Fish Foods & Feeding

Fish Food and Types: Natural and Supplementary Food

Fishes are cold-blooded vertebrate aquatic animals. They prefer to feed various types of food due to their different food and feeding habits. Among them, some feed on plant-based food and some like to eat animal-based foods while many fish species take both plants and animals-based food and they are known as omnivorous. In this case, live fish foods play an important role in aquaculture. Some fishes only prefer food as phytoplankton and zooplankton and called plankton feeders. The most important zooplankton are various types of protozoans, crustaceans, rotifers, microscopic invertebrates, insect larvae, fish eggs, etc.

Fishes also feed on comparatively larger animals such as different oligochaetes, mollusks, small-sized fishes, tadpole and frogs. Many plant materials are also consumed by fishes including different types of algae (both unicellular and filamentous), some feed on portions of higher aquatic plants such as *Azola*, water hyacinth, *Hydrilla, Spirogyra*, etc. Besides these, some fish species also take a very small amount of sand and mud with their other foods.

Food Types

Fish food can be divided into two main types:

1. Natural food and
2. Supplementary food or artificial food.

Natural Fish Food

Different types of food are produced naturally in ponds or reservoirs. These are called natural foods. They are very small and their movements depend on the direction of the water current that helps goes towards them. They are known as plankton. Plankton can be seen in all types of reservoirs, except for high flowing rivers. Plankton is one of the small flora and fauna whose movement capacity is so limited that they cannot cross the stream. Therefore, in most aquatic environments, movements of a large number of plankton species are controlled by wave and water currents. Most plankton (phytoplankton and zooplankton) can control vertical expansion through a slight movement. Some animal plankton or zooplankton can be more active and move more distances than their microbial bodies. However, their size is so small that their

movement is greatly controlled through the water current or wave. This type of plankton is called nektoplankton.

Plankton are of two the following types:

1. Phytoplankton
2. Zooplankton

Phytoplankton

Phytoplankton are the autotrophic organisms that play a key role as the natural food of various fish species. Most of the phytoplankton are not seen by the naked eye due to their microscopic structure. But when present in large enough, they produce coloured patches on the water surface because of the presence of chlorophyll, phycobiliproteins or xanthophylls in their cells. Phytoplankton form about one percent of the global biomass. The watercolour becomes green to yellow or green to brown due to the presence of plankton. They are the ideal food for fish.

Green Algae

They are a portion of very popular fish food. Their main feature is the presence of chlorophyll or green particles in the body. Sometimes water surface is covered by a layer due to the abundance of such green algae and afterward, the water is polluted. Among the various green algae, *Chlorella, Chlamydomonas, Eudorina, Volvox, Scenedesmus*, and *Ulothrix* are notable. These kinds of algae do not live for a long time. Overall, they are regulated when fertilizer and supplementary foods are stopped.

Blue-Green Algae

They are also plant-like microscopic organisms that grow in water bodies such as ponds, rivers, lakes, and streams. They are blue-green but can also be olive-green or red in colour. They also play important fish food while alive and dead. Blue-green algae do not normally visible in the water, but their populations can increase rapidly to form a large mass or scum, known as bloom. The bloom can cause harm to fish because they prevent sunlight into water bodies and make the depletion of oxygen level. The bloom commonly occurs during the summer months and when they form dense blooms then they make the water look bluish-green colour. Generally, if nutrients like phosphorus and nitrogen are available in the water that contributes to the growth of the blue-green algae. The algal bloom can also occur due to agricultural and stormwater runoff and leaching from septic systems.

Harmful Effects of Algal Bloom

If the large numbers of algae grow in the water body, they consume a lot of oxygen at night and the water body becomes an oxygen-free state. As a result, fish die due to a lack of oxygen. In addition, the plants also die and fall into the water and reduce oxygen in the water.

If the growth of algae is high, two layers are formed on the water surface. Temperature and oxygen content greatly vary in these two levels which is harmful to fish. Temperatures and oxygen levels are higher in the upper layers of the water, while the temperatures and oxygen in the lower levels are very low. In this case, the sunlight cannot reach the bottom of the water body because of the layer of algal blooms.

The pH of water also increases abnormally during the day time due to the abundance of algae. Besides, different blue-green algae such as *Oscillatoria*, Microsystis, etc. release toxin in the water which inhibits the growth of different zooplankton such as *Daphnia, Cyclops, Diaptomus, Bosmina* as well as fish.

