UDC 639; DOI 10.18551/rjoas.2022-08.23

THE EFFECT OF STOCKING DENSITY ON THE GROWTH AND SURVIVAL RATE OF MILKFISH (CHANOS CHANOS) LARVAE IN FRESHWATER

Septiana Shinta*, **Sumiarsih**, **Junaidi**
Tegal Middle School of Fisheries Business, Indonesia

ABSTRACT
Strategies to increase production, including regulating proper density levels, good environmental conditions, and adequate feeding, will increase fish growth. Increased stocking density and feeding will also enhance the residue in the rearing container, and probiotics are an alternative to solve this problem. Probiotics can reduce inorganic nitrogen waste from feed residues and feces. This research aimed to determine the effect of stocking density on the survival and growth of milkfish (*Chanos chanos*) larvae in freshwater. The results of this research conducted for 1 (one) month showed that the effect of stocking density on the absolute growth of milkfish individual weight (grams) ranged from 6.70 cm-8.13 cm, where the highest was in the stocking density level of 25 fish/ m^2. The specific growth rate ranged from 6.20% - 5.67%, where the highest was in the stocking density of 25 fish/m^2. The survival rate of milkfish until the end of this research was 85.33% - 93%. The results of the Completely Randomized Design (CRD) test with a confidence level of 95% showed that stocking density significantly affected the absolute growth of milkfish individual weight (grams) in the nursery stage (F-count = 15.0074 > F-table of 0.05 (3;8) = 4.07) and did not significantly affect the specific growth rate of milkfish in the nursery stage (F-count = 3.4887 < F-table of 0.05 (3;8) = 4.07). In general, water quality describes a range that is still within the tolerance limit and is not harmful to milkfish growth.

KEY WORDS
Milkfish, freshwater, growth, survival.

Strategies to increase production, including regulating proper density levels, good environmental conditions, and adequate feeding, will increase fish growth. The development of fish farming processes with high-density levels also affects the increase in waste in waters. This waste is generated from farming activities such as feed residues, feces, and metabolic waste (excrement). Concentrations of waste containing high nutrients can be detrimental because it will cause diseases due to viruses, bacteria, and other organisms, leading to fish death and potentially damaging the aquaculture environment. One technology that can overcome the problem of aquaculture waste is the provision of probiotics.

Probiotics are an alternative to solving the problem of intensive aquaculture waste. This technology is the most profitable because it can reduce inorganic nitrogen waste from feed residues and feces. According to Des *et al.* (2006) in Raja *et al.* (2015), probiotics with species components, including Streptomyces, can reduce nitrogen components, improve water quality, and increase oxygen content and average growth rate.

Lactobacillus plantarum, according to Mahopatra *et al.* (2014) in Raja *et al.* (2015), provides effects that can increase immune response, boost the production of erythrocytes and leukocytes, overcome stress-related temperature changes, and also substantially improve fish growth.

Milkfish rearing techniques in fresh and brackish water (ponds) are not significantly different. As a euryhaline fish that can adapt to a wide salinity range, milkfish can live well in freshwater. Adaptation of milkfish larvae reared in freshwater is longer than those reared in brackish water. Therefore, milkfish needs adaptation during the rearing process in freshwater with a water salinity of 0-5 ppt because the decreasing water salinity level will lead to death in milkfish larvae. Milkfish larvae are highly adaptable to freshwater as long as the water salinity does not decrease suddenly but gradually.

Therefore, this research was conducted to know to what extent stocking density affects the survival and growth of milkfish (Chanos chanos) larvae in freshwater.

METHODS OF RESEARCH

This research was conducted at the Freshwater Farming Pond, the Campus complex, on Martoloyo Street 22 Tegal, from July 13, 2021, to August 3, 2021.

This research used a Completely Randomized Design (CRD) with 4 treatments and 3 replications. The treatments are as follows:

- Treatment A: Milkfish nursery using probiotics with a stocking density of 25 fish/meter;
- Treatment B: Milkfish nursery using probiotics with a stocking density of 50 fish/meter;
- Treatment C: Milkfish nursery using probiotics with a stocking density of 75 fish/meter;
- Treatment D: Milkfish nursery using probiotics with a stocking density of 100 fish/meter.

