MONITORING THE UTILIZATION OF NATURAL FEED (*BRACHIONUS PLICATILIS*) DURING THE CULTURE OF MILK FISH (*CHANOS CHANOS*) BASED ON ARTIFICIAL INTELLIGENCE

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Abstract

Milkfish hatchery production is highly dependent on sustainable natural food supplies such as *Chlorella sp.* and rotifers (*Brachionus plicatilis*). The amount of feed consumption in larval rearing has a dominant effect on fish growth. Calculation of the amount of natural feed consumed by milkfish larvae and controlling water quality needs to be improved by utilizing artificial intelligence so that the calculations and controls carried out will be more efficient. This study aims to determine the amount of daily consumption of natural food for milkfish larvae and analyze the relationship between daily consumption of natural food and the growth of milkfish larvae monitored using artificial intelligence. This research was conducted in October 2022 at the Ecosystem Captive and Rehabilitation Laboratory, Faculty of Marine Science and Fisheries, Hasanuddin University, Makassar. The test animals used were milkfish larvae aged 1 day at a density of 30 fish/L. Milkfish larvae were reared using a 12 L volume aquarium and feed *Chlorella sp.* and *Brachionus plicatilis* with different densities. The study was designed using a completely randomized design (CRD) consisting of 3 density treatments with 3 replications each, namely 25, 50 and 75 ind/ml. Daily consumption of natural feed and water quality will be monitored using artificial intelligence. The results showed that under normal conditions the larvae were able to consume up to 0 ind/ml of the total amount of rotifer feeding, this indicated that rotifers were a good type of natural feed given to the milkfish larval stage. Based on the results of the study it can be concluded thatthe daily amount of feed consumed by milkfish larvae from different treatments monitored using artificial intelligence has the same effect on milkfish larvae, and there is a relationship between daily feed consumption on the growth of milkfish larvae monitored using artificial intelligence.

***Keywords**: Branchionus plicatilis, Chanos chanos, Artificial Intelligence, Larvae, Natural Feed*

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1. Introduction

One of the factors that influence cultivar life and the success of cultivation is feed (Lustiantoet al., 2020; Muryanto et al., 2019). The rearing of fish larvae in aquaculture activities is completely different from the natural environment, where fish larvae have to hunt for food to survive in the natural environment. Whereas in controlled cultivation activities the type of feed, the frequency of feeding, and the amount of feed given have all been regulated with the aim of getting a high survival rate and superior seeds (Bera et al., 2019).

The percentage of the amount of feed needed decreases with increasing size and age of fish. In addition, small fish (larvae) need more feed with a higher nutritional content, especially protein than large fish. Milkfish larvae are a type of plankton-eating fish (plankton feeder) (Muryanto et al., 2019). In general, milkfish hatchery is highly dependent on a sustainable supply of natural feed, such as Chlorella sp. and Rotifers (Brachionus plicatilis). High protein content is found in many natural feeds in the form of *Chlorella sp.* and *Brachionus plicatilis*. This species is mostly consumed by fish larvae such as milkfish (Rosady et al., 2013).

Chlorella sp. has a nutritional content of 51-58% protein, 28-32% oil, 12-17% carbohydrates, 14-22% fat, and 4-5% nucleic acids. Some of the disadvantages of using natural feeds such as the involvement of additional costs and resources, lack of reliability in sustainable production and varying nutritional quality (Sivaramakrishnan et al., 2021). Rotifers are organisms suitable for rearing fish larvae because of their unique characteristics such as very small size, relatively slow mortality, fast reproduction rate, acceptance of algae feed, easy to enrich with the required components, and can be mass cultured. Rotifers can tolerate a wide range of salinities, because rotifers have euryhaline characteristics, they can be mass cultured continuously in outdoor systems. Rotifers are microscopic organisms that are found in all aquatic systems (Kailasam et al., 2015). Consumption of milkfish larvae on natural food (rotifera) was seen in the maintenance system increasing during the cultivation period. The amount of natural rotifer feed in the rearing water decreased almost 24 hours after feeding, the amount of rotifer consumed by milkfish larvae was relatively high for one day indicating that rotifers were consumed efficiently and preferred as feed for milkfish larvae (Kusumawati et al, 2018). Calculation of natural food consumption by milkfish larvae, measurement of water quality, and detection of disease in fish are still carried out manually. Along with the development of technology, it is now starting to take advantage of the use of artificial intelligence to make time used more efficient.

