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Feeding and Nutritional Requirements of Indian Major Carps: A Review

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ABSTRACT: In India, the annual fisheries and aquaculture production increased from 0.75 million tonnes in 1950-51 to 9.6 million tonnes in 2013-2014. Globally the country now takes the second position, after China, with regard to annual fisheries and aquaculture production. Indian major carps are commercially cultured in India and the Indian subcontinent; catla (*Catla catla*), rohu (*Labeo rohita*) and mrigal (*Cirrhinus mrigala*) are considered the three major carps of India.so it is important to investigate or emphasize on the feeding and nutritional requirement of Indian major carps. This review gives insights on the protein and amino acid requirement, lipid and fatty acid requirement, vitamin and mineral requirement, feeding practices.

Keywords: - Indian Major Carp, Protein requirement, Lipid requirement, vitamin and mineral requirement, Aquafeed.

1. INTRODUCTION

The role of aquaculture in food production, economic development and food security is now well recognized. As the fastest growing food production sector, aquaculture holds promise to help provide a growing human population with food. World Population is expected to grow around 9.7 billion by the 2050. Per capita food consumption has also grown significantly.in 1960 it was 9.9 kg in 1990 it was 14.4 kg whereas in 2013 it was 19.9 kg. with increasing population, the demand of the food will increase and aquaculture has the potential to meet the increasing demand (FAO,2016). Production of aquatic animals from aquaculture in 2014 amounted to 73.8 MMT, with an estimated worth of US$160.2 billion. Demand (FAO, 2016). World aquaculture production of fish accounted for 44.1 percent of total production. During the last 25 years, aquaculture production grew up to 8.6% annually. Indian aquaculture production is growing at 6 % annually.

Indian major carps are commercially cultured in India and the Indian subcontinent; catla (*Catla catla*), rohu (*Labeo rohita*) and mrigal (*Cirrhinus mrigala*) are considered the three major carps of India. Some medium and minor carps are culture in "polyculture" type system. The principle behind this polyculture system is the utilization of all available natural food resources at different trophic levels to achieve maximum production per unit area of water body (Jhingran, 1991). Most of the farmed carps are marketed within the country for domestic consumption. In recent years, fillets, flakes and other value-added products of carps have been exported to Middle East countries. Indian carp production has registered substantial increases. India is second in world carp production, next only to China. In 2016, India had total inland finfish aquaculture production of almost 4400 thousand tonnes (FAO, 2016).

2. PROTEIN AND AMINO ACIDS

The optimal dietary protein requirement is affected by the nutritional value of the dietary protein and the level of non-protein energy in the diet. When sufficient energy sources, such as lipid and carbohydrates, are available in the diet, most of the ingested protein is utilized for protein synthesis. Adults of Indian major carps require 30% dietary protein for proper growth and survival. Fingerlings and fry of these carps require 35% and 40% dietary protein, respectively, for good growth (Sen et al., 1978; Renu karadhya and Varghese, 1986).

Indian major carps, like other animals, do not have an absolute requirement for protein but require a balanced mixture of indispensable and dispensable amino acids (Murthy and Varghese, 1998). Qualitative and quantitative amino acid requirements of Indian major carps were determined. Qualitative amino acid requirements of carps could also be estimated by employing carbon-14 (14C)- labelled isotopes. Studies on the qualitative dietary requirement of carps have indicated that they require all the ten essential amino acids (EAA) that are known as indispensable for other commercial finfish studied so far. Quantitative dietary amino acid requirements of catla, rohu and mrigal varies as per the usage and species.

In catla, fry requirement of amino acid is lower than adults except for methionine. But requirement gap is very less. The requirement of amino acid in fry is 0.90 to 6.3 % of total dietary protein of feed. In case of adults, it ranges from 1 to 7% of total

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dietary protein of feed. Where in both cases, lysine has the highest requirement and methionine being the lowest *(Ravi and Devaraj, 1991, Satheesha and Murthy, 1999, 2000*). In rohu and mrigal, it ranges from 1.0 to 5.8 % of total dietary protein of feed (Murthy and Varghese, 1995, 1996a, 1996b, 1997a,b,c,d, 1998).

Lipid and fatty acids

Lipids, or fats, are required as a source of energy and essential fatty acids. Further, lipids serve as a carrier for fat-soluble vitamins. Fatty acids and phospholipids help to maintain the structural integrity of cell membrane. The gross lipid requirement of Indian major carps is 7–8% of the diet. Young fish require relatively more fat and more protein than adults. All three Indian major carps were found to grow well when the diet contained 1% n-3 and 1% n-6 fatty acids. Body composition of Indian major carps contains a high proportion of n-3 fatty acids as well as n-6 fatty acids. Limited studies have been carried out on the dietary fatty acid requirement of Indian major carps. The essentiality of highly unsaturated fatty acids (HUFA), such as eicosapentaenoic acid (EPA) (20:5n-3) and docosahexaenoic acid (DHA) (22:6n-3), has not been reported for Indian major carps. These carps are basically freshwater species and found to grow well even in the absence of HUFA.

