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Mini Review

Feed Additives to Increase Plant Protein Substitution in Aquafeeds

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Abstract

Aquaculture is one of the fastest growing sectors as an alternative option in animal protein sources. Therefore, it is an important task to provide farmed fish with high quality diets to obtain the best performance. However, high quality fish diets should contain not only optimal quality and quantity of nutrients but also additives to keep fish healthy and optimal growth. Fishmeal (FM) is one of the most important components in practical diets for aquafeeds, but its increasing demand, unstable supply and high price have made it necessary to search for alternative protein sources. The increased utilization of soybean meal (SBM) has been embraced as a sustainable alternative to FM. Recently, functional feed additives is a natural way to transform complex feed components into absorbable nutrients. Therefore, the addition of feed additives in fish feeds would improve nutrients utilization in plant protein sources, reducing feed cost and the excretion of nutrients into the environment.

Keywords: *Soy Bean Meal; Fish Meal; Feed Additives; Aquafeeds*

Fish meal (FM) represents an ideal nutritional source of dietary protein for fish [1]. Increasing demand, unstable supply, and high prices of FM along with the continuous expansion of aquaculture are reasons for many nutritionists to realize that soon they will no longer be able to afford it as a major protein source in aquafeeds [2]. Currently one of the challenges that fish nutritionists face is the need to partially or totally replace FM with less expensive, non-traditional animal or plant protein sources [2-5].

Soybean meal (SBM) has been recognized as one of the most appropriate alternative protein sources for FM in aquafeed because of their consistent nutritional composition, comparatively balanced amino acid profile, availability, and reasonable price [6-8]. Methods for increasing SBM's inclusion rates in soy-sensitive species are required, and one of the methods is to apply dietary supplementation of functional feed additives [1,9]. Substituting SBM for FM at low levels has been relatively easy but substituting at higher levels is difficult. There are a number of challenges that must be overcome to maintain acceptable growth rates and feed efficiency values at higher levels of substitution of fish meal. The first is cost of plant protein concentrates. Until recently, fish meal protein was much less expensive than protein from soy or wheat concentrates, available as soy protein concentrate or wheat gluten meal.

It is well known that, SBM contains many anti-nutritive compounds including trypsin inhibitor, lectin, saponins, phytate, flatulence-producing oligosaccharides and allergenic protein [2]. Because the aquatic animals' intestinal tracts are not fully developed and easily damaged by the anti-nutritive compounds, several methods have been developed to eliminate the anti-nutritive compounds. As has been done previously, we can effectively decrease trypsin inhibitor and phytate content in soybeans, increase the dry matter content and increase the digestion rate of nitrogen and amino acid to improve the feed conversion ratio by heating [3]. Still, some allergenic proteins, such as glycilin, α-conglycinin and β-conglycilin, are not deactivated by heating, and will harm young animals. Some reports indicate that the fermenting process or enzyme treatment with protease and carbohydrase can decrease the content of flatulence-producing oligosaccharides and allergenic proteins, and increase the digestibility of SBM [9-11]. However, the selection of bacteria used for fermentation is very important.

To optimize the use of the plant protein in aquafeeds, there is an ongoing search to find dietary additives that could protect the intestine from the effects of SBM. Traditionally, additives have been incorporated into fish diets to control diseases, increase health, and improve the stress response [12-19]. However, little focus has been given to the use of additives for controlling intestinal inflammation [20-22]. At present, there are only two studies that evaluate the effects of additives, specifically mannan-oligosaccharide and β-glucans, on soybean meal-triggered intestinal inflammation in farmed fish [17,23-25]. These investigations indicate that only mannan-oligosaccharide is able to decrease, to varying degrees, the altered intestinal histology observed in fish fed with diets including low amounts of soybean meal [16,17].

FM contained abundant nucleic acids and nucleotides, while little was found in SBM [2]. Nucleotides as feed additives play an important role in gut development and repair, skeletal muscle development, heart function and immune response [26,27], and gained wide attention as potential immunomodulators. Research related to nucleotide nutrition in fish was stimulated by the reports of Burrells., *et al*. [28,29] who demonstrated that dietary nucleotide supplementation improved growth, immune responses and disease resistance of Atlantic salmon. Similar results have also been reported in tilapia (*Oreochromis mossambicus*) [30], Pacific white shrimp (*Litopenaeus vannamei*) [31], grouper (*Epinephelus malabaricus*) [32] and rainbow trout [33]. However, nucleotide supplementation did not significantly influence the growth of turbot (*Scophthalmus maximus* L.) fed diets with 30% to 50% SBM but could be helpful to improve the non-specific immune response and the intestinal histological structure of turbot [2].

Probiotics may be beneficial for aquatic animals and could result in improved performance and health [33-35]. Probiotics were selected for fermented soybean meal production with different amounts of solution [36]. Probiotics could play a role in the ability to utilize high levels of soybean in rainbow trout, as already observed by Sealey., *et al*. [37] and Ramos., *et al* [38]. Also, probiotics can play a role in soybean tolerance since lactic acid fermentation was able to eliminate indigestible carbohydrates and anti-nutritional factors in soybean meal fed to Atlantic salmon [39] and the addition of *Lactobacillus plantarum* has improved the ability of amberjack (*Seriola dumerili*) to deal with high levels of soybean meal [1]. Further, prebiotics increased protein digestibility of the soybean-meal-based experimental diets of red drum (*Sciaenops ocellatus*) (Linnaeus) [40].

Conclusion

In conclusion, the use of feed additive is recommended to improve the performance and health condition of cultured fish species [41]. Also, increased replacement levels of plant protein sources was observed in several cultured fish species upon the supplementation of functional feed additives which result in reducing the cost of feeding.

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