USE OF FEED ADDITIVES IN ANIMAL NUTRITION

Abstract

Reducing the dependency of aquaculture on fishmeal and other important fish feed ingredients is key for sustainable development for the aquaculture industry. One of the major bottlenecks in the expansion of coldwater fish culture in the Kashmir valley is the availability of quality fish feed at low cost. The local fish farmers of the valley are mostly dependent on feed either outside J&Kor on State Fisheries Department J & K. The State Fisheries Department also procures feed ingredients from outside theState which results in high feed cost and increased cost of production and low economic returns to the farmers. Recognizing the importance of proper feeding in successful fish production, the present article gives an idea how to formulate quality feed using locally-available feed ingredients and some feed additives to make feed more palatable and environmentally friendly as well. At the same time the production of quality feed, will create economic development among the poor sections of the society and employment generation for the uneducated/educated, skilled or unskilled sections of the society.

Keywords:- Animal nutrition, feed additive, fish, growth, immunity.

Introduction

The use of feed additives dates back to ancient times when farmers used to add salt to animal feed to improve its palatability. During the early 20th century, the use of feed additives became more widespread as scientists began to study the nutritional needs of animals. In the 1920s, vitamins were discovered and added to animal feed to prevent deficiencies and improve growth rates. This discovery led to the development of other feed additives such as minerals, amino acids, and enzymes. Today, feed additives are an essential component of animal nutrition. They are used to improve feed efficiency, promote growth, and enhance the health and well-being of animals. The use of feed additives is regulated by government agencies to ensure their safety and efficacy. As research continues to advance, we can expect to see further developments in the field of feed additives that will continue to improve animal nutrition and welfare. [3]

Proper nutrition is a pre requisite for thesuccess of any livestock system. As aquaculture is increasing day by day and new advances are being made in nutrition and feed development, it becomes necessary that the feed manufactured should be consumed readily by animals with less wastage. Feed additives are substances added to the diet for purposes other than meeting nutrient needs. According to the European Commission's commonly accepted definition, "Feed additives are products used in animal nutrition for purposes of improving the quality of feed and the quality of food from animal origin, or to improve the animals' performance and health, e.g. providing enhanced digestibility of the feed materials."[1](https://sustainableamerica.org/blog/what-are-feed-additives/)

In other words, Feed additives are an ingredient or combination of ingredients added to the basic feed mix or parts thereof to fulfill the specific need. Usually, they are used in micro-quantities and require careful handling and mixing. It is used to improve the rate of weight gain, feed efficiency, preventing and controlling disease, prevention against environmental influences. Animal feed additives are compounds that are added to the feed to improve the nutritional value, and health of the animals. Vitamins, minerals, amino acids, enzymes, and probiotics are a few examples of these supplements. In order to guarantee that the animal receives all the nutrients required for growth and development, they are used to supplement the animal's diet. Additionally, feed additives can aid in enhancing the quality of animal products including meat, milk, and eggs as well as increasing feed conversion rates, lowering the risk of disease, and reducing disease. To maintain the safety of both animals and consumers, feed additives must be used sensibly and in accordance with laws.[2]

Currently, the livestock sector uses a lot of feed additives to boost animal production, growth, and health. These additives include probiotics, enzymes, amino acids, vitamins, and minerals. They are used in animal feed to enrich the diets of the animals and make sure they get the essential nutrients. Due to the rising demand for animal protein and the requirement to increase the effectiveness of animal production, the global market for feed additives is anticipated to keep expanding. The potential harm that some chemicals could do to the environment, animal and human health, as well as both, is a source of concern. It is crucial that the industry pursues further research and development of secure and efficient feed additives.[5]

Role of Feed additives: The feed additives serve as binders, feeding stimulants, preservatives, and food colorings, among other functions. They can increase growth and performance, increase feed economy, and avoid sickness. While some additives increase the digestibility of feed, others serve as a source of vital nutrients like vitamins and minerals. Additionally, feed additives can make feed more palatable so that animals will find it more enticing. Lastly, several compounds have antibacterial properties that lower the possibility of bacterial infections in animals. Overall, the usage of feed additives can greatly increase the production and health of animals.[4]

Factors to be considered for selection of feed additive:

- They should not be poisonous
- They should not interact negatively with feed ingredients or feed nutritional quality.
- The material must be available in sufficient quantities and at a fair price
- It must not adversely affect the eating quality and consumer appeal of the meat of the animal that it is fed.

Types of feed additives:

There are several types of feed additives; each with its own unique benefits. The first type of feed additive is the **nutritional additive**. These additives are used to supplement the animal's diet with essential nutrients such as vitamins, minerals, and amino acids. Nutritional additives can help improve animal health, growth, and productivity. The second type of feed additive is the **technological additive**. These additives are used to improve the quality of the feed, such as its texture, stability, and shelf life. Technological additives can also help improve the animal's digestion and absorption of nutrients. The third type of feed additive is the **zootechnical additive**. These additives are used to improve the animal's performance, such as its growth rate, feed efficiency, and immune function. Zootechnical additives can also help reduce the environmental impact of animal production.[11]

There are a number of different feed additives used in fish feed industry including binders, antioxidants, chemo attractants, color enhancers, probiotics etc. Someof the most widely used feed additives are discussed below.

