EFFECT OF DIFFERENT LIVE FEEDS ON THE GROWTH PERFORMANCE, SURVIVAL RATE AND NUTRITIONAL PROFILES FOR EARLY LIFE STAGES OF NILE TILAPIA (*OREOCHROMIS NILOTICUS*) (LINNAEUS, 1758)*

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Abstract

The success of larval rearing depends mainly on the availability of optimal diets during their growth stages. Live feed is considered to be critically important for larviculture of aquatic animals. Different live feed will affect the growth and survival rate of fish larvae. The objectives of present study are to assess the growth and survival rate of Tilapia fingerlings feeding on the different live feed and to analyze the nutrient composition (moisture, protein, lipid, and ash) of Tilapia treated with three kinds of live feed. The research was carried out in the Wet Lab and Live food Laboratories, Fisheries and Aquaculture, Department of Zoology, University of Yangon. Three kinds of live feed, freshwater rotifer, water fleas (*Moina*), and *Haematococcus* sp. were used in the present study. Firstly, three kinds of live feeds were inoculated to obtain the sufficient amount of feed for the experiment. Rotifer species were fed on *Chlorella* sp. during the culturing period. Similarly, *Moina* species was cultured by using shrimp powder and rice bran (1:1) as feed in this species. *Haematococcus* sp. by using nutrient media. Tilapia fingerlings were introduced with different livefood after completing the mass production of live foods. Three experimental designs were set up for Tilapia culture. Experiment I was fed with Rotifer, experiment II with *Moina* while Experiment III was treated with *Haematococcus* sp. Each experiment was set up in triplicate. A total of 25 fingerlings were introduced in each tank for rearing period 35 days. Sampling was carried out at seven days interval. The highest length-specific growth rate was observed in the group fed with Moina (1.546%), followed by the *Haematococcus*-fed group (1.343%), and, in turn, the Rotifer-fed group (0.864%). The maximum weight-specific growth rate was observed in the Moina-fed group (5.254%), followed by the Rotifer-fed group (4.769%), and then the *Haematococcus*-fed group (4.508%). There was no significant difference on both specific growth rate (length and weight) and the survival rate of Tilapia fingerlings among the various treatments. The nutritional composition (moisture, protein, lipids, and ash) of Tilapia fingerlings varied with different live feed. According to the result, *Moina* is considered as the most appropriate live food when they were tested.

Keywords: Tilapia fingerling, Live feeds, Mass production, Survival rate, Growth rate, Nutritional value

Introduction

Over the past two decades, aquaculture, or fish farming, has experienced rapid growth in Myanmar, assuming an increasingly significant role in the nation's fish supply (Belton, *et al*., 2015). The Ayeyarwady Region comprises 50 percent of the total aquaculture fishpond area, followed by the Yangon Region (27 percent) and the Bago Region (13 percent). In aquaculture fishponds, Burmese farmers cultivate over 20 species of freshwater fish, including Indian major carps, Grass carp, Mrigal carp, Silver carp, Chinese carps, Tilapia, Pangasius, Striped catfish, Catla, Rohu, Common carp, Walking catfish, and Pacu (USDA, 2022). Tilapia has been reported as the most important aquaculture species of the 21st century (Shelton, 2002). Tilapia is an excellent species for aquaculture due to its high tolerance to adverse environmental conditions, relatively fast growth, resistance to disease, excellent quality of its firm-textured flesh, short generation time, and appealing taste to consumers (Corpei, 2001). In the late 1990s, improved

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strains of the larger Nile tilapia (*Oreochromis niloticus*) were introduced and observed to exhibit faster growth. Soon after, tilapia barbecue become as one of the most popular fish dishes in restaurants, pubs, and roadside stalls. The current annual tilapia harvest stands at approximately 45,000 metric tons, with the vast majority being sold in the domestic market. Myanmar boasts one of the highest annual per capita consumption rates in the world, with individuals consuming 56 kilograms per person (Holmyard, 2017). In 2016, WorldFish Myanmar introduced GIFT into the Hlawgar Hatchery in Yangon Region and Daedeye Hatchery in the Ayeyarwady Delta in collaboration with the DOF to enhanced tilapia aquaculture in the country (Lwin, *et al.*, 2022). Tilapia is extensively cultured by both smallholder farmers and commercial intensive operators in Myanmar. In recent times, tilapia species are extensively cultured in intensive farms due to high demand from local consumers and an increasing demand from restaurants and barbecue shops (FAO, 2002). Therefore, a substantial number of tilapia seeds are required for production in culture system.

