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Artificial Seawater for the Culture of Milkfish *Chanos chanos* Fry and Seaweed *Gracilariopsis bailinae* in Tanks

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Abstract - The objective of this study was to compare the growth performance of milkfish *Chanos chanos* fry and seaweeds *Gracilariopsis bailinae* in tanks reared using natural seawater and artificial seawater, which was prepared from solar sea salt in a 75-day rearing experiment. The efficiency of artificial seawater prepared by dissolving solar sea salt in tap freshwater, as rearing water (25 ppt) for milkfish *Chanos chanos* fry which was co-cultured with the alga, *Gracilariopsis bailinae*, was evaluated by comparing it with natural seawater. Significant differences were observed in body weight beginning from day 15 up to day 45 ($P<0.05$), thereafter becoming insignificant at day 60 to 75 ($P>0.05$). No significant differences in absolute weight gain and computed specific growth rates between Treatment 1 and 2 (P>0.05). In terms of length, no significant differences were observed at the start of the experiment until day 15 ($P>0.05$). However, from day 30 onwards, significant differences were observed until day 75 ($P<0.05$). Likewise, a significant difference in absolute length gain was observed between Treatment 1 and Treatment 2 at 5% level. However, the computed specific growth rate in terms of length was not statistically different between the two groups ($P>0.05$). In terms of biomass growth of seaweed, the t-test showed that after 15 days, the seaweeds reared in natural seawater was already significantly heavier than those reared in the artificial water until day 75. In terms of fish survivorship, the t-test showed no significant difference between Treatment 1 and 2 ($P>0.05$). Based on the results of the study, sea salt can be used for the culture and maintenance of euryhaline fish and seaweeds but not as effective as compared to natural seawater. During the process of evaporation and crystallization, there is a possibility that other elements were lost in the process of salt making and needs to be added in preparing the artificial seawater.

Key words: Artificial Seawater; Solar Evaporation Salt; Natural Seawater; Milkfish; Seaweed

INTRODUCTION

Land-based mariculture is an alternative for the problems that are likely to occur in open sea mariculture caused by turbulence, waves, herbivory, pests and the intensive labor to operate expensive sea cages [1]. Availability of seawater in areas far from the coast and the transportation of seawater from the coast to distant inland tanks/ponds are the serious constraints affecting land-based mariculture. Hence artificial seawater made from solar evaporation salt produced by salt farmers in the Province of Pangasinan can possibly make the artificial propagation of marine organisms such as milkfish feasible in tanks and hatcheries.

There are published recipes for the preparation of artificial seawater [2]. These have been developed and used in specialized applications involving single species and for only parts of the life cycle. An artificial seawater medium formulated and successfully tried for the culture of the microalga *Chlorella* sp. [3].

Artificial seawater systems often work quite well, especially if operated very conservatively. However, for some specialized applications such as the hatchery phases of delicate organisms, there may be some problems due to complex interactions of seawater and organisms which are presently poorly understood [4]. Artificial seawater formulations that are useable with animals may not be suitable for plants or phytoplankton. Even for marine animals, a particular formulation may not be suitable to certain species or life stages.

In the Philippines, the current top milkfish producers include Capiz and Negros Occidental in the Western Visayas, Bulacan and Pampanga in Central Luzon, Pangasinan in the Ilocos Region, and Laguna in Calabarzon. In Pangasinan, two large-scale milkfish hatcheries are available but their combination of the supply is insufficient to fulfil actual demand from local fish farm operators [5], hence the need to import from other regions or even abroad. The major source of fry in the country is Indonesia. It is hoped that more hatcheries in the region could supply the much-needed fry requirement. Meanwhile, *Gracilariopsis bailinae*, also an economically important seaweed, abounds well in fishponds in Binmaley, Pangasinan especially during the dry season.

The objective of this study was to compare the growth performance of milkfish *Chanos chanos* fry and seaweeds *Gracilariopsis bailinae* in tanks reared using natural seawater and artificial seawater, which was prepared from solar sea salt.

