

Production of Endemic Microcrustacean *Phronima Suppa* (*Phronima sp*) to Substitute *Artemia salina* in Tiger Prawn Cultivation

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Abstract

Phronima suppa (*Phronima sp.*) belongs to an endemic microcrustacea species inhabiting certain brackish water pond in Wiringtasi Village, Suppa Sub-district, Pinrang Regency, Indonesia. It has an important role to increase vitality and immunity of tiger prawn (*Penaeus monodon*) and to improve environmental quality of the brackish water pond. This species has potential chance to substitute the use of *Artemia*. Population of *Phronima suppa* in nature fluctuates, falls and even perishes after around 15 days. This study aims to produce *Phronima suppa* to be used as inoculant in the prawn brackish water pond and to substitute the use of *Artemia* in hatchery. The study is conducted in May to November, 2013 in the Field Laboratory of Fisheries and Maritime Science, Muslim University of Indonesia in Pinrang Regency. *Phronima suppa* is cultivated in controlled basin under treatment (A) by *Chlorella* sp, treatment (B) by *Chaetoceros* sp, and treatment (C) by combining *Chlorella* sp and *Chaetoceros* sp. Observed variables consist of production and water quality. The study is designed in form of Completely Randomized Design (CRD) by three treatments, while each of the treatments consist of three repetitions. Combination of *Chlorella* sp and *Chaetoceros* sp (treatment C) delivers the highest production by 35.67 ± 15.01 individual/l followed by treatment B by 34.67 ± 7.51 individual/l and treatment A by 27.35 ± 0.57 individual. This production increases in day 17 up to day 24. Productive period of *Phronima suppa* in the controlled basin is longer than in endemic habitat.

Keywords: Tiger prawn; Production; Artemia; Phronima; Plankton

Introduction

For the last twenty years, tiger prawn aquaculture industry has been attacked by white spot syndrome (WSSV) and *Vibrio harveyi* affected by the decrease of environmental capacity [1-11], lousy management of aquaculturalist [12-16] and the impacts of extreme climate change in consequence of global warming. The viruses affect about 70% of brackish water pond area in Indonesia at marginal and idle state as attacked by WSSV and *V. Harveyi* virus. Unproductive brackish water pond area in South Sulawesi, Indonesia covers an area of about 39,022 ha. It is predicted that crop failure in South Sulawesi wrecks loss of aquaculturalist around USD33.4 million per year. Loss prediction affected by shrimp disease outbreak in Indonesia reaches more than USD300 million or more than IDR3 trillion per year [13].

South Sulawesi has been appointed to be development center for tiger prawn (*Penaeus monodon* Fabricius) in Indonesia. Appointed development center for tiger prawn in South Sulawesi is located in Pinrang Regency [17]. For the last three years, population of *Phronima sp* grows up naturally in certain people's brackish water area in Suppa Sub-district, Pinrang Regency [18]. *Phronima suppa* belongs to micro crustacean from genus *Phronima* and it is endemically live in the waters of people's brackish water in Wiringtasi Village and Tasiwale Village, Suppa Sub-district. *Phronima suppa* could not be found in brackish water and waters out of those villages. The existence of *Phronima suppa* becomes an initial indicator for aquaculturalist in Suppa Sub-district as presumption of tiger prawn cultivation success to the under-attacked brackish water area by WSSV and *V. harveyi* virus [18].

Observation of the last two years shows that in average, population of *Phronima suppa* in brackish water area may generate tiger prawn survival rate of more than 70 percent for four months during period of cultivation. In the other area where *Phronima suppa* were not found, survival rate of cultivated tiger prawn as just about 10 percent [18]. It is assumed that *Phronima suppa* has an important role to improve

water quality and brackish water's basic substrate in compliance with the conditions of tiger prawn. Besides, it also becomes natural feed for the cultivated tiger prawn. The better water and soil quality restrains explosive growth of upsetting pathogen, especially for WSSV and *V. harveyi* virus. Furthermore, rich nutrient in *Phronima suppa*, as what has been presumed, may support the growth and natural immunity formation on tiger prawn against upsetting pathogen. One last year, the use of *Phronima suppa* in marginal brackish water ponds of Wiringtasi Village and Tasiwale Village have produced tiger shrimp by 150-300 kg/ha around two-months of rearing period.