When Tilapia larvae or fry are maintained in a larva rearing tank, their growth and survival rates are crucial to obtain a high yield at harvest time. The larvae need to be fed as soon as the yolk sac disappears. If not fed, the larvae may die. The success of larval rearing depends mainly on the availability of optimal diets that are easily consumed, efficiently digested, and provide the required nutrients to support good growth, survival, and health (Giri *et al*., 2002). Live food organisms are able to swim in water column and are constantly available to larvae of aquatic animals. Live feeds play an important role in the aquaculture production of various fish larvae (Das, *et al.,* 2012).

The success of aquaculture relies on maintaining a healthy cultured stock. To achieve a disease-free, healthy stock, it is essential to provide live feed along with supplemented artificial feed. In terms of acceptance, nutritional content, and other factors, artificial larval feeds cannot match live feed. Live food organisms, often referred to as “Living capsules of Nutrition”, contain essential proteins, lipids, carbohydrates, vitamins, minerals, amino acids, and fatty acids.

In this study, various live feeds were produced in the laboratory to determine the optimal live feed species crucial for survival and growth performance of fish during early life stages. The fish were then subjected to three different types of live feed, and their growth and survival rates were measured. Additionally, the nutritional composition of the experimental groups was estimate to elucidate the impact of different live foods on fish. Therefore, the present research aimed to assess the suitable live feed for the early life stages of Tilapia, with the following objectives:

- To produce the mass production of different live feed (Rotifer, *Moina* sp., and *Haematococcus* sp.,) for Tilapia fingerlings
- To examine the growth and survival rate of Tilapia fingerlings with various live feeds
- To analyze the nutrient composition (moisture, protein, lipid, and ash) of Tilapia fingerlings treated with different live feeds

Materials and Methods

The research was conducted in the Wet Laboratory and livefood Laboratory, Fisheries and Aquaculture, Department of Zoology, University of Yangon (Fig. 1).

Figure. 1. Map of the study area, Fisheries and Aquaculture, Department of Zoology (Source: Google)

The study period lasted from April 2022 to May 2023.

The tilapia fingerling (2-3 cm) was obtained from Department of Fisheries, Hlaw-Ga Fisheries Experimental station, Yangon.

Preparation of Live Feeds

Three kinds of life feed, freshwater rotifer, water fleas (*Moina*), and *Haematococcus* sp. were used in the present study.

Culture of Fresh water Rotifer

Fresh water Rotifer with a size range of approx. 90-100 µm in length was cultured in the Livefood Laboratory, Fisheries and Aquaculture, Department of Zoology, University of Yangon. *Chlorella* sp. were used as feed for Rotifer species during the cultured period. The density of Rotifer was determined daily with Sedgwick Rafter counter and Microscope (100x magnification). Partial harvests of Rotifer were conducted regularly, serving as live feed for Tilapia fingerling being cultured in the experimental tanks.

Culture of Water fleas (*Moina*)

Water fleas (*Moina*) were cultured in the same laboratory. A mixture of shrimp powder and rice bran (1:1) served as the feed for *Moina* sp. throughout the cultured period. Once the *Moina* population in the cultured tanks reached approx. 30-50 individual per mL, they were harvested to be used as food for tilapia fingerlings.

Culture of Microalgae Haematococcus sp.

Haematococcus sp. was cultured using fertilizer in the Live food laboratory. The growth of *Haematococcus* sp. population was monitored using a Hemocytometer and a Microscope with 100x magnification. On the sixth day, when the population density reached its peak at approximately 15,000 cell mL^{-1}, they were partly harvested as live feed for Tilapia fingerlings.