MATERIALS AND METHODS

Experimental Design and Treatments

The efficiency of artificial seawater prepared by dissolving solar sea salt in tap freshwater, as rearing water for milkfish *Chanos chanos* fry which was co-cultured with the alga, *Gracilariopsis bailinae*, was evaluated by comparing it with natural seawater. Hence, the study had two treatments (Treatment 1) – natural seawater and artificial seawater (Treatment 2) and had three replicates per treatment. Milkfish fry were co-cultured with seaweeds in aquaria for 75 days. The salinity in all aquaria were maintained at 25 ppt. Three-week old milkfish fry were obtained from a privately-owned Bureau of Fisheries and Aquatic Resources-assisted satellite hatchery in Lingayen, Pangasinan whereas the seaweeds were gathered from brackishwater ponds in Barangay Manat, Binmaley, Pangasinan.

Stocking Density and Feeding of Fish

In each aquaria containing 60 liters of water, 100 milkfish fry (ABW = 0.51 g; ABL = 0.17 cm) and 100 g of seaweeds were stocked. Growth performance was compared in the two treatments for up to 75 days. The fish were fed at 5% of body weight daily using a commercially available feed, with the feed ration given twice a day at 9 am and 4 pm. Aeration was provided.

Sampling, Maintenance of Aquaria and Monitoring of Water Quality

Sampling was done every 15 days by obtaining the length and weight of 10 fish per aquaria using a Vernier caliper and an analytical balance, respectively. The whole thalli of the seaweeds were collected, drained for a few minutes, and total wet weight was obtained. Water was changed in aquaria by siphoning the bottom and replacing the water after every sampling period.

Temperature, pH, and dissolved oxygen levels were taken daily using the thermometer, pH meter, and DO meter, respectively whereas ammonia levels were analyzed weekly using the API ammonia test kit.

Data Treatment and Analysis

Since there were only treatments in this study, the student t-test (Excel) for two-sample with equal variances (homoscedastic) was used to compare the growth performance and survivorship of the cultured organisms in natural seawater (Treatment 1) and artificial seawater (Treatment 2). Significance level was set at 5%.

The absolute weight gain, length gain, and specific growth rates were computed as follows:

Absolute weight gain (g) = Final weight (g) – Initial weight (g)

Absolute length gain (cm) = Final length (cm) – Initial length (cm)

Specific growth rate = (ln Final – ln Initial)/number of days X 100

RESULTS AND DISCUSSION

Growth of Fish in Terms of Weight

Figure 1 shows the trend in growth of milkfish fry throughout the 75-day culture period. Significant differences were observed in terms of weight beginning from day 15 up to day 45 (P<0.05), thereafter becoming insignificant at day 60 to 75 (P>0.05).

In terms of weight gain after 75 days, no significant difference in absolute weight gain (P>0.05) between Treatment 1 (1.56 g) and Treatment 2 (1.45 g), as well as no significant difference (P>0.05) in computed specific growth rates at 1.62% and 1.55%, for Treatments 1 and 2, respectively.

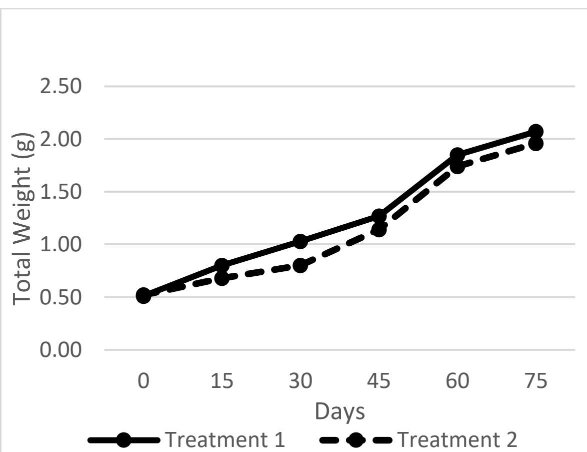

Figure 1. Growth curve of milkfish fry in terms of weight for 75 days.

Growth of Fish in Terms of Length

Figure 2 shows the growth trend in terms of length of milkfish cultured in natural seawater (Treatment 1) as compared to artificial seawater (Treatment 2) for 75 days. No significant differences were observed at the start of the experiment until day 15 (P>0.05). However, from day 30 onwards, significant differences were observed until day 75 (P<0.05).

