Importance of Live Feed in Aquaculture

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Abstract— Live food organisms include all plants (phytoplankton) and animal (zooplankton) lives grazed upon by economically important fishes. Phytoplankton's are generally eaten by zooplankton. Thus, phytoplankton forms the basis of the food chain. Live foods are able to swim in water column and are constantly available to fish and shellfish larvae are likely to stimulate larval feeding response Most of the fish and shellfish larvae in nature feed on small phytoplanktonic and zoo planktonic organisms. The success in the hatchery production of fish fingerlings for stocking in the grow-out production system is largely dependent on the availability of suitable live food for feeding fish larvae, fry and fingerlings. Live food organisms contain all the nutrients such as essential proteins, lipids, carbohydrates, vitamins, minerals, amino acids and fatty acids and hence are commonly known as "living capsules of nutrition". Providing appropriate live food at proper time play a major role in achieving maximum growth and survival of the young ones of finfish and shellfish.

Key words: Phytoplankton, Zooplankton, Fingerling, Larvae, Nutrients, Living-Capsule

I. Introduction

Aquaculture refers to the practice that involves farming economically important aquatic animals and plants under controlled conditions. Two types of larvae are found in fishes precocial and altricial. Precocial larvae are those that when yolk sac is exhausted, appear as mini-adult exhibiting fully developed fins and mature digestive system. Such fish can ingest and digest formulated diet as first food. But altricial larvae are those when the yolk sac is exhausted remain in a relatively undeveloped state. The digestive system is still rudimentary lacking a stomach. Such digestive system seems to be incapable of processing formulated diet. Live feeds are able to swim in water column and thus constantly available to the larvae. Formulated diets tend to aggregate on the water surface or sink quickly to the bottom and are thus normally less available to the larvae than the live feed. In addition the movement of live feed in the water is likely to stimulate larval feeding responses since evolutionary history has probably adapted them to attack moving prey in nature.

Zooplankton fauna is most diverse and may be used for aquaculture practices by culturing them in laboratory for fish larviculture. Compared to the production, consumption of fishes and fishery products increased tandem with the exponential human population growth, leaving huge gap between production and population. To fulfil these challenges culture of economically important fishes is must [4]. Subsequently, zooplankton densities decline due to food shortage and even fish predation pressure [7]. The littoral region is often the most diverse part of lake or river ecosystems, commonly supporting a variety of zooplanktons, their associated micro flora and a large number of animal species. Any analysis of inland water resources must address the pre-eminence of exponential human growth and utilization of freshwater resources. Small-sized zooplankton becomes predominant as they are less vulnerable to fish predation. Artificial larval feeds are no match to live food organisms in terms of acceptance, nutritional and other factors. Feeding habit of fishes in natural water bodies is different among the species but all the fishes require protein rich live food for their better growth, efficient breeding and survival [4]. Advances in live food enrichment technique have helped to boost the importance and potential of live food organisms in the raising of larval aquatic species. The success in the hatchery production of fish fingerlings for stocking in the grow-out production system is largely dependent on the availability of suitable live food for feeding fish larvae, fry and fingerlings [2]. The availability of large quantities of live foods organisms such as marine rotifer (Brachionus plicatilis and Brachionus rotundiformis) and Artemia nauplii to meet the different stages of fry production has contributed to the successful fry production of at least 60 marine finfish species and 18 species of crustaceans [2]. A common procedure during the culture of both larvae of fish and prawns is to add microalgae (i.e. "green water") to intensive culture systems together with the zooplankton prey [5], has become popular practice these days. Availability of suitable live feed organisms is one of the pre requisites in the large scale seed production of commercially important species of aqua farming. Among the wide spectrum of live food organisms, copepods and rotifers have been proved to the better food resources for fish and crustacean [1].

II. Description

A. *Zooplankton*

Zooplankton and an artificial diet containing 25% protein were provided as a feed to fry and fingerlings [4]. Zooplankton has been recognised as important source of natural food for both larvae and adults of many aqua cultural species. Most fish and prawn species rely zooplankton at some stage of their life span or other whereas some are exclusively zooplankton feeders throughout their life. Zooplankton is a valuable source of protein, amino acids, lipids, fatty acids, minerals and enzymes [12]. Zooplankton are the initial prey item for almost all fish larvae , as they switch from their yolk sacs to external feeding. Evidence from the stomach content analysis of the fingerling of Clarias gariepinus and Clarius angularis, showed that within the first few weeks of life, zooplankton are the predominant food item [3]. Live zooplankton play a vital role in the feeding of cultivable species of fishes and rotifers and copepods. Among the most widely accepted all over the world are rotifers, cladocerans and the brine shrimp. These are successfully used in hatcheries due to their high nutritive value, short generation time, capacity to grow in dense population and easy to produce in mass scale under controlled conditions [9].

There are three obvious advantages of using wild zooplankton as a live food source for the cultivation of the early larval stages of shrimp or fish species: it is the natural food source, it may be expected that its nutritional composition maximally covers the nutritional requirements of the predator larvae, especially with respect to essential fatty acids and free amino acids. The diversified composition of wild zooplankton in terms of species variety as well as ontogenetic stages assures that optimal sizes of prey organisms will be available and efficient uptake by the predator is possible at any time during the larval rearing. Depending on the harvesting potential nearby the hatchery facility , there might be a low cost involved in the harvest of this lie food compared to the infrastructure and production costs of the live food items discussed earlier [3].