Carbohydrates

Carbohydrate is the cheapest nutrient and also a less expensive energy source for carps. Being herbivorous/omnivorous feeders, Indian major carps easily digest appreciable quantities of carbohydrates in the diet. A dietary level of 22–30% of carbohydrate has been found to be optimum for the growth of Indian major carps. Growth retardation and reduced feed efficiency is observed when the carbohydrate level exceeds 35% of the diet. in practical diets, wheat flour, tapioca flour and rice flour are used as cheap sources of carbohydrate in the diet formulation. These ingredients also serve as natural binders in the diet. Carbohydrates spare some protein when protein is not available in sufficient quantities in diets.

Vitamin and minerals

Diet comprising thiamine with 8–12 mg kg^{-1} fulfils the dietary requirement, depending on the life stage. Riboflavin is a major component of Indian major carp diet because its deficiency could result into loss of blood, fin erosions etc. Riboflavin has an estimated requirement of 6–8 mg kg^{-1}. Disease resistance in respect of *Aeromonas hydrophila* was enhanced by vitamin C and lowest mortality was reported in rohu fed 600 mg vitamin C kg^{-1} diet and in mrigal fed 1000 mg kg−1 diet (Sobana, 1997). There are reports that ascorbic acid-free diets did not result in deficiency signs, mortality or significant growth variation in rohu when compared with diets with added ascorbic acid (Hasan *et al.*, 1993). In general, a dietary level of 100–150 mg ascorbic acid kg^{-1} diet has been found satisfactory. Its deficiency could result in mortality, poor growth, etc. (Agarwal and Mahajan, 1980).

Vitamin A (retinoic acid) deficiency causes displacement of the eye lens and corneal thinning, poor growth, exophthalmia and depigmentation in carps. The dietary vitamin A requirement of Indian major carps appears to be 1500 IU. Vitamin D deficiency leads to depressed growth and muscle tetany in finfish, including carps. a dietary level of 400–500 IU is required. The quantitative dietary requirement of vitamin E in Indian major carps appears to be 40–50 mg kg−1 diet. The dietary requirement of Indian major carps for vitamin K falls in the range of 5–10 mg kg−1 diet.

The dietary calcium requirements of Indian major carps has not been studied, but 4000–5000 mg calcium kg^{-1} diet is suggested. Phosphorus deficiency results in poor food conversion, anorexia. Dietary levels ranging from 5000 to 6000 mg phosphorus kg^{-1} diet have been found satisfactory. A dietary magnesium level of 500 mg kg^{-1} diet is optimum for Indian major carps, while 3–4 mg copper kg^{-1} diet has been found satisfactory. When supplemented at a level of 0.1 mg kg^{-1} diet in the diets of Indian major carp fry in nursery ponds, cobalt, in the form of cobalt chloride, enhanced growth and survival (Alikunhi, 1987). Other mineral requirements have not been investigated.

Feeding practices

Supplementary feeding is essential to increase the production of carp fry in ponds. Survival of IMC in early stages is very low (30 %). The main reason behind that is lack of inadequate and balanced feed with low management practices. The traditional or conventional diet used by small and rural fish farmers for the culture of Indian major carps is a mixture of rice bran and oilcake in equal proportions by weight. The diet consists of 1: 1 rice bran and oilcake and usually contains 25–28% crude protein. They fed twice at 10-20 % of total biomass.

It has been estimated that pellet feed with 30 % protein incorporating fish meal has shown 50 % more production than traditional rice bran and oil cake mixture (Varghese et al., 1976). But if the carps are fed with silkworm pupae, it has shown higher growth in catla (Jayaram and Shetty, 1980). Whereas dry duckweed powder and cabbage leaves have found to be inferior in growth in carp (Devaraj et al., 1981). Incorporation of earthworm meal, margarine, sardine oil and Cassia tora leaf powder in formulated diets enhanced the growth and survival of Indian major carps (Manissery et al., 1988). Murthy and Devaraj (1990, 1991a,b) evaluated leaf powders of three floating aquatic weeds – namely, *Eichhornia, Pistia* and *Salvinia* – as low-cost ingredients partially replacing fish-meal in diets for carps and reported that the *Pistia*-based diet was found to be superior to the other two diets.

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The most common method of feeding employed in carp culture in India is handfeeding, particularly by small and artisanal carp farmers. Diet is fed once daily at a rate varying from 2% to 4% of the biomass. Semi moist diets of various sizes and shapes are broadcast manually over the pond surface. Another popular method of feeding carp is bag feeding. Diet is added to an empty plastic bag, several holes (1–2 cm diameter) being made at the bottom of the bag. The bags containing diet are suspended from bamboo poles, which have been driven into the pond bottom, so that the lower end of the bag is under water. The entire diet is consumed within 2–3 h. Empty bags are removed, washed and dried before reuse the next day.

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