Water quality parameters were recorded daily during live food (Rotifer, *Moina*, and *Haematococcus* sp.) cultured period.

Experimental Design

Three experimental designs were set up for Tilapia culture. Experiment I was fed with Rotifer, experiment II with *Moina* while Experiment III was treated with *Haematococcus* sp. Each experiment was set up in triplicate. A total of 9 aquaria (120cm×60cm×45cm) was used for the experiment. All the aquaria were filled up with water and labeled according to the experimental design. The aerator was used continuously for 24 hours throughout the experimental period. A total of 25 fingerlings was added to each aquarium. On the first day, no feed was given. Starting from the second day of stocking, the fish were provided with feed at a rate of 5% of their body weight. Feed was consistently supplied based on the body weight of the fish. The experiment was conducted in triplicate for each live food variant. Tilapia fingerlings were cultured for a duration of 35 days. Sampling was carried out on the 7th, 14th, 21nd, and 28th, and 35th days of the experimental period, with subsequent measurement of individual fish's length and weight for further analysis.

The survival rate of fingerlings was recorded throughout the study period. Water quality parameters (pH, temperature, DO, and ammonia) were also analyzed daily. At the end of the experiment, fish samples were analyzed for the nutritional values (ash, lipid, protein, and moisture) by Association of Official Analytical Chemists (AOAC, 1995) at Fish Nutrition Laboratory, Department of Fisheries (DoF), Yangon.

Data Analysis

The growth and survival rates of the studied species were determined using the following formulae according to (El-gamal, 2009 and Naeem *et al*., 2011).

Length-specific growth rate = [(In final length – In initial length)] / days of rearing x 100

Weight-specific growth rate = [(In final weight – In initial weight)] / days of rearing x 100

Survival rate = (final number of fish / initial number of fish) x 100

Significant differences in growth and survival rate were tested using a one-way analysis of variance (ANOVA).

Results

The specific growth rate and survival rate of Tilapia fingerlings, which were fed with different live feeds (freshwater rotifer, water fleas (*Moina*), and *Haematococcus* sp.), were calculated at the end of the experiment. Moreover, the nutritional compositions of these study species were analyzed.

Firstly, three kinds of live feeds were inoculated in the Livefood Laboratory to obtain the sufficient amount of feed for the experiment. The highest population densities of rotifer (100 ind/mL) were found in 6th day, those of Moina (30 ind/mL) in 5th day, and those of *Haematococcus* sp. (9.00×10^6 cells/mL) in 6th day of culture period (Fig. 2, Fig. 3, and Fig. 4). Tilapia fingerlings were introduced with different livefood after completing the mass production of livefood.

The highest length-specific growth rate was observed in the group fed with Moina (1.546%), followed by the *Haematococcus*-fed group (1.343%), and, in turn, the Rotifer-fed group (0.864%) (Fig. 5). The maximum weight-specific growth rate was observed in the Moina-fed group (5.254%), followed by the Rotifer-fed group (4.769%), and then the *Haematococcus*-fed group (4.508%) (Fig. 6). The highest survival rate was observed in Rotifer-fed group (84%), followed by *Moina* (80%) and *Haematococcus* (72%) (Fig. 7). There was no significant difference on both specific growth rate (length and weight) and the survival rate of Tilapia fingerlings among the various treatments.

The nutritional composition (moisture, protein, lipids, and ash) of Tilapia fingerlings was varied with different live feed (Fig. 8). The protein content of Tilapia fingerlings was found to be highest in the Moina-fed group, while the moisture, lipid, and ash contents were highest in the Rotifer-fed group.

It was observed that there was no significant difference in water quality parameters among different treatments (Table 1). The range of temperature from (26.6 ± 0.95°C) to (26.8 ± 0.94°C), dissolved oxygen (DO) from (5.9 ± 0.28) mg/L to (5.97 ± 0.32) mg/L, and pH from (7.9 ± 0.03) to (7.913 ± 0.01) were recorded among different treatments throughout the study period. The value of ammonia was not detected during the study period.