Sampling was carried out every 1 week for 1 month of rearing. Observations included the absolute weight growth, the specific growth rate (SGR), survival rate, and water physicochemical factors. Each of the 4 (four) ponds is 5x9 meter-sized with a 3x1 meter-sized hapa.

The absolute weight growth is calculated using Effendie's formula (1997) as follows:

$$Wm = Wt - Wo$$

Where: Wm = Absolute weight growth (gram), Wt = Biomass weight at the end of the research (gram), Wo = Biomass weight at the beginning of the research (gram).

The Specific Growth Rate (SGR) is the percentage (%) of the difference between the final weight and the initial weight, divided by the length of rearing time. According to Zonneveld *et al.* (1991), the formula for calculating the specific growth rate is as follows:

$$SGR = \text{Specific Growth Rate (\%/day)} = (\ln Wt - \ln Wo)/T * 100$$

Where: Wo = Average weight of fry at the beginning of the research (g), Wt = Average weight of fry at the t-day (g), T = Length of rearing (day).

The Survival Rate (SR) is the percentage of the number of fish living from the beginning to the end of the research. The survival rate can be calculated using the following formula (Muchlisin *et al.,* 2016).

$$SR = \text{Survival Rate (\%)} = (Nt - No)/No * 100$$

Where: Nt = The number of fish at the end of the research (fish), No = The number of fish at the beginning of the research (fish).

The measurement of water Physico-Chemical factors was intended to determine the water quality as a rearing medium during the research. The physicochemical parameters observed once a week included the measurements of temperature, pH, DO, salinity and nitrite. The Dissolved Oxygen (DO) concentration was measured using the DO meter. The pH (Power of Hydrogen) or acidity degree was measured using the pH meter. The temperature was measured using a thermometer, and the nitrite was measured using a spectrophotometer. The analyzed water samples were taken from the fish rearing containers.

RESULTS AND DISCUSSION

Growth is the change in length and weight in a certain period. Individual growth is the addition of tissue due to mitotic cell division causing changes in size (Effendie, 1997).

According to Hepher (1988), the factors influencing the growth include the feed ration, fish weight, and other external and internal factors.

The observation results of the absolute growth of Milkfish individual weight (gram) are presented in Figure 1.

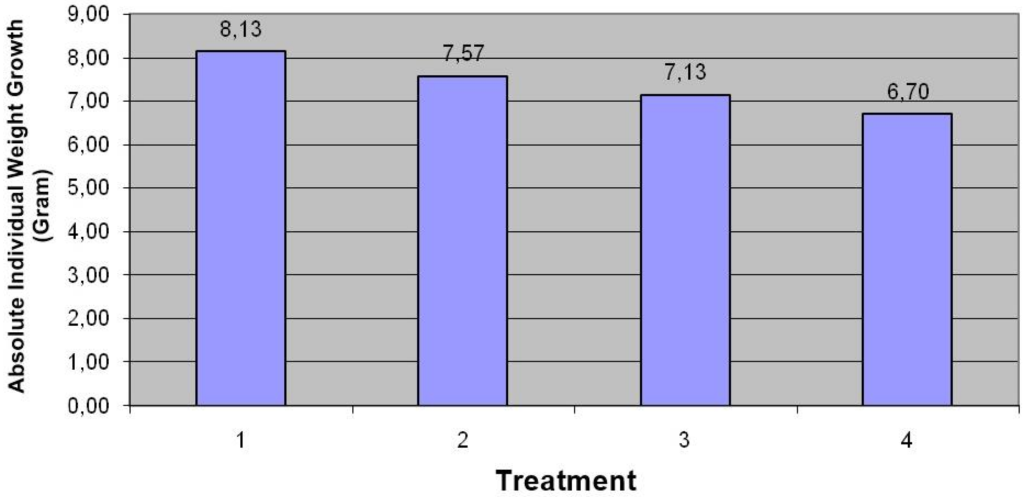

Figure 1 – Differences in the Absolute Growth of Milkfish Individual Weight (gram) during the Research

Figure 1 above shows the Absolute Growth of Milkfish Individual Weight (gram). Treatment 1 (a stocking density of 25 fish/ m^2) and Treatment 2 (a stocking density of 50 fish/ m^2) are the best absolute growth of milkfish individual weight (gram) compared to other treatments.

