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Study of Tilapia's Gut Microbiome Yields Insights to Help Boost Feed Efficiency and Lower Feed Costs

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AquaFish research paves the way to develop probiotic supplements for tilapia culture



Analysis of Nile tilapia gut microbiome indicates that alternate-day feeding and weekly pond fertilization in tilapia culture can aid fish farmers.

One of the challenges facing poor, small-scale farmers in coastal Bangladesh is how to improve aquaculture production in a sustainable way that also lowers costs and environmental impacts.

One target for cost reduction is in the area of feeds. Aquaculture growth for small-scale farms is often limited by a lack of access to affordable, high-quality feeds. For tilapia, feed can account for 60%–85% of total production costs.

A means of lowering production costs is to develop aquaculture strategies and systems that increase feed efficiency among cultured species, thereby reducing reliance on expensive feeds.

In previous investigations, AquaFish Collaborative Research Support Program researchers showed that alternate-day feeding results in higher benefit-to-cost ratios and net returns than daily and every-third-day feeding strategies in terms of tilapia grow-out in fertilized ponds. For example, tilapia and milkfish were grown to market size in the Philippines using alternate-day feeding with significant cost savings (50% feed reduction) compared to daily feeding.

Building on this past work, AquaFish partners from North Carolina State University (NCSU) and Bangladesh Agricultural University (BAU) conducted experiments on feed efficiency in Nile tilapia that characterized tilapia's gut microbiome and explored how alternate-day (or pulsed) feeding strategies affect nutrient absorption in this species.

Similar to the human gut microbiome, the community of microbes living in a fish's digestive tract can aid in the absorption of nutrients, maintain energy balance, and increase immunity. These functions make the microbes essential to fish health and grow-out.

To explore the tilapia gut microbiome, NCSU and BAU researchers analyzed tilapia fecal material and microbial communities.

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A farmer in Bangladesh throws feed in to an aquaculture pond.

The researchers found that fish fed on alternate days (every other or every third day) with pond fertilization had a greater diversity of microbes in their guts and that pulse-fed fish also had 20 unique species of bacteria compared to other treatment groups, such as extensive culture (using fertilization only) and semi-intensive culture (fertilization plus daily feeding).

They also found that fish fed on alternate days may experience a more balanced and efficient uptake of nutrients, resulting in better feed efficiency.

Ultimately, characterizing the gut microbiome of tilapia could aid in the development of probiotic supplements that support efficient and sustainable tilapia grow-out. Studies elsewhere have shown that probiotic maintenance of beneficial gut flora in cultured finfish can promote growth, greater nutrient availability, and better stock health. Additionally, supporting healthy gut flora in tilapia could allow beneficial microbes to outcompete pathogens, such as fecal coliform bacteria, which can be passed on to human consumers through improper storage and handling of fish.

AquaFish researchers are continuing to build on their work by studying how nutrients received in the early stages of growth impact the health of mature tilapia, which could improve the environmental sustainability of tilapia farming practices in the US and globally. This research aims to help fill a gap in knowledge about fish nutrition and to further develop efficient feed strategies for fish farmers that can help boost yields, income, and human nutrition.