Artificial intelligence (AI) is a branch of computer science that discusses how to use technology such as computers and smartphones to make human work more efficient (EOP, 2016). The field of cultivation, especially artificial intelligence, is used to detect one of them is the density of plankton in the cultivation container. The Case Based Reasoning (CBR) method is a method with the process of matching similarity using data from a case in the past. One application in the field of fisheries is used to diagnose types of disease in fish (Aldo and Zainul, 2020).

Connection solutions between hardware and software via the internet or also known as the Internet of Thing (IoT) Cloud Server which is intended to connect sensor devices and store values used to control pH levels and temperature of aquaculture water quality. The Internet of Thing (IoT) is intended to connect sensor devices and store sensor data values to the platform in real-time, and the received data can be immediately processed and visualized (Qalit et al., 2017). The use of IoT can be used to monitor the amount of natural feed density in aquaculture containers including the amount at which feed is given and the amount of leftover feed, so that the daily consumption of natural feed in larvae will be known. The results of monitoring daily consumption will get data results which are then linked to the growth of milkfish larvae.

This research needs to be conducted to evaluate the use of artificial intelligence in monitoring the density of Chlorella sp. and Brachionus plicatilis in milkfish larvae rearing containers, Chanos chanos.

2. Methods

Time and Place of Research

This research was carried out in October 2022 at the Ecosystem Captive and Rehabilitation Laboratory, Faculty of Marine and Fisheries Sciences, Hasanuddin University, Makassar.

Monitoring Tool Preparation

Microcontrollers, which is used is arduino uno R3 and the application used is arduino IDE. In Arduino Uno there are several pins to be connected to a water quality sensor, then in Arduino Uno there is a library that holds sensor data which is displayed via the LCD which is on top of the Arduino Uno tool.

Minicomputers, which is used is the Raspberry Pi Model 4B with a capacity of 4GB. Data received on the microcontroller is forwarded to Raspberry which functions as a server, data received from Raspberry is displayed virtually in raw form or in a file with the CSV extension, Raspberry uses the Libre application as well as if it is on a computer using Microsoft Excel. The computer process accesses raspberries using wifi and additional applications on the computer using VNC, to access VNC using a specific IP. Data received from raspberry uses a time delay every 3 minutes which is read in the VNC application.

Research Materials

The test animals used were day-old milkfish larvae with an average weight of 0.013+0.002 g, which were stocked at a density of 30 fish/L in rearing containers.

The container used in this study was an aquarium measuring 31 x 18 x 24 cm3 with a volume of 12 Lfilled with 8 L of seawater of 33 ppt salinity.The amount used is 12 pieces.

The feed used in this study was natural food for milkfish larvae given the initial feed of Chlorella sp., with a density of 5 cells/ml on the first day. Types of natural food Brachionus plicatilis given to larvae on day 2 – 7 with different densities, namely 25 ind/ml, 50 ind/ml, and 75 ind/ml. The test feeding schedule table is presented in Table 1.

Table 1. Schedule of Test Feeding

Type of feed/day of maintenance	H1	H2	H3	H4	H5	H6	H7
Chlorella sp.	■						
Branchionus plicatilis		■	■	■	■	■	■

Research Procedure

The maintenance aquarium is cleaned before use. The aquarium, aeration stone, and aeration hose are rinsed using water first, then disinfected using chlorine by rinsing, then neutralized using sodium thiosulfate by rinsing as well. All equipment that has been sterilized is left for 3-5 days.

The milkfish eggs that have been obtained are put into a clear fiber tub which has been filled with seawater of 33 ppt salinity. Then, the eggs are set aside. Eggs that are not successfully fertilized will settle to the bottom of the water and then the eggs are siphoned. Eggs that are successfully fertilized are then put into each aquarium to be used as test animals the day after they hatch into larvae.

The experimental design used was a completely randomized design (CRD), with three treatments and three replications each, so there were 9 tub units (Figure 1). The treatment tested Brachionus plicatilis (BP) densities of 25, 50 and 75 ind/ml and used an initial larval density of 30 individuals/L.