Based on the results of the analysis of variance with the Completely Randomized Design test, differences in stocking density had a very significant effect on the absolute growth of milkfish individual weight (grams) in the nursery stage (F-count = 15.0074 > F-table of 0.05 (3;8) = 4.07).

The absolute weight growth had a significant effect on the difference in the given stocking density treatments, where the higher stocking density led to different weight growth in each treatment. The high stocking density inhibited the increase in fish weight in each rearing medium due to competition among fish for space and access to feed.

Growth is a change in the size of either weight or length in a certain period (Huet, 1971). Growth will only occur if the energy content in the feed exceeds the energy required for body maintenance and damaged cell replacement (Zonneveld *et al.,* 1991).

External factors influencing growth include water and environmental conditions, while the internal factors include species, sex, genetics, and physiological status of fish.

Physical growth occurs with changes in the number or size of cells making up body tissues, while morphological growth can be seen from changes in body shape. Growth will occur if the energy needs for metabolism and maintenance of body tissues are already met according to the needs of fish (Hepher, 1988) and if the amount of feed consumed is greater than the amount needed for body maintenance and used as a source of fish energy (Huet, 1971).

The feed affects fish performance, including growth and reproduction. Therefore, quality feed is expected to increase feed utilization efficiency, reflected in increased growth. Based on the type of feed, milkfish are herbivores that tend to be omnivorous, have a toothless mouth with a very long intestine (several times longer than the length of the body). At the larvae stage, milkfish are carnivores that eat zooplankton, and then at the fry stage, they become omnivores that eat zooplankton, diatoms, and benthos. Furthermore, at the juvenile stage, they become herbivores that eat filamentous algae, detritus, small benthos, and pelleted feed. During this research, milkfish were given artificial feed. In line with the increasing time of the research, the residues of feed and metabolism affected plankton abundance that was optimally utilized by milkfish for its growth. Planktons observed during this research are presented in Table 3.

Table 3 – Observations of Plankton During the Research

Total Plankton (cell/ml)	Treatment 1	Treatment 2	Treatment 3	Treatment 4
Chlorophyta	905,000	1,877,500	2,582,500	1,030,000
Cyanophyta	150,000	190,000	100,000	100,000
Chryptophyta	10,000	-	22,500	-
Crysophyta	25,000	-	25,000	-

Planktons with the highest number are Chrolophyta and Cyanophyta. According to Lukstadt (2002), one of the contents found in the juvenile milkfish stomach is filamentous algae (Cyanophyta). Consistent with that, Amores (2003) found that juvenile and adult milkfish eat cyanobacteria, algae, and small invertebrates at the bottom of the water. Likewise, Garcia (1990) revealed that the feed preferred by milkfish from all ages is blue-green algae.

The observation results of the specific growth rate are presented in Figure 2.

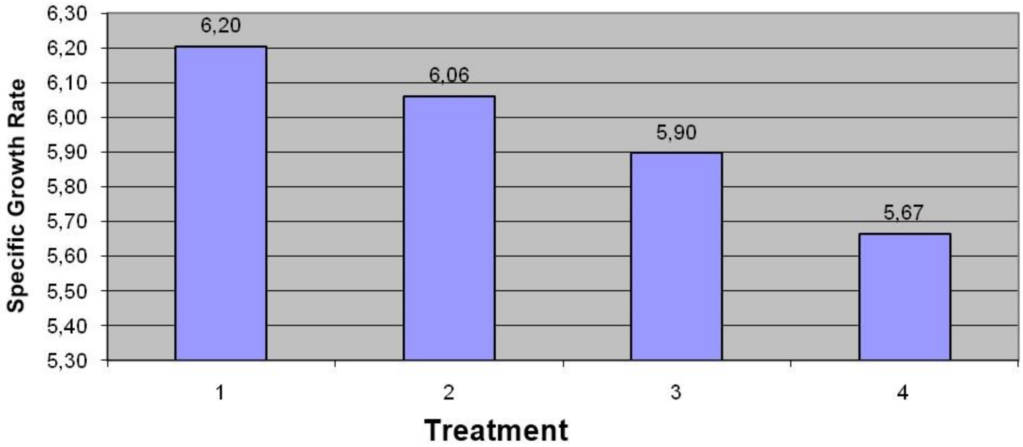

Figure 2 – Differences in Milkfish Specific Growth Rate during the Research

Based on the results of the analysis of variance with the Completely Randomized Design test, differences in stocking density had a very significant effect on the specific growth rate of Milkfish in the nursery (F-count = 3.4887, < F-table (3;8) = 4.07).

