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Exploring the intricate relationship between food availability and feeding behavior in fish larvae: A review

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Abstract

The behavior of fish larvae is related to finding food, avoiding predators, maintaining body temperature and seeking shelter. Fish larvae behavior is an action or activity carried out by fish larvae to fulfill their life needs. Several factors such as population density, level of food availability, air temperature, air quality, and lighting can affect the behavior of fish larvae. The nutritional needs of larvae are higher than adult fish, because nutrients are needed not only for activity and maintenance, but also for growth. The behavior characteristics of fish larvae towards various types of feed can vary depending on the fish species, developmental stage, and the type and quality of the feed given. The purpose of this article is to understand how the level of food availability has an impact on the destruction of life and growth of fish larvae. This preparation uses a literature review with a narrative literature review method. The results of this article can be seen in the importance of food availability in the life cycle of fish, especially in the early stages of the larvae.

Keywords: Fish behavior, fish larvae, food availability

Introduction

Fish larvae are an early stage in the fish life cycle where successful development is highly dependent on the availability of sufficient feed ^[1]. Low feed availability can negatively affect the growth and survival of fish larvae, which in turn can negatively affect fisheries production ^[2].

Basically, the success of a fishery business, especially in aquaculture, is determined by high production which is influenced by high growth and survival rates ^[3]. What affects the growth rate and survival of larvae is the availability of food, water quality, disease and pests ^[4]. The most important of these four factors is food availability ^[3]. One of the most appropriate countermeasures to shorten rearing time is to provide high-protein feed that matches the mouth opening of the larvae ^[5].

Fish larvae require more protein than adults, and the protein requirement of fish larvae in their diet varies between 35-50% ^[5]. The natural feed commonly used for fish larvae is *Artemia* ^[5]. Artificial feeds commonly used are polar red fodder and paste. ^[5]. Natural feed is food that is available in nature ^[6]. Easily digestible feed is suitable as fish larvae feed, because the digestive organs of fish larvae are still immature ^[7]. Therefore, natural feed is an appropriate larval feed to prevent high mortality of fish larvae and improve survival ^[8].

In this case, to improve the survival of fish larvae, it is necessary to use a combination of nutrients that is suitable for the needs of the fish ^[9]. In any fish species, digestive capacity increases with the age and size of the fish and with the opening of the fish mouth ^[9]. To fulfill the combination of nutrients, natural feed can be replaced with artificial feed ^[10]. The replacement should be timely according to the development of the digestive system, which is very important to promote the growth and survival of fish larvae ^[11].

Fish eggs hatch after 96-120 hours, after hatching the larvae have food reserves in the form of egg yolk that they carry since hatching, so they do not need food from outside for four days ^[9]. The larval stage is a critical stadia because many deaths occur at this stage ^[9]. When the yolk runs out, even if the fish has not found a suitable food, this transition period needs to be

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considered, starting with mixed feeding of the larvae [9]. Typical larval behavior in their foraging habitat tends to hunt prey such as rotifers and other small animals [9]. Survival is largely determined by the availability of food at the larval stage [12]. Fish survival depends on the ability of fish to adapt to food and the environment [5].

Methods

This review uses a literature review with a narrative literature review method. This method identifies, assesses, and interprets all findings on a research topic. The literature review contains a description of the theories, findings and other research materials obtained from reference materials to serve as the basis for research activities. Literature review is a comprehensive review to find rationales for research that has already been done or for further research ideas. Narrative is a series of sentences that are narrative or describe explaining, in another meaning narrative is said to be prose whose subject is a series of events. So the use of the above methods is the right way to find comparisons in research.

Discussion

Food Requirements in the Larval Phase of Fish

Nutritional requirements for larvae during development include protein, fat, carbohydrates, minerals and vitamins [13]. Nutritional requirements in larvae are higher than adult fish, because the nutrients needed are not only for activity and maintenance, but also for growth [14]. Feeding, in addition to the composition of the feed, it is also necessary to pay attention to the form of feed, the amount of feed given each day, and the frequency of feeding, because these four things affect the growth of fish [15].

In general, fish larvae need food that is easily digested and contains sufficient nutrients to support their growth and development [16]. Some types of food that are often given to fish larvae include plankton, rotifers, artemia, *Moina* sp. microalgae, and artificial feed that has been specially formulated for fish larvae [17]. Application of *Moina* sp. natural feed at different doses to Baung fish larvae resulted in an absolute length of 0.9 cm and a survival rate of 90% [23]. Meanwhile, feeding catfish larvae natural food enriched with *Moina* sp. fishmeal at the best concentration of 6 g/l produced an absolute weight gain of 0.25 g, a length gain of 2.3 cm and a survival rate of 98% [23].

