Alfalfa Leaf Protein Concentrate in Aquafeeds to Enhance Finfish Production & Reduce Environmental Impacts in Aquaculture Production

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Aquaculture, the raising of farmed fish and shellfish, is the fastest growing food sector around the world and the most efficient means of providing animal protein to human populations. Bottlenecks to sustainable aquaculture include identifying acceptable plant proteins for fish feeds. Alfalfa foliage can be refined into a high protein concentrate (alfalfa protein concentrate; APC) that shows excellent promise for use in fish feeds as an alternative to fishmeal. The objectives of this study are to: (1) Evaluate APC as an ingredient in feed for rainbow trout; (2) Evaluate APC with plant defensin and phytase for improving rainbow trout growth, well-being, and immunity; and (3) Carry out a technoeconomic and market analysis of APC production. This presentation will focus on results related to Objective 1.

Five test diets were formulated to replace fishmeal with different levels of APC (0, 5, 10, 15, and 20%). The durability index of pellets was significantly higher in the feed with 10 to 20% APC than that in the control and the 5% APC diets. Bulk density of pellets was significantly increased by APC inclusion. The control and the pellets containing 5 to10% APC maintained neutral buoyancy while the pellets containing 15% APC were shown to sink slowly and 80% of the pellets from feed containing 20% APC sank within 10 min. Oil leaking from pellets was reduced by inclusion of APC. Water stability was significantly higher for feed pellets containing 10 to 20% APC than the control or 5% APC diet. The increased density of feed pellet due to inclusion of ANC may facilitate storage or shipping and make the feed easy to handle because of the increased durability.

Palatability by rainbow trout did not change due to the inclusion of APC. The apparent digestibility coefficient (ADC) of dietary protein was similar but the ADC of dry matter and phosphorus was significantly lower in the 20% APC diet. Fecal particle distribution was significantly changed in fish fed the diet with 20% APC, with the lowest portion of large particles (>1000 μm) and highest portion of medium particles (250-1000 μm) compared to the other diets. Weight gain was significantly reduced and feed conversation ratio increased when APC was included up to 10% in the diets. The test diets had no significant impacts on fish morphology (condition factor, carcass index, hepatosomatic index, visceral fat index). Proximate compositions of whole fish and liver tissues were not significantly different among dietary treatments except that the protein content of fish fed the 5% APC diet was higher than that of fish on other diets. Alanine and betaine in liver tissue were found to be significantly lower in fish fed the 20% APC diet compared with the control group; whereas leucine, valine, threonine, malate, and succinate were significantly higher in fish fed the APC diet compared with the control group. Based on the enriched metabolite analysis, the most significant pathways that were impacted between the control and 20% APC diets included: branched chain amino acid degradation, citric acid cycle, acetyl groups transfer into mitochondria, mitochondrial electron transport chain, and ketone body metabolism. The results of this study provide baseline information for the potential of APC as fishmeal replacement in diets for rainbow trout.

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