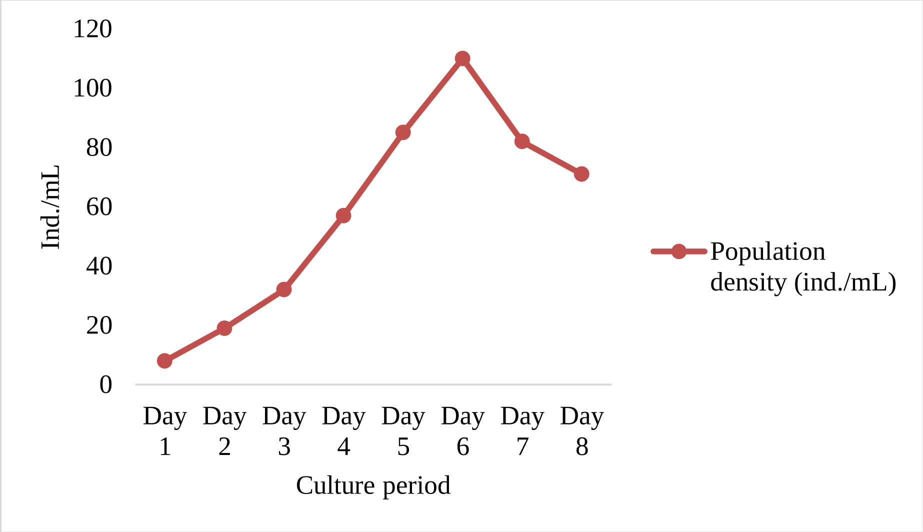

Figure. 2. The curve of population density of Rotifer *Brachionus* sp.