Binders: Binders are an essential component in the production of aquafeed, as they help to hold the feed together and prevent it from disintegrating. Binders can be made from a variety of materials, including plant-based products, animal-based products, and synthetic materials.[2]

Plant-based binders, such as starches and gums, are commonly used in fish feed production. These binders are cost-effective and readily available, making them a popular choice among manufacturers. However, they may not provide the same level of binding strength as animal-based or synthetic binders.

Animal-based binders, such as gelatin and collagen, are also used in fish feed production. These binders are derived from animal by-products and are known for their high binding strength. However, they may not be suitable for all types of fish feed, as some fish species may have an allergic reaction to these binders.

Synthetic binders, such as polyvinyl alcohol and carboxymethyl cellulose, are becoming increasingly popular in fish feed production. These binders are highly effective and

can provide superior binding strength compared to plant-based and animal-based binders. However, they may be more expensive and may not be as readily available as other types of binders.[2]

Thus, binders are an essential component in the production of fish feed. The choice of binder will depend on a variety of factors, including cost, availability, and the specific needs of the fish species being fed. Plant-based, animal-based, and synthetic binders all have their advantages and disadvantages, and it is up to the manufacturer to choose the best option for their particular situation.

Preservatives: Preservatives are commonly used in fish feed to increase its shelf life and prevent spoilage. These preservatives can be natural or synthetic and are added to the feed during the manufacturing process. The use of preservatives in fish feed is important to ensure that the feed remains fresh and nutritious for fish consumption.

One of the most common preservatives used in fish feed is ethoxyquin. Ethoxyquin is a synthetic antioxidant that is added to the feed to prevent oxidation, which can lead to spoilage. It is effective in preventing the degradation of fats and oils in the feed, which can cause rancidity and a decrease in the nutritional value of the feed. Ethoxyquin is approved by the FDA for use in animal feed, including fish feed, and is considered safe when used in accordance with the approved levels. Another preservative commonly used in fish feed is butylated hydroxyanisole (BHA). BHA is a synthetic antioxidant that is added to the feed to prevent the oxidation of fats and oils. It is effective in preventing spoilage and maintaining the nutritional value of the feed. BHA is also approved by the FDA for use in animal feed, including fish feed, and is considered safe when used in accordance with the approved levels.According to the Panel on Additives and Products or Substances Used in Animal Feed (FEEDAP), BHA up to 150 mg/kg of whole feed and ethoxyquin level of 50 mg/kg complete diet is considered safe level for all animals.Hence, the use of preservatives in fish feed is important to ensure that the feed remains fresh and nutritious for fish consumption. Ethoxyquin and BHA are two common preservatives used in fish feed that are approved by the FDA and considered safe when used in accordance with the approved levels. It is important for manufacturers to follow proper guidelines and regulations when using preservatives in fish feed to ensure the safety and quality of the feed.[2,17]

Color enhancers: Color enhancers are added to fish feed to improve the coloration of fish, which is an important trait for aquaculture and the ornamental fish trade. These enhancers are typically carotenoids, which are pigments that are found in various natural sources such as algae, crustaceans, and fish. The use of color enhancers in fish feed has been shown to have a significant impact on the coloration of fish. Studies have demonstrated that the inclusion of carotenoids in fish feed can improve the coloration of fish, particularly in species that have naturally dull or pale coloration. Some other examples of color enhancers include; Spirulina, blue - green algae that contain natural pigments, including chlorophyll and phycocyanin, Beta-

carotene is a naturally occurring pigment found in many fruits and vegetables, such as carrots and sweet potatoes. It is used to enhance orange and yellow colors in fish, like goldfish. In some cases, synthetic colorants may be used to achieve specific color enhancements in fish feed. These synthetic colorants are carefully regulated to ensure they are safe for fish and consumers.It is used to enhance the green and blue colors in some fish species.Additionally, the use of color enhancers has been shown to have a positive effect on the growth and health of fish, as carotenoids are important nutrients that are essential for various physiological processes.However, it is important to note that the use of color enhancers in fish feed is not without its drawbacks. Excessive use of these enhancers can lead to negative effects on fish health and the environment. Additionally, the use of synthetic color enhancers may have negative impacts on human health if consumed in large quantities. Therefore, it is essential to carefully regulate the use of color enhancers in fish feed to ensure that they are used in a safe and sustainable manner.[7]

Chemoattractants: Chemoattractants are chemical substances that can attract fish to a particular location. They are used in aquaculture to improve fish feeding behavior and increase the efficiency of fish farming.Chemoattractants work by stimulating the olfactory system of fish, which is responsible for their sense of smell.[8] When added to fish feed, chemoattractants can increase the palatability of the feed and encourage fish to consume more. This can lead to improved growth rates and reduced feed waste.Several types of chemoattractants have been used in fish feed, including amino acids, nucleotides, and betaine.[9] These substances have been shown to be effective in improving the feeding behavior of various fish species, including salmon, trout, and carp.In conclusion, the use of chemoattractants in fish feed can be a valuable tool for improving fish farming efficiency. Some of the common examples of chemoattractants used include blanch water, fish soluble,betaine, etc. By stimulating the olfactory system of fish, chemoattractants can increase feed consumption and promote growth. Further research is needed to optimize the use of chemoattractants in different fish species and farming conditions.[10]