The specific growth rate in Treatment 1 was 6.72% of the body weight per day, showing the highest growth. It was possible because the low stocking density allowed milkfish to grow faster.

The specific growth rate in Treatment 1 would slow down if the stocking density increased. The low level of stocking density makes fish able to utilize food well compared to high stocking density because feed is an external factor that has a role in growth (Syahid *et al.,* 2006). Fish growth is also influenced by the ability of fish to utilize feed. Too high fish density can increase fish competition in utilizing feed, so fish cannot utilize feed optimally. Sabriah and Sunarto (2009) added that the speed of growth depends on the amount of feed consumed, the number of proteins contained in the feed, water quality, and other factors such as heredity, age, endurance, and the fish ability to utilize feed.

The high level of feed digestibility is assumed to be caused by the role of Lactobacillus sp. bacteria in the probiotics given. The role of Lactobacillus sp bacteria is to balance the digestive tract microbes to increase fish digestibility by converting carbohydrates into lactic acid, which can stimulate the production of enzymes for nutrient absorption, feed consumption, growth, and inhibition from pathogenic organisms (Samadi, 2002 in Arief *et al.,* 2008).

The survival rate of milkfish ranged from 85.33% - 93%, very likely due to environmental adaptation, suitability of feed types, ability to utilize feed, availability of natural feed, and the role of probiotics. During environmental adaptation, milkfish adjust to their initial environment's salinity of 15%. The average survival rate in a stocking density of 25 fish/m^2 was 92.33%, higher than that in a stocking density of 100 fish/m^2). It was possible because competition among fish for space caused them to be stressed. A high stocking density will stimulate the fish body to produce excessive cortisol hormones, causing stress in fish. According to Djatikusumo (1977), the density factor will affect the survival of the population. Effendie (2002) furthermore adds that internal and external factors influence fish survival. The internal factors include resistance to disease, feed, and age, while the external factors include stocking density, diseases, and water quality.

Dissolved oxygen levels during this research ranged from 3.11 – 3.87 ppm, which were still within the acceptable range for milkfish growth. According to the Indonesian National Standard (*SNI*) 800 5:2014, the water dissolved oxygen content ideal for the life and growth of milkfish is > 3.50 ppm. The temperature during this research ranged from 27.8 – 29.3^o C, which was still tolerable for the growth of milkfish. Milkfish can live at temperatures between 30-35^o C (Ghufron and Kordi, 2007). The degree of acidity (pH) during this research was in the optimal pH range of 7.8. According to Ahmad *et al.* (1993), the water pH that can provide normal growth for milkfish is 6.5-8.5, while according to *SNI* 800 5:2014, the optimal pH for milkfish is 7.5-8.5. Milkfish is categorized into euryhaline fish, which can live in a fairly high salinity range (0-140 ppm). Therefore, milkfish can live in freshwater (ponds/ rice fields), brackish water (ponds), and saltwater (sea) (Purnowati *et al.,* 2007). The nitrite levels during this research ranged from 0.001 to 0.017 ppm, which were still safe for milkfish life. The safe nitrite level for milkfish growth is less than 0.30 ppm (Ahmad *et al.,* 1993) in the process of nitrite assimilation in the waters.

CONCLUSION

The effect of stocking density on the absolute growth of milkfish individual weight (gram) ranged from 6.70 cm to 8.14 cm, where the highest result was in Treatment 1 (a stocking density of 25 fish/m^2). The results of the Completely Randomized Design test showed a significant effect on the absolute growth of milkfish individual weight (grams) in the nursery stage (F-count = 15.0074 > F-table of 0.05 (3;8) = 4.07). Meanwhile, the absolute growth of milkfish biomass weight ranged from 889.63 – 2,842.77 grams, where the highest result was in Treatment 4 (a stocking density of 100 fish/m^2). The results of the Completely Randomized Design test showed that differences in stocking density had a significant effect on the absolute growth of milkfish biomass weight (gram) (F-count= 126, 5352 > F table of 0.05 (3;8) = 4.07). The specific growth rate ranged from 6.20% - 5.67%, where the highest result was in Treatment 1 (a stocking density of 25 fish/m^2). Based on the results of the Completely Randomized Design test, differences in stocking density did not have a significant effect on the specific growth rate of milkfish in the nursery stage (F-count = 3.4887 < F-table 0.05 (3;8) = 4.07). The survival rate of milkfish until the end of this research was 85.33% - 93%.