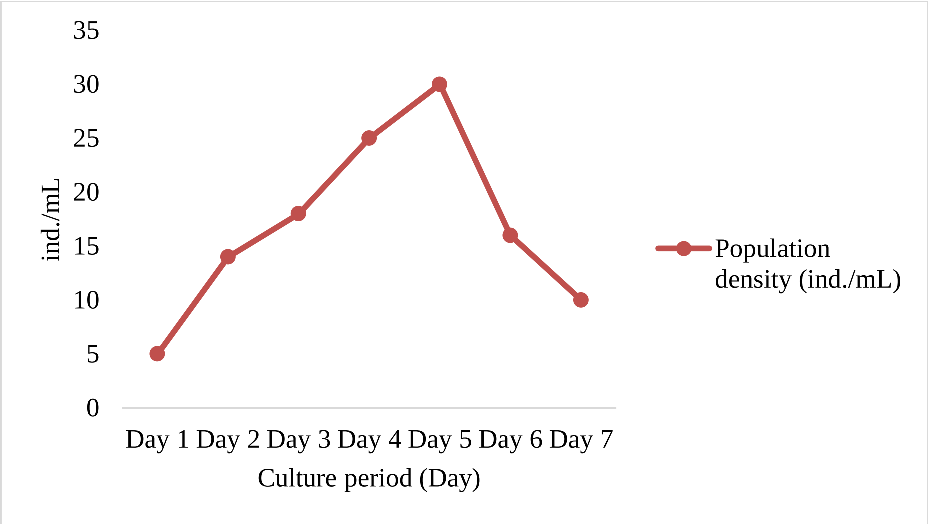

Figure. 3. The curve of population density of Moina

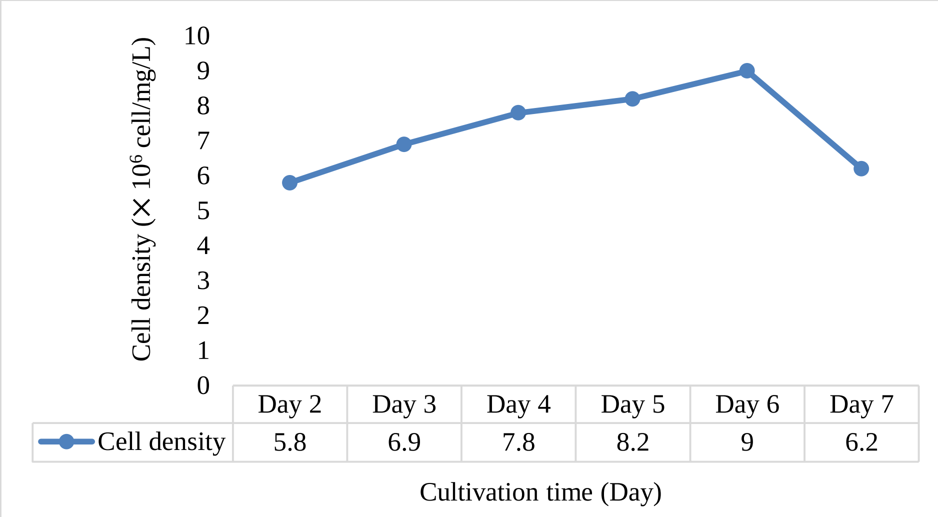

Figure. 4. The curve of population density of *Haematococcus* sp.

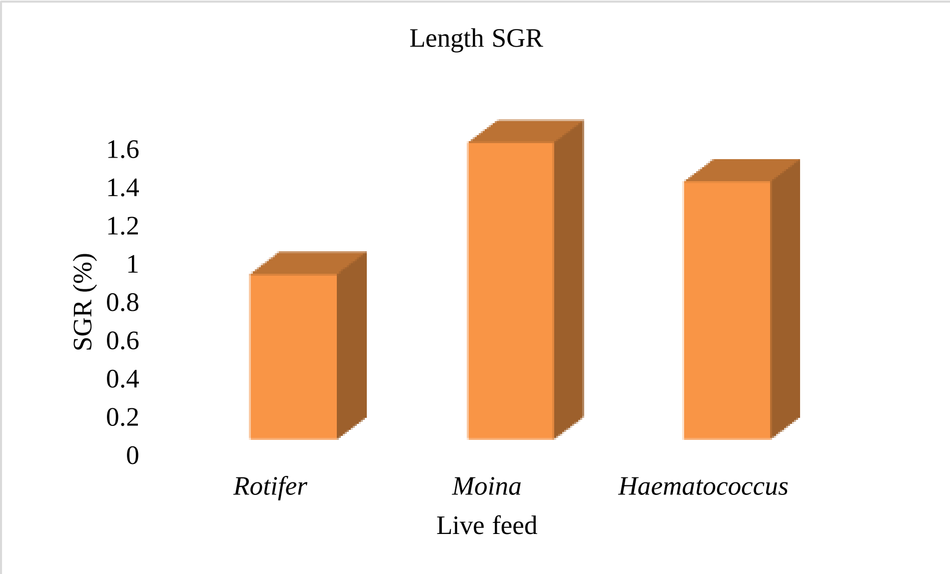

Figure. 5. Length Specific Growth Rate of Tilapia fingerlings treated with different live feed