Phronima suppa has a potency of being alternative natural feed by replacing *Artemia* which is commonly given to fish and tiger prawn hatchery. *Artemia salina* cyst belongs to a high-priced import product which continually more expensive up to 180.70 percent since last year, so it affects competitiveness of fisheries and tiger prawn product in Indonesia. *Phronima suppa* could be an alternative or substitutive feed replacing *Artemia*, so it may raise production efficiency and product competitiveness of prawn in Indonesia.

Informational restrictiveness on biological, ecological and physiological characteristics and cultivation techniques become main constraints in *Phronima suppa*'s cultivation development and

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production artificially and massively. Previous study to produce *Phronima suppa* artificially had been conducted by [18]. However, in the first week of the study, its mortality rate reaches 100 percent. Unclear details on quality conditions of media and substrate, fertilizer and feed needs as well as cultivation management become the main factors of *Phronima suppa*'s low production in artificial manner.

The dynamics of habitat and endemic environment is determined by hydro-oceanography diversity, soil and substrate as well as brackish water management. Biological potency diversity is determined by abundance, homogeneity and domination of *Phronima suppa*. Reproduction potency of *Phronima suppa* is determined by availability of mature broodstock and fecundity rate. Determinant of endemic habitat and environmental dynamics as well as biological potency of *Phronima suppa* is dominant attributes in production technology development of developed *Phronima suppa* artificially. Production in the controlled basin becomes an important factor in supplying continual *Phronima suppa* to support tiger prawn hatchery and cultivation management [9,19]. The study aims to produce *Phronima suppa* continually to be used as inoculant in prawn brackish water pond and to substitute the use of *Artemia* in hatchery.

Materials and Methods

The study is conducted in May to November, 2013 in the Field Laboratory of Fisheries and Maritime Science, Muslim University of Indonesia in Pinrang Regency. *Phronima suppa* is cultivated in the controlled basin under treatment of *Chlorella* sp (A), *Chaetoceros* sp (B), and combination of *Chlorella* sp and *Chaetoceros* sp (C). Cultivation on these plankton species applies the system based on the study of [20-26]. *Phronima suppa* is dispersed onto each of these basins

by 100 individuals per basin (Figure 1). Volume of each basin is 30 l or dispersion density of each basin is 3.33 or 3.00 individual/l [27,28].

Observed variables consist of production and water quality. Production of *Phronima suppa* is determined by equation as follows:

$$P=Nt/V$$

$$P=\text{Production (individual/l)}$$

$$Nt=\text{Amount of } Phronima \text{ suppa} \text{ in the end of study (individual)}$$

$$V=\text{Water volume (l)}$$

Observed water quality consists of temperature, salinity, dissolved oxygen, pH, and ammonia as applied by previous researchers [10,29-41]. The study is designed in form of Completely Randomized Design (CRD) by three treatments, while each of the treatments consist of three repetitions [19,42].

Findings and Discussion

Found plankton in endemic habitat of *Phronima suppa* is 25 genera consisting of 14 genera from species phytoplankton and 11 genera from species zooplankton [27]. Given plankton becomes prior feed in the controlled basin as in the study of [26,43]. Production of *Phronima suppa* in every basin is presented in following Table 1.

Production of *Phronima suppa* in every treatment increases over observation period. Initial dispersion in every treatment and repetition by 3.33 or equals to 3.00 individual/l increases over observation period. The highest production is gained in day 17 by amount of every treatment as follows: treatment C (20.37 ± 8.02 individual/l), treatment A (19.72 ± 4.36 individual/l) and treatment B (18.52 ± 3.20 individual/l). In day 24, highest production is gained by treatment C (35.67 ± 15.01 individual/l) followed by treatment B (34.67 ± 7.51 individual/l) and treatment A (27.35 ± 0.57 individual/l). In day 24, the order of production changes where the highest production is reached by the second and third treatment compared to observation in day 17.