B. Rotifer

In early 1960"s rotifer were considered as noxious animal in Japan. Many biologists developed methods to prevent their growth because they consume a lot of phytoplankton which is very important for maintaining homeostasis in the lake ecosystem. When rotifers bloom in ponds, the oxygen content in water deceases (Ito, 1955). In late 1960"s Branchionus plicatilis was identified as a suitable live food organism for early larval stages of marine fish. Fish larvae prefer rotifers as food just after algal feeding. Rotifers are smaller than other planktons. Many studies documented the utilization of rotifers as live food in early stages of fish and shellfish species of marine and freshwater [8] The size and their ability to be cultured at high population densities are the advantages for hatchery operation [8]. Rotifer forms an excellent initial food because of its appropriate size (130-320 μm), planktonic nature, rapid production rate, suitability for mass culture under controlled conditions, ability to grow and reproduce in high density cultures and the possibility of artificially manipulating its nutritional qualities along with the euryhaline nature [7]. In any rotifer culturing procedure, where the maximum number of individuals is desired, parthenogenetic (amictic) reproduction must be optimized and conditions avoided which cause sexual (mictic) reproduction, this produces smaller males and resting eggs.

C. Copepoda

Copepoda forms the largest division of Crustacea comprising over 6000 species. They are minute, often less than half a millimeter in length and are free swimming and abundant in freshwater habitat. The copepods constitute an important component of food chain in aquatic system. Copepods are of great ecological significance and serve as a major food source for numerous organisms including fish and crustaceans [6]. In addition to their value as a preferred live food in aquaculture, copepods have numerous potential to be used by man in diverse way [6]. Copepods are excellent food of high nutritional value for planktonic larvae of fishes and shrimp [8]. Copepods are unceasingly being highlighted as nutritionally significant live food for fishes and prawns. Biochemical studies showed that copepods are rich in proteins and EEA, which could enhance larval growth. In general copepods have high protein content (44-52%) [9]. Rotifers and copepods are important component of freshwater food chains and food webs, which play important role in trophodynamics.

D. Artemia

Among the live diets used in the larviculture of fish and shellfish, nauplii of the brine shrimp Artemia constitute the most widely used food item. It is also called as brine shrimp or sea monkey. The widely used species of Artemia is A. salina. The females can produce eggs either as a result of mating or via parthenogenesis. The thin shelled eggs hatches immediately and thick shelled eggs can remain in dormant state and forms cysts that float at the water surface and that are thrown ashore by wind and waves[4]. These cysts are metabolically inactive and do not further develop as long as they are kept dry. Upon immersion in seawater, the biconcave-shaped cysts hydrate, become spherical, and within the shell the embryo resumes its interrupted metabolism. After about 20 h the outer membrane of the cyst bursts and the embryo appears, surrounded by the hatching membrane[12]. While the embryo hangs underneath the empty shell, the development of the nauplii is completed and within a short period of time the hatching membrane is ruptured and the free-swimming nauplii is born.

E. Moina

Moina is a transparent zooplankton with thin, flexible and collapsible exoskeleton. The length of the female body varies from 0.4 mm to 1.65 mm[4]. The body consists of a large head, trunk and post abdomen. The head is usually smoothly rounded dorsally with no rostrum. A single large spherical compound eye is located at the apex of the head. The ventral part of the head bears snot like labrum, dorsal to which is a pair of mandibles. Antennules are fairly long. The trunk is enclosed in a two valved carapace and the abdomen is slightly protruding posteriorly beyond the carapace. The large second antenna which is the main swimming organ is a biramous structure with a stout basal joint from which the two branches arise. The five pairs of trunk limbs are enclosed within a ventral filter chamber of the carapace. The post abdomen bears a pair of long abdominal setae. The anus is not terminal and the conical portion beyond anus ends in a strong anal claws. Moina can be collected from brackishwater channels, pools and freshwater ponds[6].

F. Daphnia

Daphnia adult measures about 0.2-3 mm in length. Body is not distinctly segmented and is enclosed in a shell like structure referred to as Carapace[14]. Head is single with a compounded eye. Sometimes the anterior portion of head is pointed to form a helmet. Two antennas present. One is attached to head and the longer one is used for swimming. Mouth is located in the junction between head and body. Mandibles present. Intestine ends at the anus region. Thorax forms the central portion and bears 4 to 6 pairs of flattened legs. Brood chamber is located between the body wall and dorsal surface of the carapace. It reproduces parthenogenetically. Young ones are released in small batches. Daphnia feeds on algae, bacteria, fungi and organic debris[3].

G. *Infusoria*

Infusoria is a collective term for minute aquatic creatures such as ciliates, euglenoids, protozoa, unicellular algae and small invertebrates. It is generally found in green water ponds, freshwater bodies and brackishwater bodies11]. It mainly feeds on bacteria, algae, flagellates and on debris. It reproduces by sexually by conjugation and asexually by binary fission. The freshwater infusorians are used for the early stages of freshwater ornamental fish's Important infusoria in aquaculture- Paramecium and Stylonychia: Freshwater species Fabrea salina and Euplotes spp.: Marine species [10]

III. Conclusion

Even though the trend to develop artificial feed is fast replacing the live feed, some outstanding quality of live feed cannot be overlooked. The natural food is free from pollution, and it has high calorific value, greater digestibility, and good conversion efficiency. If the locally available species are used, they will be very effective and economical too. Hardy species such as Chaetoceros sp, Brachionus sp, Euterpina sp, etc., which withstand wide .fluctuations con-ditionsinvironmental and grow luxuriantly could be ideal feed for the larvae of prawns. In addition these species are available abundantly throughout the Indian coast. The diatom Chaetoceros sp, could well form the diet of The diatom Chaetoceros sp, could well form the diet of protozoeal stage, and the euryhaline B.plicatilis for the my sis stages.Artemia nauplii now being scarce and costly, a replacement could be found in harpacticoid copepods which could be fed to the post-larvae for good growth and higher survival.

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