Digestibility, Growth and Economic Performance of Nile Tilapia (Oreochromis Niloticus) Fed on a Mixture of Plant Protein Diets in Cages

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Abstract

Fish feed is one of the critical components in aquaculture production and accounts for over 60% of total operational costs with protein component being the most expensive ingredient. Traditionally, fishmeal (FM) has been the primary dietary animal protein source. However, with dwindling capture fisheries, FM has become increasingly scarce and expensive due to its demand from human consumers and livestock feed manufacturers. This in turn makes the cost of fish feeds expensive leading to low profit margins in farmed fish. Therefore, there is need to identify alternative, low cost, and nutritionally balanced sources of protein for the growth of the industry. Although plant-based protein sources are viable alternative in replacing FM, there have been no studies on mixture of plant proteins to establish their economic utility in fish farming. This study evaluated the effects of replacing freshwater shrimp (caridina nilotica) meal (FSM), with varying levels of soybean (Glycine max) meal (SBM), cottonseed (Gossypium spp) meal (CSM) and sunflower (Helianthus annuus) meal (SFM) on growth performance, digestibility, whole body composition and economic returns in diets of Nile tilapia (Oreochromis niloticus). Fingerlings averaging 25g in body weight were stocked in net cages installed in three 800m2 fertilized earthen ponds. Each pond had 15 cages evaluating five diets with three replicates for a culture period of six months. Three experimental set ups were designed to evaluate the efficiency of a combination of SBM with other plant protein sources in replacing FSM in fish diets. In trial 1, five isonitrogenous (30% CP) and isocaloric (3.5 kcal g-1) diets were formulated, substituting Fresh water shrimp meal with Soybean meal at rates of 0, 25, 50, 75 and 100%.Trial 2 similar diets as above were formulated replacing fresh water shrimp meal with a combination of SBM, CSM and SFM at rates 0, 25, 50, 75 and 100%. In Trial 3, similar diets as in experiment 2 were formulated replacing FM with a combination of CSM and SFM at rates 0, 25, 50, 75 and 100%. All fish were fed twice daily at 10% of their body weight. Data were expressed as means and standard error of the mean. Growth and proximate composition were analyzed using one-way ANOVA at $p< 0.05$, and differences among treatment means identified using Tukeys Multiple Range Test. Results from the study in trial 1, showed that fish fed on D0 had higher final weight ($p<0.05$) than those fed on D1, D2 and D3, while D4 had the lowest weight. In trial 2, fish fed on D1 showed growth performance that did not differ significantly from fish fed D0. However, highest FM replacement (100%), significantly ($p<0.05$) reduced growth performance. In trial 3, D0 and D1 had significantly ($p<0.05$) higher mean weights than the rest of the treatments. In the three trials, similar survival was observed among treatments, but digestibility of protein decreased significantly ($p<0.05$) with increasing inclusion levels of PPSM in the diets. In trial 1, the ash content of carcass decreased significantly with increased levels of SBM. In trial 2, fish accumulated increasing levels of ash and crude fat with increasing levels of PPSM. In trial 3, crude fat increased significantly across all dietary treatments while ash content decreased with increasing levels of PPSM. Diet D3 in trial 1 was more economically viable although it was not significantly different ($p>0.05$) from D1 and D2. In trial 2 and 3, D0 and D1 were not significantly different hence D1 was more viable because it was cheaper than D0. Based on these findings, the present study concludes that the use of either pure fishmeal or fishmeal containing a mixture of 25% of plant proteins diets leads to similar growth performance in O. niloticus, the fishmeal containing the mixture of 25% plant proteins remarkably reduces the production costs and achieves higher profits than when the pure fishmeal is used. The present study therefore, recommends that for desirable net returns plant proteins can be used in fish farming.

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