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Growth of milkfish (*Chanos chanos* forsskal) maintained in multitrophic seafarming with different water exchange systems

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ABSTRACT

Milkfish is an important commodity with high economical value, delicious meat, relatively reachable price, disease attack resistance, and non-cannibalistic, which can live in high stocking density and can be cultured in polyculture system with other animals and plants, therefore encourages many fish farmers to perform this culture system. This study was performed in experimental method with three treatments and three replications of different water exchange systems, namely, once in 2 days (Tank A), everyday (Tank B), and everyday water circulation (Tank C). Milkfish seeds with average initial weight of 11.37 ± 0.97 g and average initial length of 6.08 ± 0.78 cm were maintained for 45 days at different water exchange systems and fed with Megami pellet feed. The results showed that Tank C with water circulation performed everyday was the best treatment to improve the milkfish seed production with 100% survival rate, 1.77±0.01%.day-1 specific growth rate, 4370.37 ±1.28μm.day^{-1} absolute length growth, and 31.91 ±2.82% feed efficiency.

Key words : *Milk fish, Multitrophic seafarming, Feed efficiency, Water exchange*

Introduction

Milkfish is the main species for fish culture development in Indonesia as the most produced species either for being consumed or for being a foreign exchange earner. Milkfish is included in plankton feeder and characterized as euryhaline, which can live both in freshwater and brackish water environments. This fish culture continues to develop due to several advantages compared to other species, such as conquered breeding technique, relatively easy culture technique which can be adopted by the farmers, extreme environmental (salinity fluctuation) resistance, high response to artificial feed available commercially, capable of being maintained in high stocking density, and non-cannibalistic (Huniyah *et al.,* 2015).;

Aquaculture as part of fishery sectors is one of the solutions to overcome the fisheries demand that continues to increase. The aquaculture implementations, such as floating net cage and pen floating net utilizations are still mostly conducted in coral water area or coastal area, which indirectly damage coral reef area and marine pollution that causes habitat or marine ecosystem damages. These damages occur due to the unutilized waste that produces toxins for organisms around the culture area as the result of marine monoculture system. Therefore, mariculture development should be managed sustainably by implementing the integrated system.

Integrated Multitrophic Aquaculture (IMTA) is a culture system with ecosystem approach that can be implemented well in freshwater or marine water. This system is different from polyculture as the organism utilization is applied based on its function in the ecosystem. The IMTA development has many been performed either with two or more types of organisms. Organisms cultured in IMTA is basically composed of carnivores, detritivores, filter feeders, and inorganic waste absorber. IMTA can be applied almost in the whole world either in tropical area or subtropical area (Setyowaty *et al.,* 2013). IMTA has advantages, such as increasing the economical value, reducing culture waste, and sustaining food security through product diversification. The IMTA implementation in Indonesia is based on the local ecosystem through the local species application. This IMTA implementation does not only produce highly economical value biomass through product diversification, but also decrease the waste released to the water.

Materials and Methods

Materials and Equipments

The study was performed in Tablolong waters, Kupang District. Data sampling was performed on October to December, 2018. The container used was a floating net cage with the equipment's used were wood block, footbridge, plastic drum, nylon thread, drum strap, anchor rope, webbing, nail, saw, wood, wood chisel, silicon glue, bolt, ring, carbide, anchor drum, iron screw, anchor welding, cement, sewing needle, sewing net thread, flashlight, battery, epoxy glue.

Experimental Design

This study is a field experiment using a completely randomized design with three treatments and each treatment had three replications. Treatments applied was Tank A (water exchanges were performed once in 2 days), Tank B (water exchanges were performed everyday), and Tank C (water circulation was performed every day).

Seed Stocking

The milkfish seeds used had average weight of 11.37 ± 0.97 g and average length of 6.08 ± 0.78 cm and the seeds were obtained from the fishermen around the Tablolong waters. The experimental fish used is 100 milkfish. Dead milkfish are measured and weighed daily and accumulated once every 15 days. The maintenance was performed for 45 days. The feed applied was pellet feed (Megami). Feeding was performed ad libitum with the feeding frequency was once in 2 days (Supriyono *et al.,* 2020).

Water Quality Measurement

Physical and chemical parameters observed during the study comprised water temperature and pH. Measurement was performed every 7 days once and accumulated once every 15 days.

