Advancing Sustainable Aquaculture : Enzymatic Floating Fish Feed through FAITT Interventions in West Bengal

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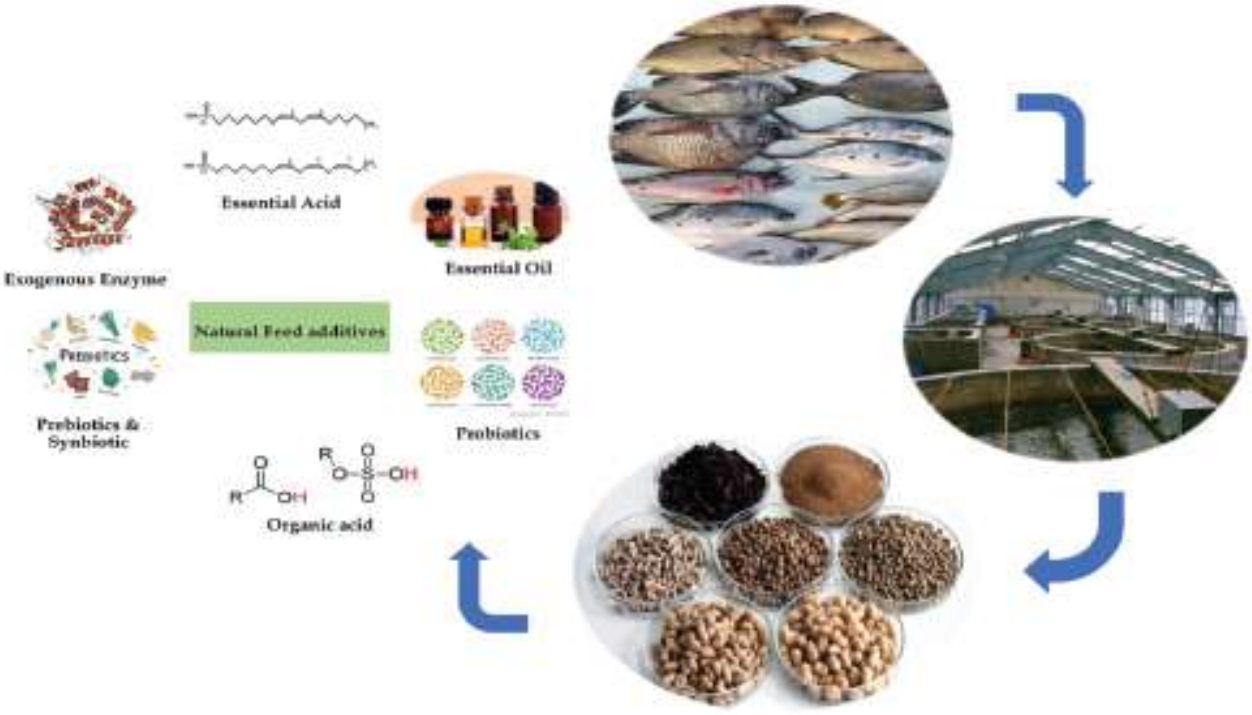
Introduction

Animal feed is a complex food product composed predominantly of raw agricultural ingredients such as forage like hay and alfalfa and partially refined ingredients like soy bean meal, cracked corn kernels and wheat middling. The relative quantities of these ingredients vary with location, season, species being fed and the cost of the ingredient. Animals are not capable of digesting all the plant matter they consume due to a number of factors; low levels of some digestive enzymes, short residence time of the food in the digestive system or the lack of specific enzymes. The purpose of adding enzymes to feed is to improve the utilization of the feed, increasing the amount of nutrients available to the animals which improves their health, lowers feed cost for the farmers and reduces farm waste volume. The benefit to the consumer has been lower prices for meat in the supermarket and restaurants relative to 50 years ago.

According to a report by Food and Agriculture organization (FAO), global population is expected to grow and reach 9 billion by 2050 and one critical challenge of growing population is the supply of food and protein source. Fishes are known to be one of the most energy efficient protein sources with average food conversion ratio (FCR) ranging from 1.2 to 2.0, having high protein (18 to 20g per 100g of serving) and low calorific value (96 to 208 calories per 100g of serving). For a growing population, it is important that feed given to farmed fish remains sustainable. Enzymes will help in using economical raw materials, increase performance, and decrease anti-nutritional factors.