In terms of body length gain, a significant difference was observed between Treatment 1 (0.30 cm) and Treatment 2 (0.24 cm) at 5% level. However, the computed specific growth rate in terms of length was not statistically different between the two groups (P>0.05).

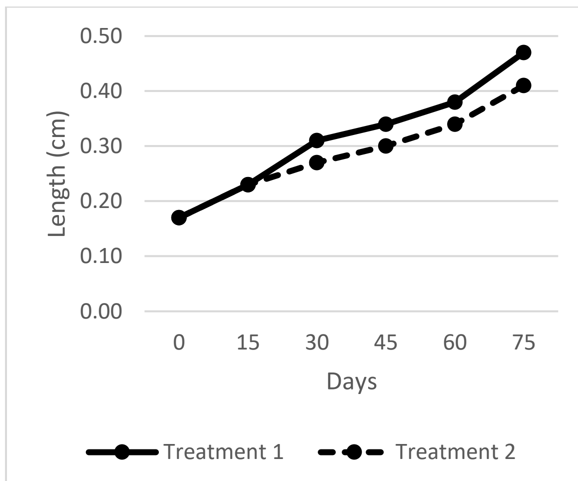

Figure 2. Growth curve of milkfish fry in terms of length for 75 days.

Biomass Gain of Seaweed

Figure 3 shows the biomass (g) of seaweed, *G. bailinae* after every sampling period throughout the 75-day culture period. The t-test showed that after 15 days, the biomass of seaweeds reared in natural seawater was already significantly heavier than those reared in the artificial water. The trend continued until the end of the culture period.

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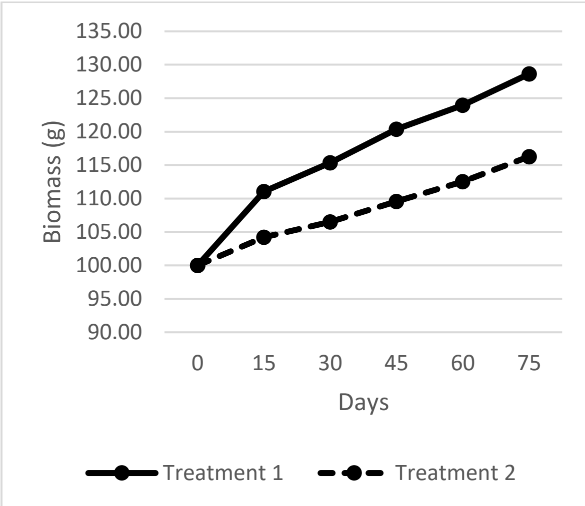

Figure 3. Biomass (g) of seaweed *G. bailinae* throughout the 75-day culture period.

Survivorship of Fish

The survival rate of milkfish fry reared in both natural seawater and artificial seawater was taken only at day 75 or at the end of the culture period in order not to expose the fish to undue stress. The t-test showed no significant difference between the mean survival rate between Treatment 1 (61.67%) and Treatment 2 (55.33%).

Water Quality Monitoring

Water temperature ranged from 24.9 to 27.1°C in Treatment 1 and from 24.7 to 27.7°C in Treatment 2 during the entire culture period. Dissolved oxygen ranged from 4.02 to 5.28 mg/L in Treatment 1 and 3.84 to 5.10 mg/L throughput the experiment whereas pH ranged from 6.18-6.91 and 6.26-6.93 for Treatments 1 and 2, respectively. On the other hand, ammonia levels ranged from 0 to 1.50 mg/L and 0 to 2.0 mg/L for Treatments 1 and 2, respectively. Ammonia levels began to increase during the third week at 0.25 mg/L for both treatments.

The water temperature, pH, and DO were all within desirable levels for the culture of aquatic species whereas total ammonia (both ammonium and ammonia) is pH related. With the pH values of less than 7 reported here, the less quantity of the toxic ammonia is available in the water and the greater the concentration of non-toxic ionic ammonium.