Treatment :

A = Brachionus plicatilis density 25 ind/ml at larva stocking density of 30 individuals/L

B = Brachionus plicatilis density of 50 ind/ml at a larva stocking density of 30 individuals/L

C = Brachionus plicatilis density of 75 ind/ml at a larva stocking density of 30 individuals/L

Treatment and Experiment Design

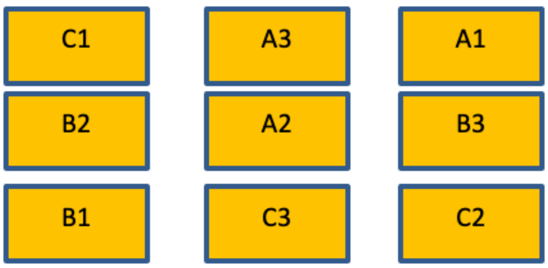

Figure 1. Trial Design Design

Observed Parameters

Total Daily Plankton Density

Calculation of density and effective use of feed per day is carried out every at 07.30 and 10.00 every day to find out the remaining feed in the rearing container, by taking 1 ml of water in the rearing medium then taking pictures using a cellphone camera which is calculated with the image J application so that digital data will be obtained later will be synchronized into an application to monitor the environment and the right amount and time of feeding.

Specific Growth

Growth observations were carried out by measuring the body weight of the fish every day for 7 days of rearing. Fish were observed by the sampling method which was taken as many as 10 fish per aquarium. Growth calculation is done using the following formula:

$$SGR= \frac{(\ln Wt-\ln Wo)}{t} \times 100\%$$

Information:

SGR= *Specific Growth Rate*(%/day)

Wt = average weight of fish at the end of rearing (g)

Wo= average weight of fish at the start of rearing (g)

t= Length of maintenance (days)

Survival Rate

Survival observations were made at the beginning of stocking and at the end of rearing. To find out the survival data of the test fish, the following formula was used:

$$SR\,(\%) = \frac{Nt}{N0} \times 100$$

Information:

SR = Survival rate (%),

Nt = Number of live fish at the end of rearing (tails),

No = Number of fish at the start of rearing (tails).

Water Quality

In this study also measured water quality parameters as research supporting data, including temperature, pH, dissolved oxygen and TDS (Total Dissolve Solid). As for measuring water quality, artificial intelligence applications are used, several sensors will be used to continuously monitor water quality parameters such as pH level, temperature, dissolved oxygen and TDS (Total Dissolve Solid). The monitored parameters are sent to the remote control via the internet of things (IoT) and displayed using the PVN application on the computer.

Data analysis

Data for length comparisons and survival calculations were analyzed using variance (ANOVA), with SNK post hoc tests ($P = 0.05$) to detect where significant differences occurred.If there is a significant effect then proceed with the W-Tuckey test. The auxiliary application for carrying out statistical tests uses the SPSS program package version 23.0. As for the water quality parameters of the maintenance media were analyzed descriptively.

3. Results and Discussion

Amount of Rotifer Natural Feed Consumption

Based on the results of calculating feed consumption in milkfish larvae which is carried out every day during rearing, the average consumption value for each treatment is obtained as shown in the graph (Figure 2) below

