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Effects of Feed Additives in Fish Feed for Improvement of Aquaculture

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Abstracts

Nutrition is the major crucial factor determining the potential of cultured fish to exhibit its genetic capability for growth and reproduction. The increased in costs and short quantity of fish feed have given reason to the need to increase research for substitutes .Therefore, the fish feeds require to be enriched with additives. Feed additives are eatable substances that are included in fish feeds in very little quantity to improve the feeds which in returns improve the growth performance and decrease mortality rate in fish. Feed additives could be widely categorized into two classes which are living and non-living. Utilization of inexpensive live feed supplements as feed additives is broadly accepted and embraced as a result of its eco-friendly nature. Hence, just few options are accessible in this class. The living organisms applied as feed are probiotics, Plants and some algae. Probiotics are applicable microorganism in feeding the host. Inclusion of probiotics to the feeds improves the feed conversion ratio and reduces the death rate. Probiotics are proven to have potential to enhance the immunity of fish to response and improve the immune system in fish There are strict laws on the usage of antibiotics and chemotherapeutics in thin the aqua feed industry as a result of bioaccumulation (Lim, et al., 2013). More importance is accorded to feed additives. Recently, many researchers proved the positive potentials of medicinal plants as feed additives. The herbs increased the growth and usage of feed in the fish and likewise decreased diseases through regulation of pathogens in gastrointestinal tract A combination of medicinal plants is applied and found to be effective and have potentials to combat diseases problem, and could supplement insufficiency of nutrients and phytochemicals. Also, treatments of fish with medicinal plants before cooking could improve the taste of the cooked fish. There is urgent need to research more on novel feed additives like inclusion of herbs on fish feeds which reduce feed costs, maximum digestibility and prevention of residual effects of hormones and antibiotics on fish muscles which in return have effects on the human that consumes them.

Key words: Aquaculture, Fish feeds, Feed additives, Probiotics, Plant antioxidant

Review article

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INTRODUCTION

Fishes are one of the excellent and inexpensive source of lean meat and more than half of the population in the world relied on fish for dietary protein source. In the past decade, high importance has been accorded to fish production and their nutrition. Nutrition is the major crucial factor determining the potential of cultured fish to exhibit its genetic capability for growth and reproduction. Live food is the best feed for fish, as it is natural and healthy (Oramary et al., 2016). The most commonly applied fish feed constitutes of fish meals as source of protein, which is between 10-50% of the running costs (Mellen, 1927). Moreso, the most accepted edible fish food habits have been strongly established (Gupta and Banerjee, 2016).The increased in costs and short quantity of fish feed have given reason to the need to increase research for substitutes (Bimbo and Crowther, 1992).Therefore, the fish feeds require to be enriched with additives. Feed additives are eatable substances that are included in fish feeds in very little quantity to improve the feeds which in returns improve the growth performance and decrease mortality rate in fish (Dada, 2015). In aquaculture, enhancement of growth performance of the fish is one of the major crucial goals. Several studies have been performed on the fish feed development. Few of the research examine the effect of natural immune-stimulant additives to fish feed. The inclusion of oils into feeds of aquatic animals, especially fish, enhance the growth performance of the species being cultured, as well as feed consumption and protein utilisation rates (Bell et al., 2000; Montero et al., 2005). There are strict laws on the usage of antibiotics and chemotherapeutics in thin the aqua feed industry as a result of bioaccumulation (Lim, et al., 2013). More Importance is accorded to feed additives. Feed additives could be widely categorized into two classes which are living and non-living. Utilization of inexpensive live feed supplements as feed additives is broadly accepted and embraced as a result of its eco-friendly nature. Hence, just few options are accessible in this class. The living organisms applied as feed are probiotics, Plants and some algae.

Probiotics in fish feeds

Probiotics are applicable microorganism in feeding the host. Inclusion of probiotics to the feeds improves the feed conversion ratio and reduces the death rate. Probiotics are proven to have potential to enhance the immunity of fish to response and improve the immune system in fish (Kumar, et al., 2016).Supplements that includes the host source probiotics such as *B. mycoides* significantly increase stress, tolerance which could assist in live transportation (Ambers, et al., 2015).Recently many of the probiotics supplements are fortified with prebiotics to improve the probiotics actions. Prebiotics are categorized as non-digestible to the host that improve the growth and metabolism of probiotics in the animal gastrointestinal tract. The generally applied prebiotics is referred to as Fructooligosaccharide (FOS) (Ye et al., 2011; Akrami et al., 2013).

