillers dried grains (HPDDG) are corn co-products rich in digestible proteins with comparatively less amino acid deficiencies. Usage of high proportion of these co-products in fish feeds is limited by the presence of excess yellow pigments which would possibly alter the fillet color of fish. Therefore three studies were designed to, i) evaluate and compare the suitability of above four corn co-products in preparing zero fish meal diets for Nile tilapia, ii) evaluate the long-term effect of corn co-product based diets on growth, fillet color and fillet nutrient quality of Nile tilapia and iii) evaluate the combined effect of corn co-products based non-fishmeal diet and salinity on growth, feed utilization and expression level of some selected genes involved in growth, osmoregulation and fatty acid desaturation and elongation.

In the first experiment, a 12 week feeding trial was conducted to evaluate and compare the suitability of CPC, CGM, DDGS and HPDDG in preparing zero fish meal diets for Nile tilapia, *Oreochromis niloticus* juveniles by comparing the growth performance, feed utilization efficiency and fillet color of fish. Five iso-nitrogenous diets with 32% protein were prepared. The 50% of protein in each diet was supplied by fish meal in control diet and one of the four corn co-products (CPC, CGM, HPDDG, DDGS) in other diets. Significantly highest specific growth rate (SGR) and survival rate (SR) were observed in the control and DDGS groups while feed utilization efficiencies were not affected by the treatments. Among instrumentally measured fillet color, lightness (L*), redness (a*) and yellowness (b*) only L* of DDGS was significantly higher than that of control, but none of the other diets differ either from DDGS or control.

A 24-week feeding trial was conducted as a second trial (21g initial weight) to evaluate the long-term effect of corn co-product-based fishmeal-free diets on growth, fillet color, and fillet fatty acid and amino acid composition. Dietary composition in this study was almost similar with the experiment-I, except control diet. In this experiment control diet contained only 10% fishmeal. Fish fed the control, HPDDG, or DDGS diet had significantly higher ($P < 0.05$) mean weight gain, specific growth rates, mean feed intake, protein efficiency ratio, and survival than those fed the other diets. Fish in these three treatments also had the lowest food conversion ratio. The dietary treatments did not affect the lightness, redness, yellowness, or crude protein and total amino acid content of fish fillets. Fillet fatty acid composition was greatly affected by the dietary treatments. The total polyunsaturated fatty acid levels were highest in the DDGS group. Similarly, the total n-6 level was highest in the DDGS group, followed by HPDDG. The total n-3 levels and n-3: n-6 ratios in the fillets of the control group were almost double those of the corn-based dietary groups.

In third experiment, two iso-nitrogenous (32% protein) diets were formulated with and without fishmeal. Four salinity levels, i.e. 0ppt, 4ppt, 8ppt and 12ppt were used to evaluate the combined effect of fishmeal replacement with salinity (2x4 factorial designs). Duplicated group of fish (initial weight~ 6 g) reared in four salinity levels were fed one of the two diets to near satiety twice a day for 12 weeks. At the end of the experiment, growth performance, feed utilization efficiency and relative expression of insulin like growth factor (IGF)-I, IGF-II, growth hormone (GH), growth hormone receptor (GHR), fatty acid $\Delta 6$ desaturase (Fadsd6) and fatty acid elongase (elov15) genes of liver and gill tissues of Nile tilapia were evaluated.

Growth performance of fish was significantly affected by the salinity while no statistical differences were observed for two diets. Percentage weight gain and mean feed intake of fish reared at 4‰ was significantly higher than that of others irrespective of the diet. Food conversion ratio of fish reared in 0‰ was significantly lower than the fish in 8‰ and 12‰. This study revealed the possibility of totally replacing

fishmeal in Nile tilapia juveniles reared in 0‰ to 12‰ salinity without compromising growth performances. Salinity regulation of gene expression was identified only in IGF-I, IGF-II and Fadsd6 genes and dietary effects were limited only to elov15. No interactive effects of diet and salinity were identified for gene expression.