Food requirements in fish larvae can also be influenced by environmental factors such as water temperature, availability of natural food, and water quality [18]. In addition, it is important to pay attention to the amount of food given to fish larvae. Too much or too little feeding can adversely affect the growth and health of fish larvae [19].

Behavioral Characteristics of Fish Larvae Towards Different Feed Types

The behavioral characteristics of fish larvae towards different types of feed can vary depending on the fish species, developmental stage, and the type and quality of feed being fed. However, in general, there are some characteristics of fish larval behavior towards different types of feed, including: Natural food, fish larvae need high quality food in order to live, the availability of natural food is a very important factor, natural food is also a source of fish food which is seen as a

high nutritional value containing calories, natural fish food is food for fish larvae such as phytoplankton, zooplankton and benthos [22]. Natural food plays a role in the main feed for marine fish and crustacean fry that still survive and cannot be replaced in nutritional quality completely by artificial feed [28]. Larval feeding behavior through changes in physical form is influenced by artificial feed during the larval phase [25].

In addition to artificial feed, fish larvae can also be fed artificial feed specifically designed to meet their nutritional needs. Behavioral characteristics of fish larvae when fed artificial feed include active foraging, fast and agile movement, and avoidance of non-preferred feed. Artificial feed or alternative feed can increase fish productivity [26].

Live feed such as artemia and rotifers are often fed to fish larvae that are still very small and unable to digest solid feed [5]. Behavioral characteristics of fish larvae when fed live feed include collecting feed with fast and agile movements, and capturing feed with their natural instinctive movements.

Fish larvae fed with supplementary feed such as silk worms or water fleas will also show the behavioral response of larval clamfish to food in their habitat tends to hunt prey such as rotifers and other small animals and their survival is largely determined by the availability of food at the larval stage [5].

The selection of the right type and quality of feed is very important in supporting the growth and health of fish larvae because the behavior of fish larvae can vary depending on environmental conditions, water hygiene, and the quality and type of feed given [5]. Feeds that respond very well to fish larvae are artemia, polar red and paste feeds are not responded at all by fish larvae [5].

Factors Affecting the Level of Food Availability of Fish Larvae

Natural food availability is an important factor in fish spawning, especially at the hatchery stage [20]. The level of fish larval food availability is influenced by various factors including environmental conditions, food availability, competition between organisms as well as the physical condition of organisms and water quality [21]. Water quality such as temperature, ammonia and nitrite levels, dissolved oxygen and hydrochloric acid (pH), as well as the ratio between feed amount and density are factors that affect the survival of fish larvae [21].

Sub-optimal water quality leads to insufficient natural food availability and causes a lack of larval food which results in mortality [21]. Untimely feeding also affects fish growth and results in poor fish larval survival [21]. The growth of fish larvae is disrupted due to lack of available feed [21].

Efforts to Overcome Low Food Availability in the Fish Larval Phase that Impacts Survival

Low food availability in the larval phase of fish can result in poor survival and growth [27]. The high mortality of fish in the larval stage can be overcome by providing food that is suitable for the larval mouth opening [29].

Specific growth rate, daily length growth rate, and daily feed consumption rate are influenced by natural feeding. Artificial feed is fed to fish larvae to overcome the low availability of natural feed [25]. Artificial feed pays attention to the composition of nutrients in making it required by fish larvae in that phase [24].

Table 1: Comparison of Feed Requirements in the Larval Phase

Fish Species	Age (Days)	Feed Form	Feed Dosage	Daily feed frequency	Source
<i>Cyprinus carpio</i>	7	Pellet halus	5%	2	[30]
<i>Oreochromis niloticus</i>	5	Pellet halus	3-5%	3	[31]
<i>Clarias sp</i>	10	<i>Tubifex sp.</i>	10%	2	[32]
<i>Pangasianodon hypophthalmus</i>	12	Pakan Komersil	40%	3	[27]
<i>Osteochilus vittatus</i>	10	<i>Moina Sp.</i>			

Conclusion

Fish larvae are an early stage in the life cycle of fish where successful development is highly dependent on adequate food availability. Therefore, low levels of food availability can adversely affect their growth. Growth and survival rates are influenced by, among others, feed availability, environmental quality, pests and diseases. One of the basic needs of aquaculture management that plays an important role is the need for feed both qualitatively and quantitatively.

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