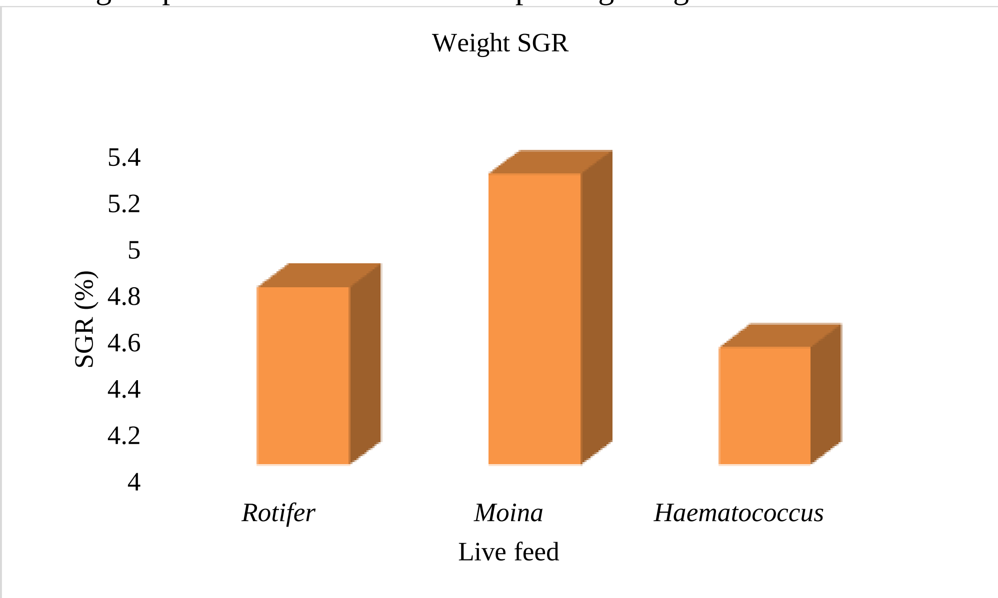

Figure. 6. Weight Specific Growth Rate of Tilapia fingerlings treated with different live feed