Result of variance analysis toward all of plankton-added treatments have unreal effect statistically concerning the production of *Phronima suppa* ($P>0.05$) in day 17 or day 24 due to the production of *Phronima suppa* in all treatments are considered as high. It can be proved by comparing the findings above and the findings of [28]) as presented in Table 2 and Figure 2. The highest product average based on the findings of [28] by feeding brackish water bottom soil substrate (treatment Q) in day 24 is 22.53 ± 8.08 individual/l; then followed by feeding silk algae substrate (*Chaetomorpha* sp) or treatment P is 7.72 ± 7.42 individual/l and feed combination of brackish water bottom soil substrate and silk algae or treatment R is 4.90 ± 1.96 individual/l. The death of silk algae in the observed basin causes the death of *Phronima suppa*. Then, decomposition of silk algae in the observed basin makes the observed object stress and dead [15,23]. Findings on the use of substrate takes an obvious effect ($P<0.05$) on the highest production by giving brackish water bottom soil substrate (treatment Q) at the same findings of [44-47].

In fact, treatment C produce a higher product average compared to treatment B and A in day 24 (Table 1 and Figure 2). Based on the findings of [20,25]. It is explained that *Chaetoceros* sp contains 35.00% protein, 6.90% fat, 6.60% carbohydrate and 28.00% ash content. *Chlorella* sp contains 21.85% protein, 2.41% fat and 23.78% carbohydrate. Treatment C made from the combination of *Chaetoceros* sp and *Chlorella* sp supplies the more complete and varied nutrient to produce the highest production compared to treatment A and C in day 24.

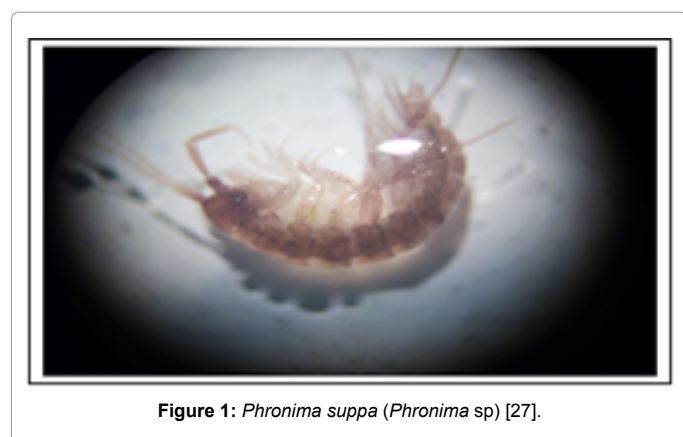


Figure 1: *Phronima suppa* (*Phronima* sp) [27].

Observation Period	Repetition	Treatment		
		A	B	C
Day 17	1	17.78	16.67	11.11
	2	24.72	22.22	25.00
	3	16.67	16.67	25.00
	Amount	59.17	55.56	61.11
	Average	19.72 ± 4.36	18.52 ± 3.20	20.37 ± 8.02
Day 24	1	27.00	35.00	35.00
	2	28.06	42.00	51.00
	3	27.00	27.00	21.00
	Amount	82.06	104.00	107.00
	Average	27.35 ± 0.57	34.67 ± 7.51	35.67 ± 15.01

Table 1: Production of *Phronima suppa* (individual/l) during research.

Treatment	Repetition	Production (individual/l)
P	1	15.58
	2	6.74
	3	0.84
	Total	23.16
	Average	7.72 ± 7.42
Q	1	29.22
	2	24.81
	3	13.55
	Total	67.58
	Average	22.53 ± 8.08
R	1	4.42
	2	3.22
	3	7.06
	Total	14.70
	Average	4.90 ± 1.96

Table 2: Product average of *Phronima suppa* based on the findings of Fattah et al., [28] in day 24.