Preventing Measures of Algal Bloom. The following simple steps should be taken to prevent the growth of blue-green algae:

- Using phosphate-free detergents, and household cleaning products.
- You can also prevent it by providing personal care.
- By stopping or minimizing the application of fertilizers that contain phosphorus.
- Preventing agricultural runoff by making plantation along the waterways.
- Making reconstruction of natural shoreline on the lake and other water bodies.
- By confirming or checking the septic system that does not leak into the water source.

Zooplankton

Plankton play a crucial role in aquaculture. Zooplankton are one kind of heterotrophic organisms. They mainly feed on phytoplankton but some are detritivorous. Their body size range from microscopic to large-sized such as jellyfish which are visible in the naked eye. They inhabit different types of water bodies such as the freshwater system and oceans. Zooplankton are the ecologically important organisms that maintain the essential constituent of the food chain. They are larger than phytoplankton. When many numbers of zooplankton are raised in the water bodies, the watercolor is gray or light brown or light black. They are the main food of fish larvae and fingerlings. Among zooplankton, some types of lower animals are available in the reservoir, known as rotifers. These are the favorite fish food.

Supplementary or Artificial Fish Foods

When we cultivate fish in large quantities and raise them, then it will not depend only on natural food. They have to provide supplementary or artificial foods made from outside. Besides, if we depend only on natural foods, they can disrupt the entire nutrition of fish. In addition, organic and inorganic fertilizers are also needed in connection with a fish meal in the water body to produce the right amount of natural food. In this case, we can provide organic fertilizers such as cow dung, compost, earthworm, various types of sugarcane products and inorganic fertilizers like ammonium sulfate, urea, single super phosphate(SSP), murate of potash(MP) and so on which influence the growth of natural foods such as plankton (phytoplankton and zooplankton). We can also provide lime regularly into the water body that enhances the health of fish, purity of water and ability to make fish food. Besides these, about ten types of amino-acids are needed in the nutrition for cultivated fish. These amino acids are called essential amino acids. These include:

1. Arginine,
2. Histidine,
3. Isoleucine,
4. Lucine,
5. Lysine,
6. Methionine,
7. Tryptophan,
8. Phenylalanine,
9. Threonine and
10. Valine.

In the supplementary diet, the required amino-acids should be at the appropriate levels. Fish food should contain 35% of protein levels. Carbohydrates are also very important nutrient components for fish. This carbohydrate generates the energy of the fish body.

Fish can store additional carbohydrates in the liver in the form of glycogen or stored in the body's muscle and when needed, they can use it. About 4 kilocalories of energy are found in almost every gram of carbohydrates. The supplementary diet of fish should contain a good percent of carbohydrates. In addition to carbohydrates, fish need to be fat for nutrition. Food should contain 4-8 percent fat. Essential fats like tocopherol should be present in the diet of fish. Besides, protein, carbohydrates and fats, the body of the fish requires various nutrients such as minerals like calcium(Ca), phosphorus(P), potassium(K), chloride(Cl), magnesium(Mg), zinc(Zn), copper(Cu), iodine(I), iron(Fe), etc.

To make a balanced diet vitamin should be added to the supplementary food. In this case, different types of vitamins such as Vitamin A, Vitamin B (riboflavin, pyridoxine,

niacin), Vitamin E Vitamin D and Vitamin K are the most important. Supplemental food of fish is also made using animal-based ingredients such as fish powder, silkworm pupa, animal, slaughterhouse meat and blood, etc. Plant-based ingredients such as mustard oil cake, coconut cake, soybean meal, rice bran, wheat flour, wheat bran, etc are also used to make fish food.

Features of Supplementary Food

The availability and low cost of plant-based foods such as rice grain, rice bran, etc are usually used to make supplementary food in combination with mustard oil cake, or groundnut cake. They also reduce the cost of production. The price of coconut cake is relatively high, so the use of mustard oil cake is more prevalent. Artificial Feed Selection Criteria for Fish

Ingredients for artificial foods should be cheap and locally available. Palatable feed ingredients should be selected so that fish can be easily accepted due to its palatability. You should use such types of ingredients that help to increase the fish yield so that you can earn extra money by selling your fish.

