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Review Article

Feeding and Nutritional Requirement of Yellowtail *Seriola quinqueradiata*: A Review

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ABSTRACT

Aquaculture is the fastest food growing sector in the world. In the last 25 years, it is growing ay an average of around 8%. As aquaculture is increasing rapidly demand of aquafeed is also increasing. But Indian aquaculture is dominated by one species (L. vannamei). But species diversification in aquaculture industry can bring a broad market for seafood. In Japan, S. quinqueradiata contribute a major chunk in total aquaculture production. It has very high growth in cage and it also feeds on the trash fish. But culturing this species will have constraint in India. So, there is a need for insight in these species nutritional and feeding requirements. This paper presents protein and amino acid requirement, energy requirement, lipid and fatty acid requirement, carbohydrate requirement, vitamin and mineral requirement and feeding practices.

Keywords: *S. quinqueradiata, Yellowtail fish, nutrient requirement, feeding requirement.*

INTRODUCTION

The present shortage of animal proteins in world is attributed to the discrepancy between the rate of population growth and the rate of growth in animal protein production. The growth of human population and food production is thus not proportional. Moreover, increase in human population along with changing perceptions on quality food has led to increased demand for fish.

Aquaculture is the fastest growing food sector. Which provide food, nutrition, income and livelihoods millions of people worldwide. Global aquaculture production in 2016 amounted to 110.2 MMT, with an estimated worth of US$ 243.5 billion (FAO, 2018). Among that 80 MMT was of food fish whereas 30.1 MMT was of aquatic plants as well as around 38 thousand tonnes of non food products. 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 2017 it was 20.5 kg. With increasing population, the demand of the food will increase and aquaculture has the potential to meet the increasing demand (FAO, 2018).

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Yellowtail fish is endemic to Japan and adjacent waters. It is called by three names by the weight of the fish. The fish with <50 g is called mojako, from 50g to 5kg are called Hamachi and more than 5kg are called buri. Mojako which are stocked on April reach to 1 to 1.5 kg weight by the December. But harvesting takes place when it reaches 2 to 5 kg.

Yellowtail (*Seriola quinqueradiata*) is one of the economically important finfish for aquaculture in Japan. Fish are normally cultured in floating net cages in coastal zones. Since artificial seed production has not been used for yellowtail, fingerlings of yellowtail, known as *mojyako* in Japanese, are caught in the wild while they are schooling along coastal currents with drifting objects (e.g. algae). Commercial production of yellowtail began in the 1950s, and production has expanded rapidly since the 1960s. The total production of yellowtail in Japan was about 140,000 tons in 1997, representing about 70% of the total production of aquaculture marine finfish in Japan. Fingerlings of ≤ 10 g is stocked for after one and half year. Most yellowtail growers target a market size of about 2–5 kg, while some growers even raise the fish to a weight of 7–8 kg.

Yellowtail fish has several advantages for culture. 1) culture is easy to maintain, 2) they are fast growing, 3) they are having high market demand and high value as well. But major disadvantage is its long culture duration.

Nutritional Requirements

Protein and amino acids

The protein requirement of fish is affected by several factors, such as growth rate, nutritional quality of the ingredients (protein digestibility and amino acid composition) and digestible energy content of the diet. Optimum dietary energy is required in the feed for the fish, excessive energy may result into the decreased nutrient intake by the animal or excessive fat deposition in the body. Therefore, a balanced energy-to-protein ratio (E/P) is important.

Energy

It is generally believed that fish, like other animals, control their feed intake in order to meet their energy intakes in tune with their growth rates (Kaushik and Médale, 1994). Masumoto et al. (1997) determined the energy requirement of juvenile yellowtail (23–26°C, initial body weight (BW) 12 g and final (BW) 120 g for maintenance and maximum gain. The estimated maintenance energy level based on body composition analysis for fasting fish was 134 kJ kg^{-1}, BWday $^{-1}$, and the level for zero growth was estimated from the results of feeding experiments to be 214 kJ kg^{-1}, $BWday^{-1}$. The energy requirement for maximum growth based on the relationship between growth rate and energy intake was estimated to be 772 kJ kg^{-1}, BWday $^{-1}$ which is higher then carp and rainbow trout.

Lipids and fatty acids

It is very well known that marine finfishes mostly require n-3. That's why Yellowtail require the n-3 rather than the n-6 series of fatty acids (Furukawa et al., 1966; Tsukahara et al., 1967). Moreover, unlike rainbow trout or other freshwater fish species, yellowtail are unable to use 18:3 (n-3) as an essential fatty acid (EFA) and require n-3 highly unsaturated fatty acids (HUFA) with 20 or more carbon atoms (Yone, 1978). A comparison of the effect of various fish oil sources on the growth of yellowtail (40 g) showed that oil high in n-3 HUFA (squid liver oil, sardine oil and skip-jack oil) had better nutritional value than that of oil containing low levels of n-3 HUFA (pollack liver oil and herring oil) (Deshimaru et al., 1982a). The optimum dietary lipid level for young yellowtail (45–80 g) was 9% when squid oil containing 27% n-3 HUFA was used and 15% when pollack liver oil containing 13% n-3 HUFA was used (Deshimaru et al., 1982b). Based on these results, the n-3 HUFA requirement for yellowtail is estimated to be approximately 2% of the diet (Deshimaru et al., 1982b).