The use of solar salt as rearing media for marine organisms can support the growth of euryhaline marine organisms such as milkfish and seaweed to some extent but not as ideal compared to natural seawater, just as it is. Other elements may have been lacking. For instance, an artificial seawater made from salt crystals for the maintenance of commercial seaweeds (*Ulva lactuca*, *Gracilaria edulis*, and *G. corticata*) with comparable growth as compared to those reared in natural seawater [1]. However, the artificial seawater of 33 ppt was prepared by dissolving 3.5 kg of sea salt crystals in 100-L of fresh water along with 100 g of calcium chloride and 10 g of sodium bicarbonate.

The characteristics of artificial seawater as well as natural seawater used to culture seaweeds such as pH, salinity, TDS, dissolved nutrients and also chlorophyll pigments, photosynthesis and respiration of seaweeds at the end of culture period were also compared. Except for the levels of dissolved nutrients and phytosynthetic potential, no major variations could be observed in the characteristics between the artificial and natural seawater media [1].

Artificial seawater was also prepared for the stock culture of a microalga *Chlorella* sp. [3]. Aside from the common salt crystals as the major ingredient, 16 other chemical elements were added in minute amounts such as gypsum, sodium bicarbonate, potassium bromide, magnesium chloride, sodium sulphate, potassium chloride, boric acid, calcium chloride, strontium nitrate, zinc acetate, potassium phosphate, lithium chloride, aluminum sulphate, sodium thiosulphate, potassium sulphate, and EDTA.

In another study, the use of commercially available salt and crude common salt was compared in preparing artificial seawater for larval rearing of *Macrobrachium malcolmsonii* at 18 ppt, the required salinity for larval development [6]. They reported higher production of 50.39 post-larvae/L in crude common salt medium than 47.03 post-larvae/L in synthetic brackish water medium as well as significantly higher survival (50.47%) in crude common salt medium than in the synthetic medium (47.07%).

The sea salt used in the present study was obtained by solar evaporation and natural crystallization. Solar evaporation salt is a seasonal activity during the dry season wherein the water evaporates under the effect of the sun and the wind, and the water salinity increases, until crystallization of the salt is obtained. During the process of evaporation and crystallization, there is a possibility that other elements were lost in the process and needs to be added in preparing artificial seawater.

Based on the results of the study, sea salt can be used for the culture and maintenance of euryhaline fish and seaweeds but not as effective as compared to natural seawater. Technically, seawater is a complex mixture of 96.5 percent pure water, 2.5 percent salts, and smaller amounts of other substances, including dissolved inorganic and organic materials, particulates, and dissolved gases [7]. It is recommended that the sea salt in the study must be analyzed for its exact chemical composition to determine the chemical elements lacking in it, in order to use it in the preparation of artificial seawater for rearing marine fish, invertebrates, and algae.

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REFERENCES

[1] Kaladharan, P. 2000. Artificial seawater for seaweed culture. *Indian Journal of Fisheries* 47(3): 257-259.

[2] Bidwell, J.P. and S. Spotte. 1985. Artificial Seawaters - Formulas and Methods. Jones and Bartlett Publishers, Boston, 350 pp.

[3] Natarajan, P., S. Palanisamy, S. Mohan and R. Thiagarajan 1997. Development of novel techniques to maintain Chlorella spp. stock culture in artificial seawater. Marine Fisheries Information Service Technical and Extension Service No. 149, Central Marine Fisheries research Institute, p. 12-13.

[4] Huguenin, J.E. and J. Colt. 1989. Design and Operating Guide for Aquaculture Seawater Systems. Elsevier, Amsterdam, 263 pp.

[5] German, J.D. and M.A.G. Catabay. 2018. Analysis of milkfish supply chain in the Philippines: A case study in Dagupan, Philippines. AIP Conference Proceedings. 4th Electronic and Green Materials International Conference. DOI:10.1063/1.5080860

[6] Soundarapandian, P., John Samuel, M. and T. Kannupandi. 1994. Commercial production of *Macrobrachium malcolmsonii* seeds using synthetic water and crude common salt. *Mahasagar* 27(2): 139-142.

[7] Thurman, H.V. and A.P. Trujillo. 2001. Essentials of Oceanography. Seventh Edition. Prentice Hall.