Probiotics: Probiotics are live microorganisms that, when administered in adequate amounts, confer health benefits to the host. The use of probiotics in aquaculture has been gaining attention due to their potential to improve fish health and growth performance, as well as to reduce the environmental impact of fish farming. One of the main benefits of probiotics in fish feed is their ability to improve the gut microbiota of fish. The gut microbiota plays a crucial role in fish health and digestion, and disturbances in the gut microbiota can lead to various diseases. Probiotics can help to restore and maintain a healthy gut microbiota in fish, which can improve their overall health and growth performance.[6]Most common probiotics contain species of Lactobacillus species like *L.acidophillus*, *L.factis*, *L.plantrum* and *Enterococcus faccacis*[3]. In addition to their effects on the gut microbiota, probiotics in fish feed have also been shown to enhance the immune system of fish. This can lead to increased resistance to diseases and infections, as well as improved survival rates.[12] Furthermore, probiotics can also improve the feed conversion ratio of fish, which can reduce the amount of feed required to produce a given

amount of fish, thus reducing the environmental impact of fish farming. Therefore, the use of probiotics in fish feed has the potential to improve fish health and growth performance, as well as to reduce the environmental impact of fish farming. Further research is needed to fully understand the mechanisms underlying the effects of probiotics in fish, as well as to optimize their use in aquaculture.[13]

Prebiotics, such as -glucan in koi, *C. carpio koi*, and ferula in zebrafish, GOS in goldfish, *C. auratusgibelo*, and zebrafish, *D. rerio*, increased cellular and humoral immune responses by increasing phagocytic capacity and respiratory burst activity. Alkaline phosphatase has antibacterial capabilities because of its hydrolytic activity, according to Iger and Abraham and its increase may indicate a better immune response.[6]

Advantages of feed additives:

- They offer several advantages, including improving animal health, growth performance, and feed efficiency. [14]
- Feed additives can also enhance the nutritional value of animal feed by increasing the digestibility of nutrients.
- Additionally, they can help to reduce the environmental impact of animal production by reducing waste and emissions.
- Some feed additives can also improve the quality of animal products, such as meat and milk, by enhancing their flavor, texture, and shelf life.
- However, it is important to note that the use of feed additives must be carefully monitored and regulated to ensure their safety and effectiveness.
- Overall, the benefits of feed additives make them an important tool for modern animal production systems.[2,17]

Recent trends in feed additives:

R.A. Oluwafemi et al conducted a study on RECENT TRENDS IN THE UTILIZATION OF MEDICINAL PLANTS AS GROWTH PROMOTERS IN POULTRY NUTRITION. The study revealed that use of plant extracts like no, cinnamon and pepper as feed additives in poultry can be valuable because they allow maximizing the overall performance and improvement in digestibility of poultry. The most of plant extracts tested in poultry experiments exhibited positive effects on the productivity and no any harmful effects on animal health and products obtained from the animal. Therefore, they can be used as a botanical alternative in poultry production.[15]

José María GarcíaBeltrán et al. **(2022)** studied Nature-identical compounds as feed additives in aquaculture. The study revealed that Nature-identical compounds including phytochemicals, secondary plant metabolitescan be considered a promising alternative to be added to fish diets to promote growth performance, manipulate the gut microbiota, and improve the immune and oxidative status of fish as well as control bacterial infections in this important aquatic industry.[16]

The agro-food sector produces large quantities of byproducts, some of which may contain valuable molecules with high functionality and/or bioactivity. Byproducts, which are typically secondary products obtained from primary agro-food production processes, support the idea of a circular economy by serving as an intriguing and less expensive source of ingredients that may be useful, such as peptides, carotenoids, and phenolic compounds (Margarida Faustino et al, 2019).[6]

Scope:

The scope of feed additives is vast, as they can be used to improve animal health, increase growth rates, and enhance the quality of animal products such as meat, milk, and eggs. Additionally, feed additives can be used to reduce the environmental impact of animal production by reducing the amount of waste produced. Overall, the use of feed additives is an important aspect of modern animal agriculture and plays a critical role in ensuring the sustainability and efficiency of animal production.

Conclusion:

The purpose of feed additives isto increase production by making feed more palatable and enhanced resistance to infectious disease, which would ultimately lead to sustainable aquaculture. The feed additives are eco-friendly and mostly natural products, may not result in negative impact on aquaculture. Keeping in view the multiple benefits of feed additives, sufficient research is required as far as its dosage, mode of action, timing, duration are concerned.

ETHICAL APPROVAL AND CONSENT TO PARTICIPATE

- Not Applicable

CONSENT TO PUBLISH

- Not Applicable

DATE AVAILABILITY STATEMENT

- The data that supports the findings of this study are available from the corresponding author upon reasonable request.

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