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## High Energy Feeds in Inland Aquaculture

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### Abstract

Inland fish production mainly consists of capture based fishing activities and is mainly dependent on exotic species such as *Tilapia* sp., Indian carps and Chinese carps. However, sustainability of aquaculture production depends on proper feeding and farm management. Feeding of fish has become one of the critical management practices today, as it occupies 50-60% from the total cost of production. Of the feed ingredients, protein source is one of the expensive ingredients in the formulated feed. Fish meal is still an essential ingredient in the diets and it is also an expensive feed ingredient compared to other protein sources and thus represents a significant cost element in feed and production cost.

### Introduction

Feeding fish in water environment is quite different than that of land animals. While feeding fish, the nutrient contribution of natural aquatic organisms in ponds, the effects of feeding on water quality and the loss of nutrients if the feed is not consumed immediately are taken into consideration.

Energy requirements are lower for fish than for warm-blooded animals and hence fish requires a higher dietary protein to energy ratio. Fish require some lipids which terrestrial animals do not, such as  $\omega$ -3 fatty acids for some species. Fish have got ability to absorb soluble minerals from the water. Fish are not fed *ad lib.* like livestock and poultry and their feed allowances are based on mode of feeding. Hence, feed allowance influences the dietary nutrient requirements for maximum growth. As fish are fed in water, the feed that is not consumed within a reasonable time leads not only to economic losses but also greatly reduces water quality. Therefore, feed allowance, feeding method and water stability of feeds are very important considerations for aquaculture. Fish convert feeds into body tissue more efficiently than do farm animals.

Fish requires energy and other nutrients for growth, reproduction and health. Growth is characterized primarily by an increase in protein, minerals and water. Energy yielding nutrients such as lipid and carbohydrate are important to support the growth process, and an adequate supply of vitamins is also required. These nutrients may come from natural aquatic organisms or prepared feed. However, in contemporary aquaculture prepared feeds from commercial foodstuffs are the primary source. Thus a familiarization with the nutrients and their sources, requirement and role in metabolism are necessary for successful aquaculture.

Nutritional requirements must be balanced so that the fish will have enough essential nutrients for optimum growth. All types of formulated fish diet must satisfy the nutritional requirements of the cultured species in terms of proteins

(essential amino acids), lipids (essential fatty acids), energy, vitamins and minerals.

### Carbohydrates/ Energy

**C**arbohydrates are important, less expensive and immediate source of energy. Besides, dietary carbohydrates provide carbon chains necessary for the synthesis of physiologically important biochemicals such as steroids, fatty acids and chitin. The high assimilation of carbohydrates may be related to high activities of specific carbohydrates particularly chitinases and cellulases.

### Energy

**P**rotein and lipids are the primary sources of metabolic energy followed by carbohydrate in fish. The energy level in carp diets are normally maintained at 3.5-4.0 kcal g<sup>-1</sup>. Under the conditions where energy intake is inadequate, fish derive energy first from protein at the cost of flesh growth. Excess protein is not only wasteful but also causes stress to fish while excess energy is known to induce lipogenesis thus necessitating a balance between protein and energy in diet formulation.

### Protein and Amino Acids

**I**n fish nutrition, protein is the most important nutrient promoting growth and is the major component of body tissues. Since protein acts both as structural component and as most preferred energy source, its requirement for fish is more than the mammals. As protein rich ingredients are costlier, therefore, it is necessary to ascertain the qualitative and quantitative requirements of dietary protein in order to reduce the cost of feed. Fishes are ammonotelic which excrete ammonia as the end product of protein metabolism. Ammonia is diffused to water through gills. The excretion of ammonia demands lesser amount of energy (4.1 kcal g<sup>-1</sup>) in comparison to ureotelic mammals and uricotelic birds. Hence, fishes utilize protein more efficiently in comparison to other terrestrial animals.

### Lipids and Fatty Acids

**L**ipids are the richest energy component of feed and act as insulator and regulate body temperature. Lipids are almost completely digestible by fish and seem to be favoured over carbohydrate as an energy source. Dietary lipids, besides providing energy, serve as sources of essential fatty acids. Dietary lipids influence flavour and texture of fish feeds and also flesh quality of fish.

### Minerals and Vitamins

**M**inerals play important role in fish nutrition. Vitamins are also essential for optimum growth and physiological functions of fish, but required in small quantity as compared to energy and protein.

### Conclusion

**T**he Indian major carps viz. *Labeo rohita*, *Catla catla* and *Cirrhinus mrigala* are the predominant group of fish species native to the Indian subcontinent. These fish are produced primarily in fertilized ponds with the use of supplementary feed. Supplementary feed is found to be a useful tool for providing nutrient components and energy required for better growth and production. Animal based protein feed like fish meal is the most common ingredient of supplementary feed in fish culture practices which is the major source of protein. Fish meal is the expensive source of protein in aquaculture feed. But due to the increased demand and being expensive and shortages, plant based protein sources are also included such as soybean, ground nut oil cake and plant protein by-products, which showed good results for cultured fish species.