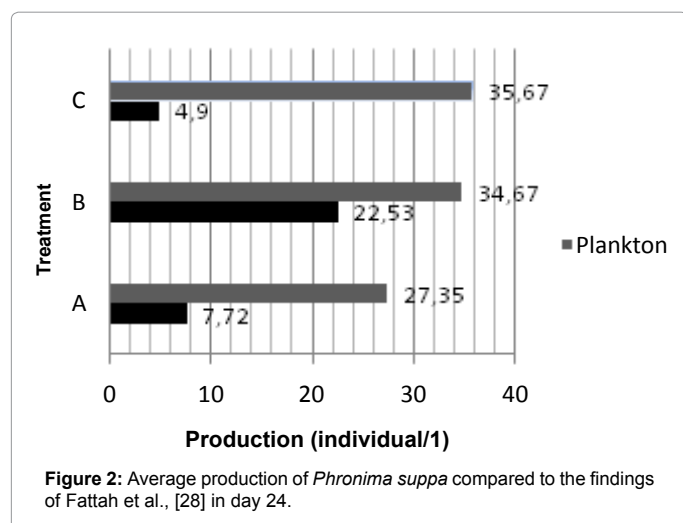


Figure 2: Average production of *Phronima suppa* compared to the findings of Fattah et al., [28] in day 24.

In day 17, the highest average production is reached by treatment C (20.37 ± 8.02 individual/l) followed by treatment A (19.72 ± 4.36 individual/l) and treatment B (18.52 ± 3.20 individual/l). The highest average production in day 24 is gained by treatment C (35.67 ± 15.01 individual/l) followed by treatment B (34.67 ± 7.51 individual/l) and treatment A (27.35 ± 0.57 individual/l). Production in day 1, day 17 and day 24 are presented in Figure 3.

Production of *Phronima suppa* increases gradually from day 17 to day 24 (Figure 3). Production enhancement depicts that production of *Phronima suppa* is in logarithmic phase and it has not reached stationary phase (Figure 3). Production of *Phronima suppa* in this study has not reached subsequent phase, i.e. stationary phase (c), depletion phase (d) or death phase (e). Growth curve of *Phronima suppa* follows common growth model of water organism [16,39,41,48-50]

Productive period of *Phronima suppa* in controlled basin is longer than in endemic habitat. Stationary phase (c), depletion phase (d) and death phase (e) in endemic habitat occur in day 15 [27]. These three phases have not been determined in this study (Figure 4).

Continual availability of natural feed and complete environmental factor control affects productive period of *Phronima suppa* which is longer than its productive period in controlled basin compared to endemic habitat. It becomes an indication that *Phronima suppa* may be

produced on a sustained basis by feeding combination of phytoplankton species *Chlorella* sp and *Chaetoceros* sp. It opens up an opportunity to produce *Phronima suppa* as a substitution of *Artemia salina* for the operating-hatchery needs and brackish water cultivation.

Life of *Phronima suppa* is highly affected by media quality. It conforms to the statement of [1,48] that the life of waters organism is highly affected by physical and chemical factor of the waters. As a whole, media quality in all treatments are homogeneous, so they can meet the requirements of CRD design, but they are negatively affecting research process. All parameters are in appropriate range with value of media quality condition based on the reference (Table 3). Taken together, media inside of controlled basin meets the life requirements of *Phronima suppa*. It correlates to the findings of [27] who observes population of *Phronima suppa* in its endemic habitat.

Ammonia content in the observed basin is higher than what is written in the reference. Ammonia concentration in the observed basin comes from metabolism of testing animal and plankton. It depicts that *Phronima suppa* has high tolerance toward ammonia content. The effect of high ammonia content in the observed basin may be neutralized or controlled by plankton.

