

Potential use of corn co-products in fishmeal-free diets for juvenile Nile tilapia *Oreochromis niloticus*

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Abstract We conducted a 12-week feeding trial to evaluate the effects of total fishmeal replacement with different corn co-products on growth performance, feed utilization efficiency, and body composition in juvenile Nile tilapia *Oreochromis niloticus*. Five isonitrogenous diets were prepared. Fifty percent of the dietary protein was obtained from fishmeal (control diet) or from one of four corn co-products (experimental diets), namely corn protein concentrate, corn gluten meal, high-protein distillers' dried grains (HPDDG), or distillers' dried grains with solubles (DDGS). Fish with an initial mean weight of 4.5 g were fed one of the five diets twice a day to near satiety. Significantly higher ($P < 0.05$) specific growth rates and survival occurred in the fish fed the control diet or DDGS, followed by those fed the HPDDG; mean feed intakes by fish in these three groups were significantly greater than those in the others. Food conversion ratio, protein efficiency ratio, and total amino acid content of the whole body were not affected by changes in dietary ingredients. Whole-body and fillet protein contents were highest in the HPDDG group, whereas the lipid content was highest in those fed DDGS. DDGS can be used to fully replace the fishmeal components of Nile tilapia diets.

Keywords Amino acids · DDGS · Feed utilization · Fillet quality · Growth performance · HPDDG

Introduction

The search for alternatives to replace the fishmeal component of aquafeed has received a good deal of attention, resulting in considerable research progress over the last two decades. A vast array of proteins from both plant and animal sources have been evaluated for their suitability as partial or total replacements for fishmeal in aquafeeds [1–7]. Among the ingredients tested, industrial by-products or co-products that are considered unsuitable for direct human consumption have received much interest [8]. In this context, protein-rich co-products of the corn-milling industry play an important role as protein sources in the manufacture of animal feeds, including aquafeeds.

Corn gluten meal (CGM) and corn protein concentrate (CPC) are co-products of the corn wet-milling industry, and CGM has been used widely in aquafeeds [9]. Distillers' dried grains with solubles (DDGS) and high-protein distillers' dried grains (HPDDG) are co-products of the corn dry-milling industry that are used in fuel ethanol production. HPDDG is a relatively new product of the corn ethanol industry, and its nutritional value is much more consistent than that of DDGS [10]. Unlike other more conventional plant protein sources, such as soybean meal and cotton seed meal, corn co-products are free from anti-nutritional factors [11, 12], and few amino acid deficiencies have been reported for them [13]. However, variations among varieties of corn co-products in factors such as percentage protein due to differences between the wet-milling and dry-milling processes have been observed.

Tilapia, a group of fish with herbivorous or omnivorous feeding habits, are the most commonly aquacultured fish in

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