REFERENCES

1. Ahmad T, Priyono A, Aslianti T, Setiadharma T, Kasprio. 1993. Pedoman Teknis Pembenihan Ikan Bandeng. Seri Pengembangan Hasil Penelitian Perikanan No.PHP/KAN/24/1993. Badan Penelitian and Pengembangan Pertanian. 68 hal.
2. Arief, M., Mufidah & Kusriningrum. 2008. Pengaruh penambahan probiotik pada pakan buatan terhadap pertumbuhan and rasio konversi pakan ikan nila gift (Oreocromis niloticus). Berkala Ilmiah Perikanan. 3 (2): 53-58.
3. Djatikusumo, E. W. 1977. Dinamika Populasi.AUP. Jakarta.148 hlm.
4. Effendie, M. I. 1997. Metode Biologi Perikanan. Yayasan Pustaka Nusantara, Yogyakarta. 163 hal.

5. Effendie, M. I. 2002. Biologi Perikanan. Yayasan Dwi Sari. Yogyakarta. 112 hal.
6. Ghufron. M, and H. Kordi. 2007. Pengelolaan Kualitas Air. Rineka Cipta. Jakarta.
7. Hepher, B. 1988. Nutrition of Pond Fishes. Cambridge University Press, Cambridge. New York.
8. Huet, M. 1971. Textbook of fish culture breeding and cultivation of fish. Fishing New Books, Ltd., England.
9. Lukstadt, C. and Reiti, T. 2002. Investigation on Feeding Behaviour of Juvenile Milkfish (Chanos Chanos Forskal) in Brackishwater Lagoons on South Tarawa, Kribati.Verhandlungen der Gesellschaft Fur Ichtyologie Band 3.2 (2): 37 – 38.
10. Moriarty DJW. 1999. Disease control in shrimp aquaculture with probiotic bacteria In Microbial Biosystems: Newfrontiers-proceedings of the 8th international symposium on microbial ecology. Bell, CR, Brylinsky, M, and P. Johnson- Green (eds). Atlantic Canada Society for Microbial Ecology, Halifax.
11. Muchlisin, Z.A., A.A. Arisa, A.A. Muhammadar, N. Fadli, I.I Arisa and M.N. SitiAzizah. 2016. Growth performance and feed utilization of keureling (Tor tambra) fingerlings fed a formulated diet with different doses of vitamin E (alpha-tocopherol). Archives of Polish Fisheries, 23: 47–52.
12. Purnomowati, I., Hidayati, D., and Saparinto, C. 2007. Ragam Olahan Bandeng. Kanisius. Yogyakarta.
13. Raja. S, Nandhini. E, Sahana. K and Dhanakkodi. B (2015). Beneficial and destructive effects of probiotics in aquaculture systems-A review. International Journal of Fisheries and Aquatic Studies. 2. 153-159.
14. Sabariah and Sunarto. 2009. Pemberian Pakan Buatan dengan Dosis yang Berbeda terhadap Pertumbuhan and Konsumsi Pakan Benih Ikan Semah dalam Upaya Domestikasi. Jurnal Akuakultur Indonesia. 8(1): 67-76.
15. SNI: 8005-2014. Produksi Ikan Bandeng (Chanos chanos, Forskal 1775) Ukuran Konsumsi secara Semi Intensif di Tambak.
16. Syahid M, A Subhan, and R Armando. 2006. Budidaya Bandeng Organik secara Polikultur. Jakarta: Penebar Swadaya.
17. Zonneveld N. and E.A. Huisman, and J.H. Boon. 1991. Prinsip-prinsip Budidaya Ikan. Jakarta: Gramedia Pustaka Utama. p.23-31.