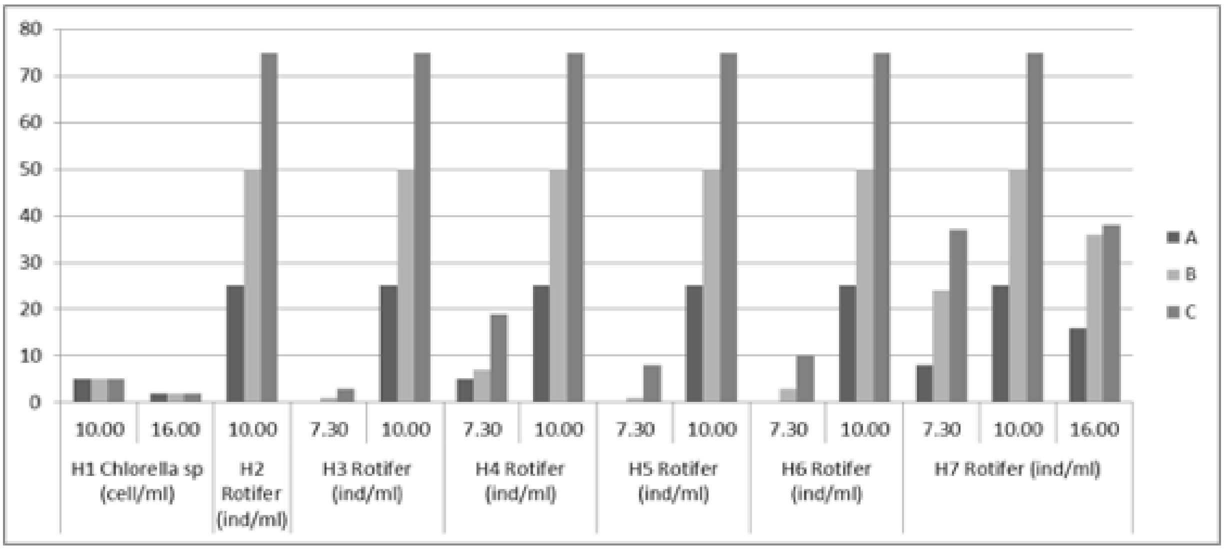

Figure 2. Graph of Total Roifer Natural Feed Consumption

Specific Growth

Based on the results of measuring the weight of milkfish larvae which were carried out every day for 7 days, the average weight was obtained as shown in (Figure 3) and (Table 2) below.

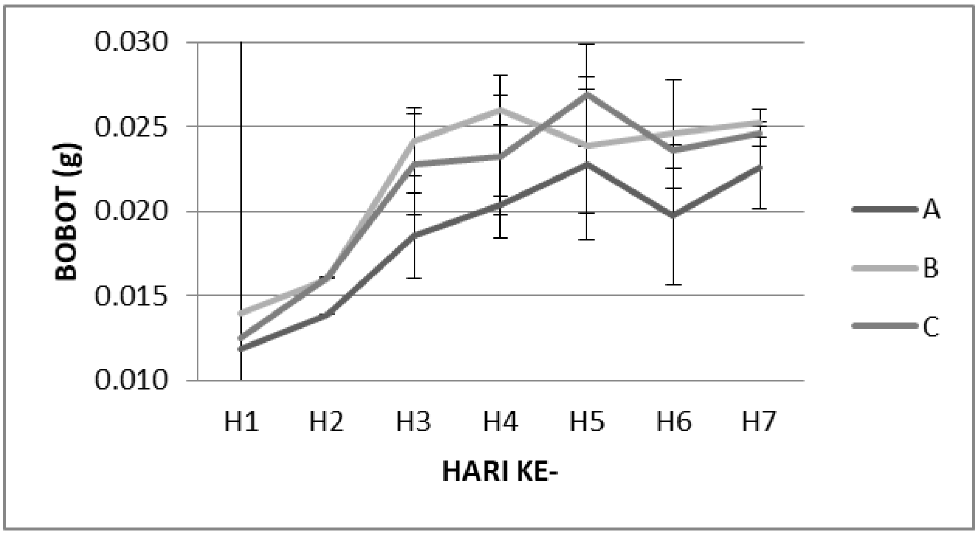

Figure 3. Graph of Milkfish Larvae Weight Measurement

Table 2. Milkfish Larvae Weight for 7 days in each treatment

Total Density *Branchionus plicatilis* Different	Weight growth absolute (g) ± Stdv	Specific weight growth (%/day) ± Stdv
A (25 ind/ml)	0.011 + 0.00a	0.15 + 0.03^{a}
B (50 ind/ml)	0.011 + 0.04a	016 + 0.04^{a}
C (75 ind.ml)	0.012 + 0.00 a	0.17 + 0.0^{a}

Based on the results of the analysis of variance (ANOVA) feeding Brachionus plicatilis at different densities showed no significant effect on larval weight ($p>0.05$) between all treatments.

Survival Rate of Milkfish Larvae

Based on the results of calculating the number of milkfish larvae which were calculated every day for 7 days, the average value for each treatment was obtained as shown in the ANOVA test results presented in (Table 3) below.