Raw Materials in Fish Feed

Most of the raw materials used in fish feed industry are plant based; corn, corn gluten meal, rice bran, wheat bran, sunflower seed meal, groundnut meal, cottonseed meal, linseed meal, copra meal and DORB (de-oiled rice bran). All these raw materials have high fibre, which are the undigested part of the feed, not digested by the innate enzymes naturally found in the fish gut. The non-digestible fibre includes high levels of non-starch polysaccharides made of cellulose, hemicellulose and lignin. There are many evidences that have reported increase in the viscosity of digested feed due to the presence of non-starch polysaccharides, which leads to decrease in the available nutrients in the feed.

Application of Enzymes in Animal Feed Industry

The application of enzymes as feed additive has a history of twenty years. In feed industry, enzymes are used to enhance nutrient digestibility, focusing on removing the anti-nutritive effects of non-starch polysaccharides (NSP). Besides, phytase is not only used to increase the utilisation of phytate P, but also to alleviate environmental burdens by reducing P excretion in the excreta. Enzymes can also be used to noncereal grain components of the diet. These vegetable protein sources are often high in NSP, which are poorly characterised in regard to their molecular structures. The enzyme industry today is constantly searching for new areas of application. Some recent data demonstrate the role of glycanases (carbohydrates degrading enzymes) as an alternative to in-feed antibiotics.

Innate Enzymes in Fishes

The most common enzymes reported in carps are given

Lipase——àAmylase

Trypsin——à Maltase

Chymotrypsin——à Cellulase- exogenous (microbial)

Most feed ingredients of plant origin also contain anti-nutritional factors such as protease inhibitors (Kunitz trypsin inhibitors, Bowman-Brik Inhibitors), lectins, saponins and phytic acids. Unlike etherate-nutritional factors, phytic acid is not degraded by heat treatment during pelleting. Phytic acid is known to interfere in absorption of minerals like calcium, magnesium and potassium; having an adverse effect on the growth and development of fishes.

Exogenous Enzyme Supplementation

Supplementation of exogenous NSPases (non-starch polysaccharides degrading enzymes) and phytases is known to improve digestion of natural and supplemented feed, thereby improving the feed efficiency and performance.

Addition of NSPases and phytases is a smart solution for improving the profitability in aquaculture. It not only helps in the digestion of high fibre containing raw materials but also helps in reducing the usage of minerals like MCP and DCP (mono and dicalcium phosphate). Foundation for Aquaculture Innovation and Technology Transfer (FAITT) research team has formulated an enzyme product with the combination of NSPases and phytase based on the raw materials used in fish feed and the feeding behaviour and study performances.

Bhojan Enzyme Floating Feed (Bhojan E Feed) is a multi-substrate enzyme powder (from the reputed company commercial Multi Enzyme purchased and used for this study) containing NSP (Non-Starch Polysaccharide) enzymes and phytase developed to improve the nutrient quality of fish feed. Application of the product is at farm level, where it is mixed with the feed right before consumption by the animals.

This paper summarizes the application and benefits of Bojan enzyme Feed through digestibility and growth trials conducted at FAITT Research Laboratory and subsequent commercial trials done in, Andhra Pradesh, India, and its application in fish farm .

IN VIVO GROWTH STUDIES

Two in vivo trials were conducted in commercial farms at Radhamani and Nimthori near Tamluk West Bengal to demonstrate the benefits of Bhojan Enzyme Floating Feed (Bhojan E Feed). The farms had a mixed culture of Indian major carps Rohu and Catla. Bhojan Enzyme Floating Feed (Bhojan E Feed) was fed in treatment pond and fishes were fed with feed without product supplementation and control Pond other commercially available floating feed The fish were fed once in a day for a period of 90 days. The effect of enzyme supplementation on weight gain was recorded by netting approximately 100 fish, thrice from sides of the pond and the average weight was calculated and recorded once in 30 days.

Farm trial I

The details of the farm trial I is given in the table 1

Table 1. Farm trial I details

Trial I	Control	Treatment
Area of culture	30 acres	10 acres
Stocking density	Rohu- 55,000 & Catla- 2000	Rohu- 25,000 & Catla- 3000
Diet	Commercial fish feed without supplementation of enzymes	Bhojan Enzyme Floating Feed (Bhojan E Feed)

Results

Commercial trial I showed increase in weight gain in treated group than control groups (Fig. 1). At the end of the trial, the treatment group having Rohu weighed 50g more and Catla weighed 40g more than the control group.