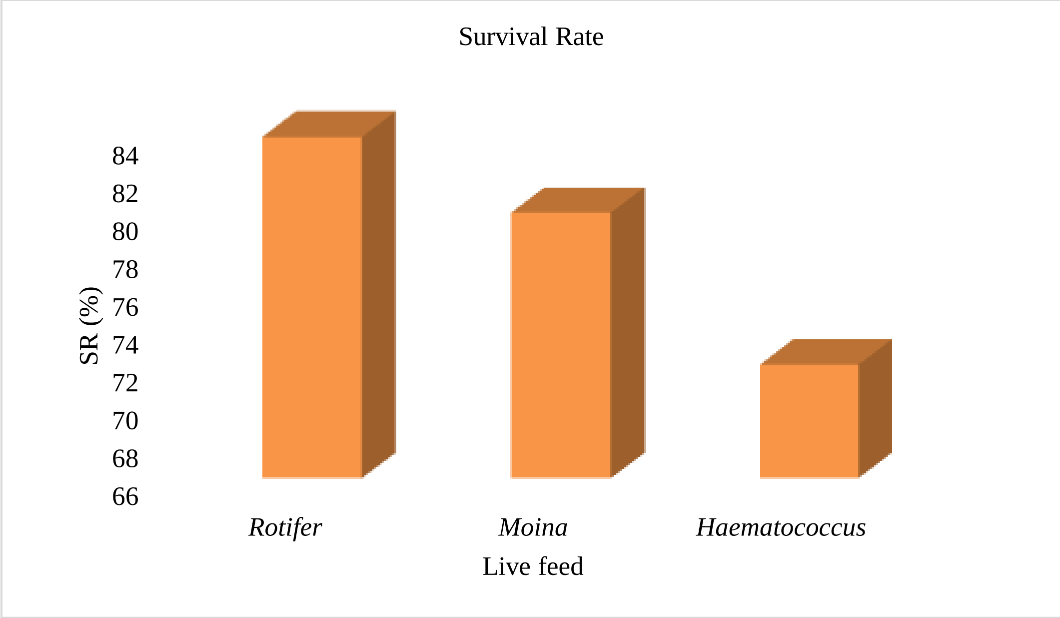

Figure. 7. Survival Rate of Tilapia fingerlings treated with different live feed

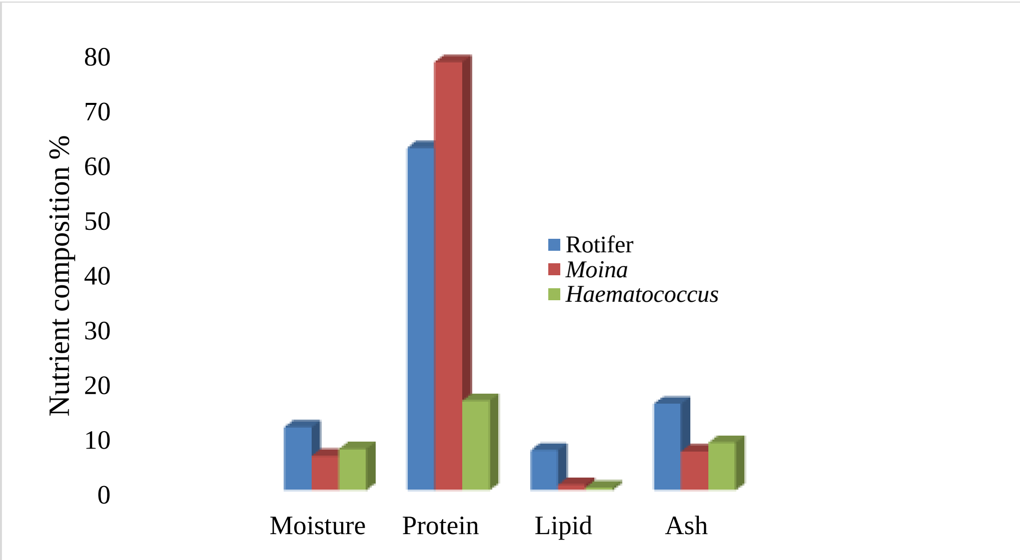

Figure. 8. Nutrient composition of Tilapia fingerlings treated with different live feed

Table 1 Water quality parameters in Nile tilapia, *Oreochromis niloticus* cultured tank under different treatment during the study period

Live feed	T (°C)			DO (mg/L)			pH			Ammonia (mg/L)		
	Mean	±	SD	Mean	±	SD	Mean	±	SD	Mea	±	SD
Rotifer	26.809	±	0.9420	5.915	±	0.353	7.913	±	0.01	0	±	0
Moina	26.738	±	0.945	5.972	±	0.315	7.906	±	0.01	0	±	0
Haematococcus	26.603	±	0.948	5.904	±	0.281	7.9	±	0.03	0	±	0

Discussion

Larval rearing is one of the most difficult points in aquaculture due to its high mortality. The risk of mortality can be overcome by feeding suitable live feed. In the present study, three kinds of live feed (Rotifer, *Moina*, and *Hametococcus*) were cultured as food for Tilapia fish larvae. Production of nutritious Rotifers depends on the production of microalgae used to feed them. Many researchers have recently chosen *Moina macrocopa* as a potential live feed to be studied as food sources for tilapia fry rearing (Ramesh *et al*., 2014). *Moina* species are an important source of essential nutrients such as amino acids, protein, lipids, fatty acids, enzymes and vitamins (El-Naggar *et al.*, 2019). Rice bran and shrimp powder are potential feed for *Moina* since they contain various nutrients such as protein (12–13%), lipid (16–20%), linoleic acid, acids α linolenate, vitamin B (Faria *et al*., 2012; Murtaza *et al*., 2011). So, rice bran and shrimp powder are used as the food source for *Moina* species in the present study.

Haematococcus sp. is a unicellular freshwater microalga that is a promising source of bioactive substances, such as carotenoids, proteins, and fatty acids (FAs), particularly astaxanthin, a powerful antioxidant (Mehariya, *et al.*, 2020). *Haematococcus* sp. was inoculated with nutritive media as feed for Tilapia fingerlings in the current experiment. The highest population density was reached in the 6^{th} day of culture period (9.00×10^6 cells /mL) in the present study.

The specific growth rate and survival rate of Tilapia fingerlings were calculated at the end of the experiment to assess their growth performance. The highest length-specific growth rate was observed in the group fed with *Moina* (1.546%), followed by the *Haematococcus*-fed group (1.343%), and, in turn, the Rotifer-fed group (0.864%). The maximum weight-specific growth rate was observed in the Moina-fed group (5.254%), followed by the Rotifer-fed group (4.769%), and then the *Haematococcus*-fed group (4.508%). Statistical analysis of the average Specific Growth Rate (SGR) among treatments reveals that there is no significant difference ($p > 0.05$) in both body length and body weight. Hussain *et al*., (1987) recorded that the survival rate of Tilapia ranged from 82% to 90% by feeding on live feed. In the present study, the highest survival rate was observed in tilapia fingerlings fed with Rotifers (84%), *Moina* (80%) and *Haematococcus* (72%). There was no significant difference ($p>0.05$) in the survival rate of Tilapia fingerlings among the various treatments. According to Rocha *et al.*, (2017), the utilization of zooplankton as an initial feed for fish larvae, such as in the rearing of codfish larvae, can enhance fish growth and survival. Compared to artificial feed, live feed contains relatively higher nutrients and is easily obtained at relatively low costs. It also has a size that matches the mouth opening of the fish, particularly the size of the fingerlings (Putra, *et al.*, 2019). So, live feed was observed as ideal feed for survival and growth of Tilapia fingerlings in this study.