Table 3. Milkfish larvae survival rate for 7 days in each treatment

The number of Branchionus plicatilis is different	Average Survival rate (%/day)
A (25 ind/ml)	0.42±0.4a
B (50 ind/ml)	1.25±0.4a
C (75 ind.ml)	1.11±0.6a

Based on the results of the analysis of variance (ANOVA) feeding Brachionus plicatilis at different densities showed no significant effect on larval survival ($p>0.05$) between all treatments.

Water Quality

The results of water quality measurements were measured using artificial intelligence in the form of sensors consisting of 4 parameters, namely temperature, pH, DO, and TDS which are based on the optimal environment for milkfish larvae. Data on the results of water quality measurements are presented in (Table 4).

Table 4. Water Quality Parameter Measurement Data

Hari	KUALITAS AIR											
	DO (mg/L)			SUHU (°C)			pH			TDS (mg/L)		
	A	B	C	A	B	C	A	B	C	A	B	C
H1	4 - 6.18	4.36 - 7.18	4.86 - 7.9	31.56 - 32.25	31.62 - 32.63	31.94 - 33	2 - 6	6 - 7	6	1245 - 1330	1236 - 1340	1236 - 1279
H2	3.61 - 14.08	3.61 - 14.08	3.86 - 11.61	31.56 - 32.94	31.62 - 32.94	32 - 32.69	3 - 7	6 - 8	6	1284 - 1335	1279 - 1340	1231 - 1284
H3	3.93 - 4.93	3.93 - 8.36	5.40 - 11.61	31.62 - 32.19	31.75 - 32.5	32.06 - 32.75	2 - 7	6 - 7	6	1279 - 1330	1279 - 1335	1231 - 1279
H4	3.64 - 4	3.64 - 4.04	4.29 - 5.04	31.5 - 32.25	31.62 - 32.44	31.94 - 32.81	3 - 8	6 - 7	6	1289 - 1340	1270 - 1315	1236 - 1279
H5	3 - 3.93	3 - 3.79	3.72 - 4.97	31.81 - 32.31	31.87 - 32.56	31.19 - 32.94	2 - 7	7	6	1284 - 1335	1270 - 1320	1236 - 1284
H6	3.07 - 3.32	3.07 - 3.32	3.64 - 4.89	31.56 - 32.19	31.81 - 32.44	31.87 - 32.69	2 - 8	6 - 7	6	1284 - 1320	1274 - 1315	1236 - 1299
H7	3.18 - 4.43	2.11 - 3.32	3.57 - 4.43	31.56 - 32.13	31.94 - 32.56	31.94 - 32.63	6 - 8	6 - 7	6	1289 - 1335	1279 - 1325	1236 - 1284

Amount of Rotifer Natural Feed Consumption

Based on observations during the study period, it was seen that on the third day of administration of Brachionus plicatilis all treatments, consumption of rotifers in milkfish larvae, the amount of feed Brachionus plicatilis in treatment A was 0 ind/mL, treatment B was 1 ind/mL, and treatment C was 3 ind/mL. on the fourth day, feed consumption decreased compared to the previous day, namely in treatment A 5 ind/mL, treatment B 7 ind/mL, and treatment C 19 ind/mL. On the fifth day, treatment A was 0 ind/mL, treatment B was 1 ind/mL. and treatment C 8 ind/mL. On the sixth day, many larvae died, resulting in less feed consumption. On the sixth day, feed consumption began to decrease again with treatment A 8 ind/mL, treatment B 24 ind/mL, and treatment C 32 ind/mL. Whereas on the seventh day where the remaining larvae in the rearing container were decreasing,

