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Effects of long-term feeding of corn co-product-based diets on growth, fillet color, and fatty acid and amino acid composition of Nile tilapia, *Oreochromis niloticus*

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ABSTRACT

We conducted a 24-week feeding trial with Nile tilapia *Oreochromis niloticus* to evaluate the effects of long-term feeding of corn co-product-based diets on growth, fillet color, and fillet fatty acid and amino acid composition. Five iso-nitrogenous diets were prepared (34% protein). The control diet included 10% fishmeal. Fishmeal was eliminated from the other four diets, and 50% of the dietary protein was supplied by one of four corn co-products, namely high-protein distillers' dried grains (HPDDG), distillers' dried grains with solubles (DDGS), corn gluten meal (CGM), and corn protein concentrate (CPC). Fish with an initial mean weight of 21 g were fed one of the five diets twice a day to near satiety. 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 lipid and ash content were highest in the CGM group. Fillet fatty acid composition was greatly affected by the dietary treatments. The CGM and CPC groups had significantly highest palmitic acid (16:0) and total saturated fatty acid levels, whereas linoleic acid (18:2n − 6) and 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. Our results suggest that dietary inclusion of HPDDG or DDGS in non-fishmeal diets at up to 50% of dietary protein does not negatively affect growth performance, feed utilization efficiency, or fillet color and amino acid composition, but further improvement of n − 3 fatty acid composition is necessary to ensure human health benefits.

Statement of relevance: Fishmeal free diets ensure the sustainability of aquaculture.

1. Introduction

In response to the rising demand for, and cost of, fishmeal, the use of dietary alternatives is becoming a common practice in aqua-feed formulations. Among the categories of alternatives, plant-based ingredients have long received great attention (Gatlin et al., 2007; Hansen et al., 2006; Olsen et al., 2007; Vilhelmsson et al., 2004). Corn co-products such as corn gluten meal (CGM), distillers' dried grains with solubles (DDGS), and high-protein distillers' dried grains (HPDDG) are among the plant-based ingredients rich in digestible proteins. Unlike conventional plant protein sources such as soybean meal, these co-products are free from anti-nutritional factors (Robinson and Li, 2008; Shiau et al., 1987) and deficient in only few amino acids (Cheng and Hardy, 2004). Yellow pigments inherent in the corn, however, limit the proportion of corn co-products that is acceptable for use in feeding food fishes. For instance, xanthophylls in corn-based ingredients could alter the fish fillet color (Gatlin et al., 2007).

Fillet color is an important sensory attribute of food fish that directly determines the acceptability of the product (Dhanapal et al., 2013; Gatlin et al., 2007; Ross, 2000). It is also among the attributes of fish quality that could easily be altered by changes in the pigments in dietary ingredients (Gatlin et al., 2007; Skonberg et al., 1998). The effects of dietary pigments on fillet color have been reported in rainbow trout and some other food fish species, including salmon (Akhtar et al., 1999;

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