Application of Herbs in fish feeds

Nowadays, many researchers proved the positive potentials of medicinal plants as feed additives. The herbs increased the growth and usage of feed in the fish and likewise decreased diseases through regulation of pathogens in gastrointestinal tract (Farahi et al., 2012; Manaf et al., 2016). A combination of medicinal plants is applied and found to be effective and have potentials to combat diseases problem, and could supplement insufficiency of nutrients and phytochemicals. Also, treatments of fish with medicinal plants before cooking could improve the taste of the cooked fish (Agbabiaka et al., 2016). Many researchers established that the usage of

plant based protein in fish feeds increased growth performance (Kumar et al., 2016). Meanwhile some draw their conclusion that soya beans based protein substitute in fish feeds improve fish growth. Hence, the constituents of plant sources of protein includes enzymes inhibitors, toxins such as gossypol tannins, saponins, alaectins, Phytic acid and so on which could affect the fish growth performance negatively (Ali, et al., 2016). The effective ways to overpower the adverse effect of toxins or antin-minerals or anti-vitamins such as phytase could be substituted in the feed. Phytase, have potentials to enhance the availability of phytate-phosphorus in fish feeds (Cain and Garling, 1995; Nwanna, 2007). Moreover the ratio of dietary calcium and phosphorus are essential for the activity of phytatse (Li et al., 2016). The application of probiotics in fish diets could also reduce the adverse effects of anti-nutrients ((Mellen, 1927). Some researchers found positive outcomes on vegetables and other food wastes in fish diets (Akpoilih et al., 2016).Though, some scientists established the application of poultry waste meals in replacement of fish meal due to the fact that poultry waste is cheaper and affordable than fish meals (Yones and Metwalli, 2016). Few studies established that salt could be utilize as additive in fish feeds as growth enhancers (Kumar, et al., 2016). But the utilization of such additives is specific to some particular species and depends on location of the river. Antibiotics and many other chemicals have been tried as growth enhancers, antibacterial and for other several functions in fish and shellfish (Jayaprakas and Sambhu, 1996). The application of theses hormones, antibiotics and other chemicals is discouraged in aquaculture field as a result of the residual effects in fish muscle also in prawns. Plants are of nature source and are safe and affordable, they are proved to promote several activities such as anti-stress, growth enhancer, stimulate appetite and immunostimulation in aquaculture activities (Citarasu and Babu, 2002; Sivaram, et al., 2004). Several extracts from herbs and spices are established to increase animal performance through stimulation of action on gut secretions or through a direct bactericidal effect on gut microflora and moreso, the plants active principles in the diets induce the flow of the digestive enzyme and the growth enhancement in herbs leads to high protein synthesis (Citarasu, 2010).

Uses of Garlic in Fish feed

Garlic is one of the important medicinal herb broadly cultivated in many countries and has played a crucial dietary function as well as medicinal purpose for centuries. Garlic (*Allium sativum*) is a perennial bulb-growing plant which belongs to the genus Allium in the family *Liliaceae* that has been used for decades as a flavouring agent, traditional medicine, and a functional food for improvement of physical and mental health. Garlic has been researched in several forms of extracts: aqueous, ethanol and dried powder (Shin and Kim, 2004). It consists a variety of organosulfur compounds like allicin, ajoene, S-allylcysteine, diallyl disulfide, S-methylcysteine sulfoxide and S-allylcysteine (Chi et al., 1982). The inclusion of the garlic extract proved a significant increment in weight gain and feed efficiency of sterlet sturgeon in 10wks trial. Nonetheless, the parameters are not significantly different between 0.5 and 1% GE groups, while condition factor was highest in 0.5% GE group among treatments. From these results, it was concluded that the addition of 0.5% GE to commercial diet was optimal for growth performance of sterlet sturgeon. In second trial, fish were fed diets with (0.5% GE) and without GE for 5 wk. In all parameters investigated, fish fed diet 0.5% GE present a significant increment, (Shalaby et al., 2006) reported significant increased weight gain, feed efficiency, protein efficiency ratio (PER) and specific growth rate (SGR) in Nile tilapia which were fed diet containing garlic powder of 30.0 g/kg diet. Also, Diab et al. (2002) indicated feeding diet with 2.5% garlic/kg diet yield in the highest growth performance in *O. niloticus*. In the same

species, Abou-Zeid (2002) reported a positive increment in biomass and specific growth rate with garlic inclusion. Metwally (2009) also indicated that the best performance was obtained in Nile tilapia fed diet with garlic powder of 32 g/kg diet. A significant improvement in growth, feed conversion and protein efficiency was seen in rainbow trout fish when fed with diet containing 1.0% garlic (Nya and Austin, 2009). Dietary garlic extract could lead to excessive lipid accumulation in fish flesh as a result of increase in protein utilization for fish fed garlic extract diet can decrease the function of lipid as an energy source for growth, therefore, deposition of lipid was high in garlic extract group than in control. Although there is constant controversy concerning the effect of garlic as growth enhancer for fish, the report suggested that dietary garlic for juvenile sterlet sturgeon (60 to 250 g) can greatly affect growth performance and feed utilization. Protein efficiency ratio and feed efficiency are applied as quality indicator for fish diet and its amino acid balance. Wherefore these factors are applied for evaluation protein utilization and turnover (Shalaby et al., 2006).