Feed is a very important factor in fish maintenance, one of which is the maintenance of fish larvae. In the results of research on the use of natural food by milkfish larvae can be consumed properly on the first day given the type of feed Chlorella sp. but not 100%. The frequency of feeding chosen is 1x a day, where this frequency is good for the larvae to take advantage of the feed because the larvae are hungry and start looking for food in the morning and the live food given is able to survive in water, different from artificial feed which will settle in maintenance medium if given in excess. It is suspected that the type of rotifer feed is suitable for consumption by milkfish larvae that are 2 days old. This is supported by the statement of Haneash et al, (2015) rotifers are needed to be used as initial feed after the yolk phase is almost exhausted (critical) then given natural food from the phytoplankton and rotifer groups for newly hatched larvae and even during pralarva maintenance until it reaches the seeds. The protein content in the rotifers was based on the type, namely for the SS type rotifers 44.83%, for the S type rotifers 69.38%, and for the 56.82% type rotifers. Then the fat content for the SS type is 6.16%, for the S type it is 9.22%, and for the L type it is 8.68%. The results of the study by Prijono et al (2017) the results of observing the larvae in each rearing container showed that the larvae which were fed with a frequency of 1 time/day had very active swimming movements attacking the feed and on microscopic observations of the stomach contents of the larvae, showed that every morning the larvae ate 5-15 ind. of rotifers, while in the evening through a microscope it was known that 2-5 ind. of the remaining rotifers were found in the stomach of the larvae. In the treatment of the frequency of feeding 2 and 3 times, / day, the larvae showed symptoms of lack of feed. This can be known from the results of microscopic observations of gastric contents which turned out to be only found rotifers between 0-5 ind/larvae.

Specific Growth

Growth is a process of weight gain in an organism whose size can be determined by measuring the weight in this case the milkfish larvae in units of time. The results of the analysis of variance showed that the specific growth rate (SGR) of milkfish larvae had no significant effect ($p>0.05$) between treatments with different amounts of rotifers. It is suspected that in the three treatments the ability of milkfish larvae to utilize the rotifer feed given was the same, as seen from the increase in weight and length each day and the results of the ANOVA test. The completeness of nutrients in the feed is needed to maintain normal larval growth. According to Jayanthi et al (2022) the requirements for good fish feed for the larvae are adequate nutritional quality according to the needs of the larvae, the size of the feed is smaller than the mouth opening of the fish larvae, the feed is live not dead or synthetic feed, and the best food is from the Rotifera species, namely from the genus Brachionus. There are several factors that affect the growth of milkfish larvae, namely external and internal factors. External factors include the amount and available food, optimal water quality, and stocking density in one container. Internal factors affecting the growth of milkfish larvae include heredity (genetic), disease and parasites. Growth is very closely related to good environmental conditions, so to achieve good growth, the availability of sufficient feed and the right stocking density and supported by controlling water quality will increase larval growth (Akbar et al, 2021). Protein is needed for larvae for growth. Fish need about 50% of calories from protein which functions as a builder of muscles, cells and body tissues, especially for young fish. Protein contains as much as 50-55% carbon, 5-7% hydrogen and 20-25% oxygen which together with fats and carbohydrates, also contains as much as 15-18% nitrogen, the average is 16% and partly is an element of sulfur and contains a small amount of phosphate and iron. These nutrients are needed for growth and repair and maintenance of tissues and organs (Hadijah et al., 2017). and 20-25% oxygen together with fats and carbohydrates, also contain nitrogen as much as 15-18%, the average is 16% and partly is elemental sulfur and contains a little phosphate and iron. These nutrients are needed for growth and repair and maintenance of tissues and organs (Hadijah et al., 2017). and 20-25% oxygen together with fats and carbohydrates, also contain nitrogen as much as 15-18%, the average is 16% and partly is elemental sulfur and contains a little phosphate and iron. These nutrients are needed for growth and repair and maintenance of tissues and organs (Hadijah et al., 2017).

Survival Rate of Milkfish Larvae

Survival rate or usually referred to as survival is the percentage of the number of reared larvae that are able to survive until the end of rearing, which is compared to the number of larvae stocked at the beginning of rearing. The results of the study for survival parameters on day 3, death began to occur, then on day 6 mass mortality began to occur and on day 8 was the peak of larval death so that it meant that on day 8 the survival rate was 0% in all treatments. It can be seen that the consumption of natural rotifer food on the third day decreased and affected the survival of milkfish larvae.