Carbohydrates

Carbohydrate utilization among fish species is extremely variable. However, tilapia and catfish can digest over 70% of uncooked dietary starch, while rainbow trout can digest less than 50%. The optimum carbohydrate level for yellowtail was investigated by feeding a fish-meal-based diet supplemented with gelatinized starch at levels of 0, 10, 20 or 40% (Shimeno et al., 1979). The growth rate, feed efficiency and energy retention, as well as body fat and glycogen content, were higher in fish fed diets with 10% and 20% starch levels than in fish fed diets with 0% and 40% starch levels. The protein digestibility of fish fed a diet with a starch level of 40% was lower than that of fish fed a diet with 20% starch (56% vs. 78%). The effects of various carbohydrate sources on the growth rate of yellowtail were also tested. At the 15% inclusion level, the growth of fish fed starch was better than that of fish fed fructose (Shimeno et al., 1979). Yellowtail cannot utilize dietary glucose well. In fact, the digestibility of glucose is higher than that of gelatinized starch, although the growth performance of fish fed glucose is inferior to that of fish fed starch at a 10% dietary level (Furuichi et al., 1986).

Vitamins and minerals

The quantitative requirements of the yellowtail have been determined by feeding purified casein-gelatin diets containing graded levels of vitamins. The requirement value can vary depending on the criteria used – e.g. maximum weight gain, feed conversion efficiency or tissue vitamin concentration.

The interaction between macronutrients and vitamins was studied. When the dietary protein level was increased from 59% to 79%, the pyridoxine requirement increased by 1.4-fold. On the other hand, the α-tocopherol requirement increased from 35 to 93 mg kg−1 and 160 mg kg−1 as the dietary lipid level increased from 8% to 15% and 25%, respectively (Hosokawa, 1999).

The effects of mega doses of vitamins E and C on immune responses in yellowtail fingerlings were studied. When the fish were fed diets containing two to five times or 16–50 times the required amount of dietary vitamin E or vitamin C, respectively, phagocytic activity and antibody titre in fish fed those diets increased compared with those in fish fed diets with the required levels of vitamin E or C. As a result, fish fed megadoses of these two vitamins increased their resistance to Pseudotuberculosis and streptococcicosis (Hosokawa, 1999).

Hosokawa et al. (1985) examined the effects on the growth of yellowtail of casein-based semipurified diets supplemented with various levels of mineral mixture (Halver, 1957). The best growth was obtained from the diet containing an 8% mineral level. Fish fed a diet without the mineral mixture showed an initial loss of appetite, followed by dark coloration, scoliosis, anaemiaand death (Makino, 1990). When yellowtail were fed diets devoid of sodium (Na), potassium (K) and chloride (Cl), they exhibited no apparent deficiency signs. Thus, the yellowtail's requirements for these minerals may be met with absorption of these minerals from sea water by drinking. Fish fed diets devoid of calcium and magnesium showed slightly reduced growth rates and feed efficiency, which may be an indication of the essentiality of these minerals in the diet (Ikeda, 1976).

Feeding practices

1. It has been suggested that krill meal, especially the astaxanthin in the meal, is an effective component in the reproductive performance of red sea bream brood-stock. Verakunpiriya et al. (1997) found that the supplementation of astaxanthin in dry pellets was effective for brood-stock yellowtail and the optimum level appears to be 30 p.p.m., but egg quality was reduced at levels above 30 p.p.m.
2. Trash fish :- one of the major reason of preference of this species for culture is because they are fed with low quality trash fishes like sand lance, sardine etc.. but in the current scenario, the catch of these species are decreasing day by day, because of that the yellow fish feeds need an alternate source.
3. Moist feed:- During the second year of their culture, they are mostly fed moist diet. These types of feeds are given in the low temperature (< 15^o C). Because this species does not prefer or eat dry feed at low temperature.
4. Mechanical method: - The current overfishing, trash fishes does not provide

feed as per the requirement. Because of that, mechanically prepared pellet feeds are fed. Yellowtail feeding behavior for pelleted feed is almost similar to trour and salmon. Which means fishes will eat most of the feed given within 10 minutes.

CONCLUSION

Yellowtail fish culture has started successfully on a commercial level in Japan. Because of it is more suitability for aquaculture, it has become the one of the most important commercially species in marine fish farming as a cage culture. The fish are cultured mostly in floating net cages in the shallow coastal regions, and in recent years the submerged cage culture technique has contributed to the expansion of production. in spite of the well-developed situation, there are still some problems. Diseases and the shortage of feed are serious constraints for future progress. The development of suitable disease Control techniques and new effective feeds will furnish a key for the solution of these problems. Development of more efficient environment friendly feeds necessary. There for this feeding and nutritional requirement of yellowtail this is helpful for growth performance and survival. At present, yellowtail growers, mostly family groups, can find a ready market for their product, and its realize middle-class incomes. On the other hand, consumers are able to obtain a stable supply of this staple food. It contributes a major chunk of the production. Even if the culture duration is long, its market demand is also very high and it also feed on trash fish. Therefore it can describe as a potential species for culture in India. The techniques of intensive marine fish culture developed with yellowtail will be a valuable example for the development of marine farming in the future.

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