Data Analysis

Survival Rate

All fish samples were counted on the initial study period, while on the final study period, fish samples that were alive were counted and subtracted from the dead fish samples, and then the data obtained were recorded. The counting result of fish on the initial and final study period was calculated using the following formula (Effendie, 1997):

$$\frac{Total\ of\ final\ experimental\ animal\ (fish}{Total\ of\ initial\ experimental\ animal\ (fish)} X100\%$$

where:
SR = Survival rate (%)
No = Total of initial experimental animal (fish)
Nt = Total of final experimental animal (fish)
Specific Growth Rate (SGR)
The specific growth rate of milkfish was determined with the formula of Huisman (1987):

$$GR = \left[\sqrt[t]{\frac{Wt}{W0}} - 1 \right] x\ 100$$

where:
SGR = Specific growth rate (%.day-1)
Wt = Average final fish weight (g.fish-1)
W0 = Average initial fish weight (g.fish-1)
t = Maintenance period (day)

Absolute Length Growth Rate

Absolute length growth rate was calculated by using the following formula (Allen *et al.,* 2006):

$$ALG = \frac{SLt - SLo}{ts}$$

where:
ALG = Absolute length growth rate (µm.day-1)

SL0 = Initial fish length (cm)
SLt = Final fish length (cm)
t = Period (days)

Feed Efficiency Value

To identify the amount of feed consumption and digestion in milkfish, the feed was weighed on the initial study period, and then the measurement data were recorded. Milkfish was also weighed on the final study period, and the weight data were recorded. The number of dead fish during study period was also weighed and recorded. The feed weight from the initial to final study period was entirely weighed and recorded. The calculation of feed efficiency was based on Tacon (1993).

$$FE = \frac{(wt + D)}{F} - woX100$$

where:
FE = Feed efficiency (%)
F = Total of feed given (gr)
Wt = Experimental animal biomass on the final study period (g)
Wo = Experimental animal biomass on the ini tial study period (g)
D = Dead experimental animal weight during the study period (g)

Results and Discussion

Survival Rate

Survival percentage rate within 45 days for all the treatments was 100%. This condition indicates that milkfish maintenance with water exchange system can be performed eligibly due to producing high survival rate. Rachimi *et al*. (2016) stated that in terms of adapting to the environment, fish has certain range of tolerance and resistance on the environmental change following the environmental variation. The result of survival rate can be seen in Figure 1.

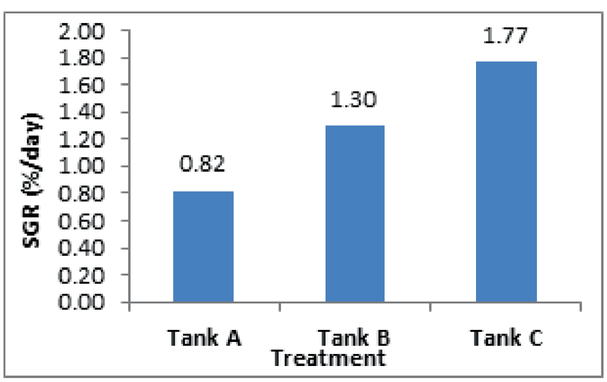

Fig. 1. The specific growth rate value of milkfish

Absolute Length Growth Rate (ALG)

The calculation result of absolute length growth rate in milkfish at the final maintenance was identified that treatments obtained a significant difference in the absolute length growth rate of milkfish ($p<0.05$). Based on the calculation of absolute length growth rate, the highest value was obtained from Tank C treatment at 4370.37±1.28μmday^{-1}, while the lowest value was obtained from Tank A at 1485.19 ±6.42μm.day^{-1}.

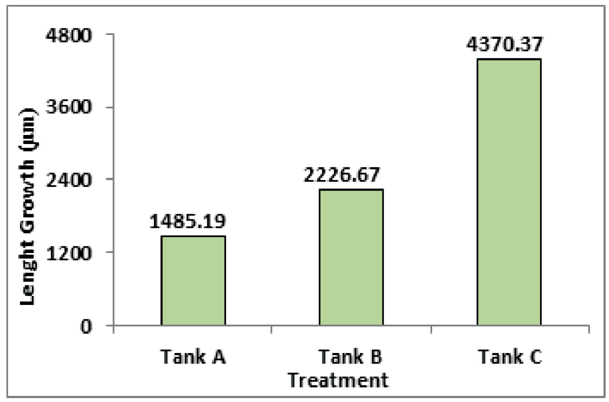

Fig. 2. The absolute length growth rate value of fish on the final maintenance period

Feed Efficiency (FE)

Feed is utilized by the body for metabolism, movement, sexual organ production, treatment, or cell replacement (Muryanto *et al*., 2018). Feed utilization efficiency is determined by growth and total of feed given. The feed efficiency value will show how far the feed given can promote increased body weight in fish. Feed efficiency can be identified from several factors; one of which is feed conversion ratio (Handayani, 2011).