On the third day, observing under a microscope also found copepods. The results of observations on the 3rd day of the dead larvae were red, and the results of observations of milkfish larvae under a microscope were the number of paramecium in the bodies of the dead larvae. According to Akbar et al (2021) in larval rearing there are several factors that influence mortality, namely internal factors and external factors. Internal factors consist of age and ability to adapt to the environment (adaptation), and external factors, namely competition in obtaining feed, population density in rearing media, fish diseases, and other biological characteristics related to life cycle, handling and capture at harvest samples for measurement and calculation of the number of larvae. In addition, optimal utilization of the feed given is one of the things that causes high or low larval survival. This is supported by the statement of Azhari et al (2017) that in rearing larvae one of the limiting factors is stocking density and the density of the amount of feed in the rearing medium, which is related to the space for larvae to compete for feed and competition for the use of oxygen. So that this can cause disruption of the behavior of fish larvae to the space for movement which can eventually lead to decreased survival. According to Pratama et all (2021) One effort that can be made to overcome the low survival rate of fish larvae is by providing proper feed, both in selecting the type of feed, size, the amount and nutritional content of the feed given. In addition, optimal utilization of the feed given is one of the things that causes high or low survival.The critical period for larvae is also a factor in the occurrence of death. The larval critical period begins when absorption of yolk has been completed, if the larva does not find food that can meet its needs during this period, it will weaken and eventually die.

Water Quality

Measurement of water quality parameters using a sensor with an Arduino Uno connected to an IoT (Internet of Thing) based computer with a maintenance container, during the research in the maintenance tank, the water quality parameters measured were temperature, pH, DO, and TDS.

The results obtained for 7 days of maintenance, the temperature in treatment A ranged from 31.5-32.94oC, in treatment B it ranged from 31.62-32.94oC, and treatment C ranged from 32.19-33oC. If you look at the range of values in all treatments, it looks diverse. The results obtained for the pH parameter, the average value per day for the pH parameter for treatment A ranged from 2-8, for treatment B it ranged from 6-7, and for treatment C the pH value was 6. The results obtained for the DO parameter, the average value - Average DO for all treatments, obtained DO values in treatment A ranged from 3-14.08 mg/l, for treatment B obtained values ranging from 2.11-14.08 mg/l, and for treatment C obtained values ranging from 3.57-11.61 mg/l. The results obtained for the TDS parameter, the TDS values were measured every day, for treatment A the range was between 1245-1340 mg/l, for treatment B the TDS values ranged from 1236-1340 mg/l, and for treatment C the average value was obtained average ranged from 1231-1299 mg/l.

Temperature>42.7 °C and <8.5 °C can result in death of milkfish reared, while the optimum temperature is around 29 – 32.6 °C. Low temperatures can reduce activity, responsiveness, food intake, growth and development of fry and juvenile milkfish (Ganesh et al., 2020). The optimal pH value for milkfish cultivation is 6.5 – 9. Some aquatic organisms are sensitive to changes in pH and have a preference with an average of 7. Inappropriate acidity (pH) values can cause fish stress, decreased productivity, slow growth, and death (Putri et al., 2016). The range of DO values for the maintenance of milkfish larvae with a limit value of 4 – 7 ppm. A low DO concentration will increase the denitrification process, because the denitrification process takes place optimally at low DO. Increased concentrations of nitrite and ammonia are by-products of the denitrification process (Putri et al., 2016). TDS is the amount of material dissolved in the water. These materials can be carbonates, bicarbonates, chlorides, sulfates, phosphates, nitrates, calcium, magnesium, sodium, organic ions, colloidal compounds and others.TDS is the content of dissolved solids in the form of substances, organic matter, inorganic salts and dissolved gases (Kusuma et al, 2020)..

4. Conclusion

The conclusions in this study, namely; (1) The amount of consumption and utilization of natural daily food on a regular basis can be determined in milkfish larvae which are monitored using artificial intelligence; (2) The results of the analysis between the amount of consumption and utilization of natural feed with weight gain and length given different amounts of feed have the same impact on milkfish larvae which are monitored using artificial intelligence , so we get the right amount of rotifer density of 25 ind/ml to use.

Suggestion

Using the application of feeding to milkfish larvae with a total density of rotifer natural feed of 25ind/ml.

To increase the number of panelists in utilizing the calculation of the amount of feed consumption and measurement of water quality parameters in real time based on artificial intelligence with other types of cultivars. In carrying out further research it is recommended to use a more sophisticated type of camera in terms of obtaining clearer image results on the rearing medium, and adding the number of sensors for water quality parameters so that the data obtained is more complete.

Thank-You Note

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