Commercial fish feed

Manufactured feeds are an important part of modern commercial aquaculture, providing the balanced nutrition needed by farmed fish. The feeds, in the form of granules or pellets, provide the nutrition in a stable and concentrated form, enabling the fish to feed efficiently and grow to their full potential. Many of the fish farmed more intensively around the world today are carnivorous, for example Atlantic salmon, trout, sea bass, and turbot. In the development of modern aquaculture, starting in the 1970s, fishmeal and fish oil were key components of the feeds for these species. They are combined with other ingredients such as vegetable proteins, cereal grains, vitamins and minerals and formed into feed pellets. Wheat, for example, is widely used as it helps to bind the ingredients in the pellets. Other forms of fish feed being used include feeds made entirely with vegetable materials for species such as carp, moist feeds preferred by some species (easier to make but more difficult to store), and trash fish — that is fish caught and fed directly to larger species being raised in aquaculture pens.

Hatchery feeds

Specialised feeds are produced for fish hatcheries. In species such as salmon and trout, the newly hatched fry first feed from their yolk sacs and then can be fed with starter feeds. Marine species such as sea bass, sea bream, flounders and turbot consume the nutrition in their yolk sacs during the first few days post hatching and then are fed for several weeks on live prey, in the form of rotifers and brine shrimp (Artemia).

Development of manufactured feeds

Until the end of World War II most fish hatcheries relied on raw meat (horse meat in particular) as a dietary staple for trout. In the early 1950s, John E. (Red) Hanson, while working for the New Mexico Game and Fish Department, began experimenting with dietary routine and dry pellet formulations. The first fish feed pellets were introduced to hatchery trout at the Red River Hatchery near Taos. The pellets resulted in improved conversion rates of food intake to fish production, and lead in turn to the wider adoption of fish pellets in hatcheries.

Sustainability

Traditionally two of the most important ingredients have been fishmeal and fish oil. These come mainly from the processing of fish from the wild catch, usually pelagic species that are generally not suited to processing for human consumption. Fish sold for human consumption attract a higher price than those used to make fishmeal. The fishmeal fisheries are often referred to as reduction fisheries. The world's largest reduction fishery is in the Pacific, off the coast of Peru and Chile and is regulated by the governments of those countries. The North Atlantic is another important source of fish for fishmeal and fish oil. Many major suppliers belong to the International Fishmeal and Fish Oil Organisation. Fishmeal is a brown, flour-like material made by specialist producers that cook, press, dry and grind the fish. The fish oil is effectively a by-product of this process that proves to be a rich source of energy and fatty acids for fish, including the important long-chain omega-3 fatty acids EPA and DHA now linked to the health benefits associated with eating oily fish such as salmon and mackerel. Fish in general also are good sources of many vitamins and minerals and are often recommended as part of a healthy diet by governmental food agencies. The current drive-in research and development is enabling aquaculture by supplementing fishmeal and fish oil with vegetable proteins and oils. Other potential raw material resources are also being explored. For example, the U.S. biotechnology company BioTork is piloting the use of raw materials such as unmarketable papaya and by-products from biodiesel production to produce fish feed components, as well as feeding agricultural waste to algae and fungi that manufacture some of the proteins and omega-3 oils needed for fish food. In 2020 scientists reported the development of a microalgae-based fish-free aquaculture feed with substantial gains in sustainability, performance, economic viability, and human health. The feed consists of protein-rich defatted biomass of *Nannochloropsis oculata* and whole cells of DHA-rich *Schizochytrium sp.* and was found to perform better in growth, weight gain, specific growth rate, best feed conversion ratio and fish nutrient content than the reference diet of ocean-derived fishmeal and fish oil

Modern fish feed

Modern fish feeds are made by grinding and mixing together ingredients such as fishmeal, vegetable proteins and binding agents such as wheat. In the current technology, fish feed extruders play a key role in production lines. Although the majority of the process of the fish

feed production occurs in the extruder, grinding and mixing can highly affect the quality of the final product. Water is added and the resulting paste is extruded through holes in a metal plate. The diameter of the holes is usually the most important parameter that sets the diameter of the pellets, which can range from less than a millimetre to over a centimetre. As the feed is extruded it is cut to form pellets of the required length. The pellets are dried and oils are added. Adjusting parameters such as temperature and pressure enables the manufacturers to make pellets that suit different fish farming methods, for example feeds that float or sink slowly and feeds suited to recirculation systems. The dry feed pellets are stable for relatively long periods, for convenient storage and distribution.

Reference

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