The nutrient compositions of Tilapia fingerlings after 35 days rearing period were analyzed. The highest moisture content was recorded in Tilapia fingerlings that fed on Rotifer (11.51%) followed by *Haematococcus* (7.56%) and *Moina* (6.28%). A feed that contains a high protein content is favorable because it serves as the essential nutrient provider that supports fish development and survival (Rocha *et al*., 2017; Karlsen *et al.*, 2015). Furthermore, the lipid content in Tilapia fry varied with the different nutrient used for live feed. Both protein and lipids are essential nutrients that play a significant role in the rearing of fish fry (Radhakrishnan *et al*., 2020). In the present study, tilapia fingerlings that were fed Miona enriched with rice bran exhibited the highest protein content (78.12%), while the highest lipid content was found in Tilapia fingerlings that feed on Rotifer (7.3%). The percentage of ash in Tilapia fingerlings that consumed various live feeds was 7.1% for Moina, 8.7% for *Haematococcus*, and 15.8% for Rotifer, respectively. Ash comprises various minerals that play essential roles in the structural integrity of organisms, such as calcium, magnesium, phosphorus, iron, zinc, and so on (Pilot, 2014).

Water quality is very importance in aquaculture farming. Maintaining balanced levels of water quality parameters is essential for both the health and growth of farmed aquatic species.

Water temperature can affect the metabolism, feeding rates, and the degree of ammonia toxicity in fish and shrimp. The temperature range was 26.81±0.94°C to 26.60± 0.95°C during the experimental period. De Verdal *et al.,* (2018) observed that the water temperature plays a key role in regulating the metabolic processes of fish. The optimum temperature for Tilapia culture is 26°C to 32°C (Khan *et al.*, 2008). The water temperature in the experimental tanks was found to be suitable for the culture unit. In this experiment, no value of ammonia was detected because live feed can reduce the water quality deterioration. Dissolved oxygen concentration is an important water quality parameter that affects the growth and survival of fish. A reduction in dissolved oxygen content has negative effects on the growth, reproduction, and other biological activities of fish, and extremely low dissolved oxygen levels can be lethal to fish. Tilapia can tolerate dissolved oxygen concentrations as low as 0.1 mg/L (Dan and Little, 2000). In the present study, the average value of DO was around 5.97±0.32 mg/L in each treatment during the study period. A higher level of dissolved oxygen concentration was recorded in the experimental tanks as a result of aeration throughout the experiment. The level of pH was found to be optimal range 7.9±0.03 to 7.913±0.01during the experiments. In the current study, water quality was found to be improved as the Tilapia fingerlings fed on live feed. The ideal pH range for fish life is 6.5 to 9.0, while pH values below 4 and above 11 leads to fish mortality (Craig, and Helfrich, 2009).

Conclusion

This research was provided what kind of live food is the best for the growth and survival rate of Tilapia fingerling. The information was valuable knowledge for Tilapia aquaculture in Myanmar. In addition, the composition of the nutritional value of experimental fish was evaluated intend to produce high protein fish for human consumption. We contribute the information to the farmers as well as to the researchers on how to produce live feed for Tilapia to obtain a high yield in the aquaculture farm. The findings of this study indicated that for aquaculture purposes, tilapia fingerlings can be successfully cultivated in aquatic environments with different live feeds, leading to increased fish production and improved economic returns.

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