Garlic paste

Garlic paste is applied as antibiotic and antibacterial properties, garlic prohibits the multiplication of bacteria, hence, there is properties of antibacterial in garlic. Nutritional content of garlic/ 100g, Moisture: 62.8%, protein: 6.3%, carborhydrates: 29%, Fiber 0.8%,Total fat : 0.1%, Total ash 1.%, calcium: 0.03%, phosphorus: 0.31%, Iron : 0.001%, vitamins C:13mg and Nicotinic acid 0.4mg.The caloric value is 142 per 100gm(Bhosale et al., 2010).

Uses of Rosemary in Fish feed

Rosemary extract is a positive dietary additive to induce effective technical and economical growth of catfish reared. (Turan and Yiğitarslan, 2016) proved that the inclusion of rosemary extracts increased growth and enhanced few nonspecific immunity indicators of tilapia, *Oreochromis mossambicus*. Likewise, rosemary extract improved feed conversion, efficiency of broilers fed diet supplemented with such herb (Ghazalah and Ali, 2008). Cristea et al. (2012) indicated that fish of feed additives improve the digestibility and utilization efficiency of nutrients in aquaculture.

Cumin Powder

Animal scientist found out that cumin stimulates the secretion of pancreatic enzymes, crucial factors in nutrient digestibility and assimilation. Nutritional content of cumin /100gms , carborhydrates 44.24gm, proteins 17.819gm, fats 1.535, dietary fibers 10.5gm. iron 66.36mg, sodium 168mg, zinc 4.8mg,ncalcium 931mg, vitamins like vit . A 64mg, thiamine B_1 0.628mg, riboflavin B_2 0.327mg, niacin B_3 4.579mg, foliate B_9 10mg, vitamin C 7.7mg and E 3.38mg (USDA, 2008).

Black cumin Oil

Black cumin is a cultivated seed that has been known since acient time. The nutrient level of the black seed consists of 20.8% crude protein, 3.7% ash, 7.0% moisture, 34.8% lipids, and 33.7% carbohydrate (Atta, 2003). Black cumin's substances have potent to act as antibacterial, antifungal, antiviral, antiprotozoal, antihistaminic, anti-oxidant, anti-inflammatory, and immunostimulant. Specifically, it is apply to treat several health issues such as asthma, hypertension, inflammation, cough, bronchitis, headache, eczema, flu fever, and dizziness (Altınrterim, 2010). Supplement of black cumin added to fish feed yield positive effects on the

growth rate of fish and resulted in lower microbial activity during storage period (Öz, 2013). Black cumin oil is also very active in some pathogenic Gram-positive and Gram-negative bacteria (Hanafy and Hatem, 1991). According to Öz et al. (2017) in a research on the effects of black cumin oil (*Nigella sativa*) on sensory, chemical and microbiological properties of rainbow trout during 23 days of storage at 2±1 ºC. The result of the study showed the total sensory scores of the cooked rainbow trout reduced throughout the storage period. There was no significant differences between all groups in terms of sensory parameters ($p>0.05$). The sensory result shows that addition of black cumin to rainbow trout feed had no influence on fish in terms of flavor, aroma, or color; the control group and the other groups showed similar in overall acceptability by the panelists. Also changes in TVB-N values of rainbow trout kept in ice, during storage, the result showed significant differences in the TVB-N content of rainbow trout, at the end of storage, TVB-N did not reach the limit of 35 mg/100 g treated with black cumin Oil (Öz, et al., 2017). In the study carried out by Öz et al. (2018) on the Effect of black cumin oil (*Nigella sativa*) on the growth performance, body composition and fatty acid profile of rainbow trout (*Oncorhynchus mykiss*) The results showed that black cumin oil affected protein content and the differences between groups were statistically significant ($p<0.05$). Also, from the same work, on the results of lipid, the quantity of black cumin oil in the feed increased the total amount of lipids in the fish. The crude ash level in the study were also statistically significant differences. The study of (Öz, et al., 2018) showed that rainbow trout fed with black cumin oil supplements have higher raw protein, raw cinder, lipid and proportion of dry matter when compared to the results given by others in several studies. Also, in another research carried out by Öz (2018) on the effects of black cumin (*Nigella sativa*) oil on ammonia and biogenic amine production in rainbow trout, In the study, the author found that initial histamine level at the beginning of the storage period was 0.01–0.06 mg/100 g and it remained under 2 mg/100 g throughout the storage period. Histamine levels of 5 mg/100 g, is the legal limit determined by the FDA in trout muscle (FDA, 1995), was not seen in any of the groups throughout the study period, the conclusion on the effect of black cumin on histamine is that , black cumin oil has potent to reduce histamine in trout muscle. The results of the study of Öz (2018) suggest that the inclusion of black cumin oil decreased ammonia and biogenic amine production in rainbow trout.

CONCLUSION

Fish and shellfish are valuable and inexpensive sources of Omega fatty acids and several other important nutrients for human consumption. There is constant need to increase aquaculture production and management. There is urgent need to research more on novel feed additives like inclusion of herbs on fish feeds which reduce feed costs, maximum digestibility and prevention of residual effects of hormones and antibiotics on fish muscles which in returns have effects on human that consumes them.

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