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SUCCESS STORY

Conditioning Juvenile Tilapia for Improved Growth and Health Outcomes in Bangladesh

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



Analysis of Nile tilapia gut microbiome indicates that nutritional programming in tilapia culture can aid fish farmers.

The Nile tilapia (*Oreochromis niloticus*) is one of the most widely cultured fish species in the world. In Bangladesh, aquaculture of tilapia has expanded rapidly over the last 20 years, and has become an increasingly important source of protein for the nation's poor. But the costs of growing tilapia, particularly the cost of feed, can be prohibitive with feed accounting for up to 80% of production costs.

As a result, many farmers in Bangladesh raise tilapia without using feed. Instead, following older technologies developed in large part by the PD/A CRSP (an USAID program from the 1980s), they fertilize their fish ponds to promote primary production, a natural food source for tilapia. Though this approach allows farmers to reduce overhead costs, it also limits economic returns since non-fed tilapia grow at a slower rate than fish fed commercial diets.

The AquaFish Innovation Lab (AquaFish IL), a USAID-funded program based at Oregon State University that helps to improve aquaculture practices in developing nations, has identified strategies that reduce the use of expensive feeds while increasing production and income for small- and mid-scale fish farmers.

Drs. Russell Borski, Scott Salger, and Courtney Deck, AquaFish IL researchers from North Carolina State University, teamed up with researchers from Bangladesh Agricultural University to investigate the potential for improving nutrient uptake efficiency in tilapia by restricting their dietary protein early in life. This technique, called “nutritional programming,” conditions juvenile tilapia to absorb protein more efficiently, which can result in faster growth throughout their life cycle.

Key to the success of this approach are the millions of microorganisms that live in the fish's digestive tract, collectively known as the “gut flora.” Just as in humans, the diversity of tilapia's gut flora is important to their overall health, and plays a role in how efficiently the fish can digest their food, which in turn affects how fast they grow. Fish that have more of the beneficial types of gut microbes digest nutrients better and have stronger immune systems.

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This work was informed by previous USAID-funded CRSP research which found that tilapia fed on alternate days have a more balanced and diverse gut flora than the same fish that are fed every day. In order to determine whether nutritional conditioning affects the diversity of gut flora in tilapia, several groups of tilapia fry were grown in tanks, and fed either a low- or high-protein diet for 7, 14, or 21 days. After 60 days, researchers compared the lengths and weights of the fish, and analyzed the diversity of their gut microbes. Results showed that young tilapia given a protein-restricted diet for the first two weeks of life, then fed a high-protein diet afterwards, grew larger and had a higher diversity of gut microbes than fish fed a normal-protein diet from the start.

The diversity of gut microbes was primarily affected by the length of time the fish consumed a particular diet, and not by the amount of protein in the diet. Future research should focus on identifying which microbes are most important for improved nutrient uptake in tilapia. This can pave the way for developing probiotic supplements that could improve growth rates and overall health of farmed tilapia.

For fish farmers in Bangladesh and beyond, this research means more than advancing scientific knowledge. It provides tangible ways to grow bigger fish while reducing operating costs, and helps put more money in farmers' pockets and more food on their plates.