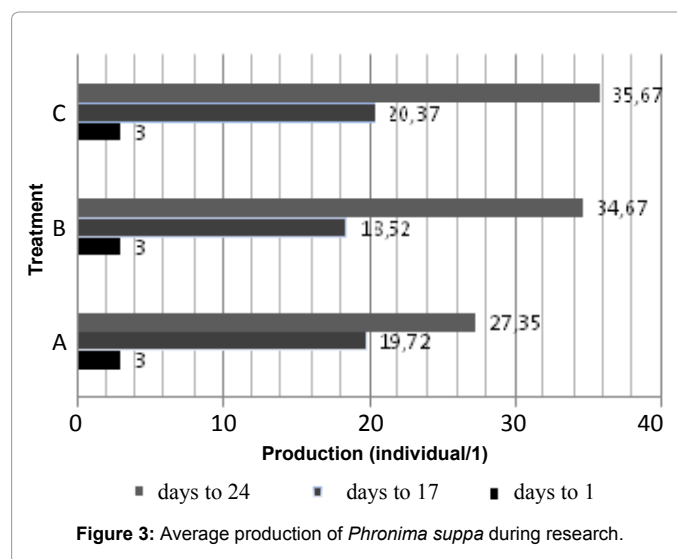


Figure 3: Average production of *Phronima suppa* during research.

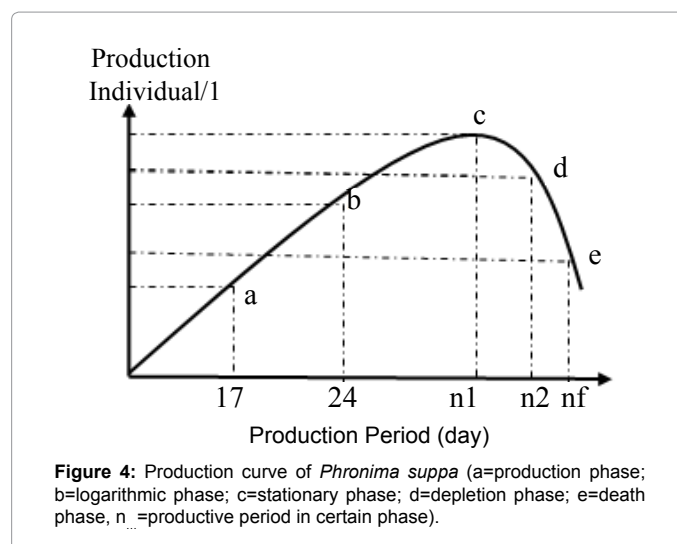


Figure 4: Production curve of *Phronima suppa* (a=production phase; b=logarithmic phase; c=stationary phase; d=depletion phase; e=death phase, n₁...=productive period in certain phase).

Observed media factors	Indicator value range of media quality			Indicator value range of media quality based on the reference [27]
	Treatment			
	A	B	C	
Temperature (°C)	27.00-31.00	27.00-31.00	27.00-31.00	30.30-38.00
Salinity (ppt)	31.0-35.0	31.0-35.00	31.0-35.0	21-27
Dissolved oxygen (ppm)	4.9-5.6	4.7-5.6	4.9-5.4	2.6-4.9
pH	8.0- 9.0	8.0-9.0	8.0-9.0	8.0-9.0
Ammonia (ppm)	1.7-3.5	1.7-3.5	1.8-3.5	0.08-1.47

Table 3: Indicator value range of media quality based on the calculation and indicator value range of media quality which meets the life and growth requirement of *Phronima suppa*.

Conclusion and Suggestion

Based on the findings, it is concluded that *Phronima suppa* may be produced in controlled basin by feeding plankton from species *Chaetoceros* sp, *Chlorella* sp, and combination of *Chaetoceros* sp and *Chlorella* sp. Feed combination of *Chaetoceros* sp and *Chlorella* sp delivers a higher product compared to single feed made from *Chaetoceros* sp or *Chlorella* sp. It is suggested to combine *Chaetoceros* sp and *Chlorella* sp to reach continuous *Phronima suppa* production.

Potency possessed by *Phronima suppa* may be set as national leading product and substitution of *Artemia salina* to improve national product competitiveness of tiger prawn. Hence, national policy and private sector support are needed to improve this species.

Credits

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