Farm trial II

The details of the farm trial II are given in the table 2.

Table 2. Farm trial II details

Trial II	Control	Treatment
Area of culture	20 acres	10 acres
Stocking density	Rohu- 35,000 & Catla- 2000	Rohu- 25,000 & Catla- 3000
Diet	Commercial fish feed without supplementation of enzymes	Bhojan Enzyme Floating Feed (Bhojan E Feed)

Results

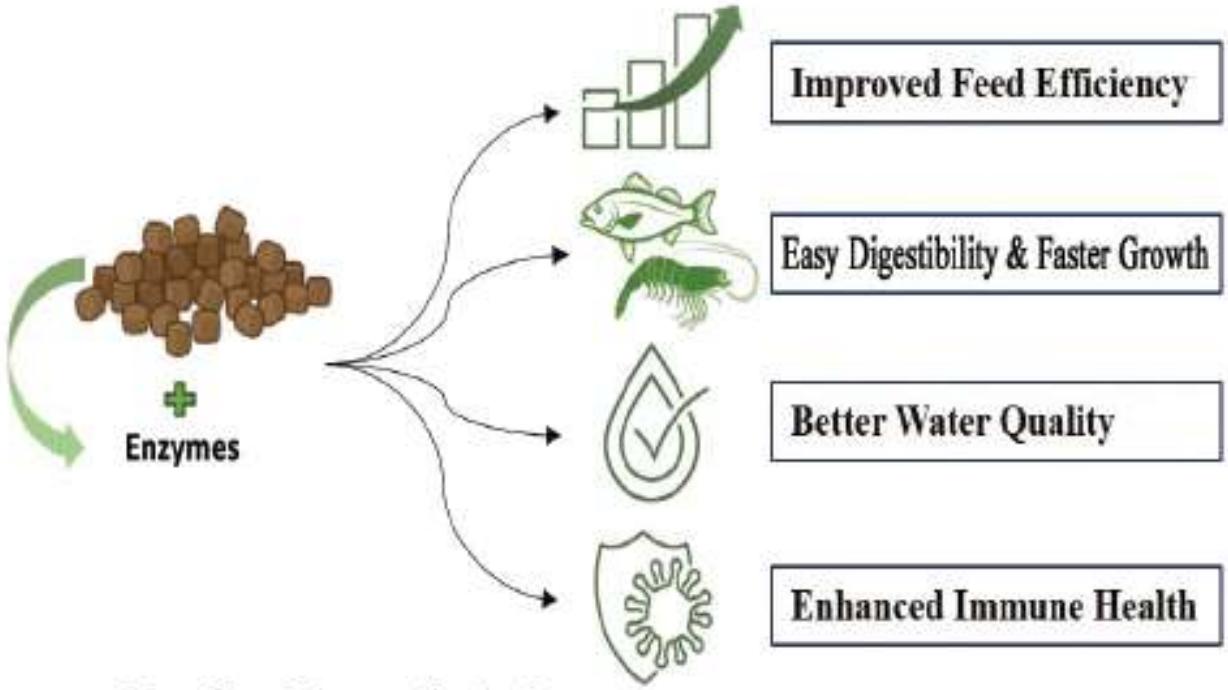
Trial II, control group of Catla were 20 grams less than the treatment group, and the same group gained 190 grams more than control group at the end of the trial (Fig. 2). similarly, Rohu in treatment ponds gained 30 grams more than the control group at the end of the trial.

Skin Pigmentation

In both the above trials better utilization of phytoplankton and algae resulted in enhanced carotenoid bioavailability. Supplementation of Bhojan Enzyme Floating Feed (Bhojan E Feed) showed an increase the pigmentation of carps. This was observed by visual examination during the trials and was consistently reported by farmers.

CONCLUSION

Post pellet application of enzymes application for fish feed is an attractive way of solving the indigestibility of high fibre containing feed raw materials. Not only does it improve the fish performance, but also decreases the eutrophication of pond water caused due to release of undigested feed and phosphorus, thus helping the farmers in maintaining water quality and animal health. This study further to prove the bioavailability of Enzyme percentage in feed and the percentage of loss while manufacturing feeds (due to steam and cooking process) similarly, to standardize the inclusion ratios of per ton in feed productions.



Benefits of Enzymatic Feed