Based on Figure 4, feed efficiency value in Tank C treatment obtained the highest value at 31.91±2.82%, while Tank A treatment obtained the lowest value at 23.84±1.80%. Feed quality influences the feed conversion ratio of fish as fish will utilize feed more for growth. In this study, fish was maintained in a multitrophic sea culture were fed with similar feed type. Difference in feed efficiency in both tanks may be influenced by the water quality during the study period.

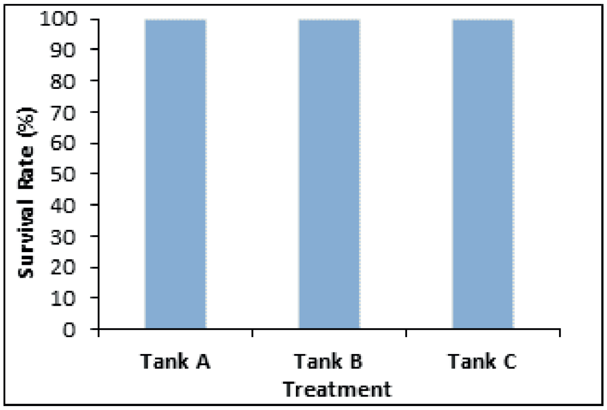

Fig. 3. The survival rate of milkfish in three different water exchange system treatments for 45 days

Specific Growth Rate (SGR)

Growth is an important component in aquaculture biota productivity. Growth will perform better when the fish body approaches the iso-osmotic condition. In general, growth is an expression of increased volume, wet weight, or dry weight in periodical change rate (Diansyah *et al.*, 2014). Milkfish culture with different water exchange system had insignificant difference on the specific growth rate of milkfish ($p>0.05$). The highest specific growth rate value (Figure 2) was obtained from Tank C (water circulation was performed everyday) at 1.77±0.01%.day^{-1}, while the lowest specific growth rate value was obtained from Tank A (water exchange was performed once in 2days) at0.82±0.01%.day^{-1}.

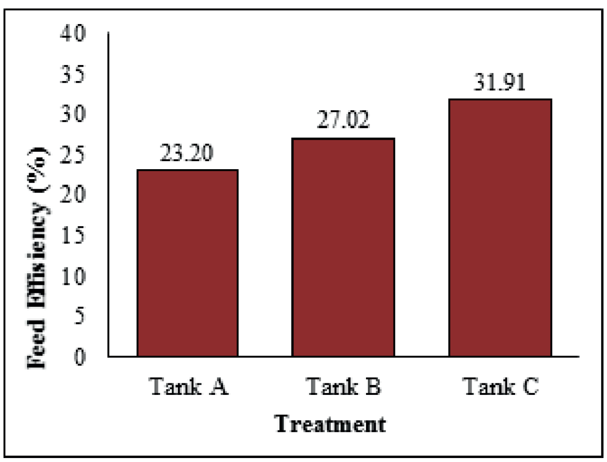

Fig. 4. Feed efficiency of milkfish

Water Physicochemical Quality

The water physicochemical quality was measured directly during the study period on the floating net cage for once in 7 days. The milkfish culture should always notify on the water quality as milkfish can grow well when the environmental condition conforms with its living capability. The water physicochemical observation results during milkfish maintenance in sea by using the floating net cage containing temperature and pH can be seen in Table 1. The aquatic biota has certain temperature range for living and growth (Hastuti *et al.*, 2012). Water quality during maintenance was in good range and could be tolerated for milkfish growth. Measurement was performed once in 7 days and accumulated every 15 days.

Temperature plays important role in water ecosystem condition control. Water temperature during the study period were 30.2 ^{0}C - 32.0 ^{0}C. Meanwhile, the temperature required for cultured fish in the tropical area should be among 27 ^{0}C - 32 ^{0}C. Water temperature has an important role in activity, growth, appetite, and feed digestion process regulations (Jaya *et al.*, 2013). The acidity level or pH during the study period were among 7.92-8.03. Similar to dissolved oxygen, the seawater pH tends to have no problem due to its characteristic as being closed to base. The seawater pH is commonly among 7.5-8.5.

Conclusion

Based on the study results, it can be concluded that the milkfish cultured in a circulation system performed everyday is the best treatment that can improve the milkfish seed production.

Table 1. Average data of water physico-chemical quality for milkfish maintenance cultured in multitrophic seaculture way

Tank	First Sampling		Second Sampling		Third Sampling	
	Temperature	pH	Temperature	pH	Temperature	pH
A	30.2	7.7	32.0	7.6	31.8	7.4
B	31.6	6.6	30.7	6.8	30.7	6.2
C	30.3	6.6	30.3	6.6	30.5	6.5

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