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Intensive shrimp *Penaeus semisulcatus* Dee Haan, culture in the Arabian Gulf during the summer

By

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ABSTRACT

P. semisulcatus juveniles (average weight 9.7g) from Manifa Lagoon on the Arabian Gulf were randomly stocked in tanks (0.8m^3) at three stocking density levels (25, 50 and 75 shrimp/m^3) in four replicates.

The tanks were put together in a flow-through system and were covered with plastic nets. Water flow rates were 1, 2, and 3 litres/min for densities 25, 50 and 75 shrimp/m^3, respectively, Filtered aerated seawater (30± 3 °C) was utilized. Fresh water was mixed with the seawater to keep water salinity down to 39‰. The whole system was shaded to reduce water temperature from the direct sun light. Shrimps were fed during the night for six weeks experimental period. No mortality occurred throughout the experimental period. Growth rates were similar in the three stocking densities, under the experimental conditions. Future studies are needed to determine the maximum sustainable stocking densities.

INTRODUCTION :

During the last 25 years, shrimp aquaculture has been developing rapidly in many places around world . In Saudi Arabia, most cultured shrimp species. (*P. monodong* and P. *indicus*) have lower marketable value than *P. semisulcatus*. Many researchers in Kuwait, Saudi Arabia and UAE have succeeded in producing postlarval *(p.p. semisulcatus)* using the common shrimp hatchery techniques (Farmer and Al-Attar, 1981; Al-Attar, 1978; Mohamed, El-Musa and Abdul - Ghaffar, 1981). However, the growout trials of the same species failed due to a problem with cannibalism, which could not be overcome under the semi-intensive culture condition. In other words, cannibalism has been identified as a constraint to the intensive production of *P. semisulcauts.* (Therefore, the only source of *P. semisulactus* is from the natural stock).

The purpose of this study is to compare *P. semisulcatus* at different stocking densities and to overcome the cannibalism and the effect of high water temperature during the summer months in the Arabian Gulf. (This will be accomplished using environmental manipulation techniques. Survival and growth rates will be indicators of the experimental success rate).

MATERIAL AND METHODS

Culture condition :

Juvenile shrimps were collected by a commercial fisherman from Manifa Bay in The Arabian Gulf using a small boat. Shrimps were transferred, to concrete tanks 0.8 m^3 in dark cool room (18°C) for a two weeks adaptation period with feeding at maintenance level in tanks. Groups of 20, 40 and 60 mixed sexes *P. semisulcatus* *(average weight 9.7g) were randomly stocked into 0.8m^3 four rpplicates tanks arranged in a flow-through system as described by Garling and Wilson (1976). Each tank was considered as an experimental unit. Tanks were covered with plastic net. The whole system was shaded ? to prevent direct sunlight from raising water temperature and to reduce light intensity. The tanks were aerated using 0.5 HP air-compressor connected to one 25 cm airstone in each tank to keep dissolved oxygen level between 8-9 ppm. Seawater was pumped from a depth of 5m from Manifa Bay and mixed with well water to reduce water salinity from 44 to 39 ppt. The mixed water with an average temperature of 30 ±3°C was used after filtration using slow sand filter and aeration to remove aquatic organisms, solid particles, excessive iron and undesired gases such as hydrogen sulfide and carbon dioxide.

Experimental diet :

Shrimp grower produced by Provimi B. V. ROT 9791 2 mm in size was utilized. The daily ration was based on 10 percent of the shrimp body weight divided into five feedings from sunset to early morning. Shrimp were weighed every two weeks and the amount of feeds were adjusted accordingly. The experiment was conducted for six weeks. The tanks (0.8m^3) were flushed by lowering water level down to half every day at 0800 h. to get rid of any organic wastes, and to count the number of molts. At the end of the experiment all the shrimp from each tank were weighed individually .

Analyses :

Diet samples were analyzed in triplicate for moisture, crude protein, crude fat (ether extract), crude fiber and total ash content. The methods of analyses were performed as described in AOAC (1980) .

One-way analysis of variance (ANOVA) and Duncan's multiple range test were used to compare treatment means for significant differences (Snedecor and Conchran, 1981).

Results :

No disease symptoms nor mortality occurred in any of the stocking density levels (treatments) throughout the experimental period. It was noticed that stating on the 3rd week that molts occurred at almost constant times and were not consumed by the shrimp. Covering the system with a shade helped reducing water temperature from 36 °C to 33 °C at noon which inturn resulted in reducing heat stress during the experiment. Water quality parametres (Do (8-9 ppm) and pH (7.7-7.2) did not change significantly ($P>0.05$). That were due to the high mixed seawater flow rate and the daily flushing technique used in this study.

The proximate analysis values of the experimental feed are presented in Table1. These values agreed well with the estimated values, which were recommended for shrimp by the National Research Council of the USA (1993). The growth and feed efficiency parametres of *P. semisulcatus* are shown in Table 2. There was no significant difference among the initial and final weights and feed conversion rates of shrimp ($P>0.05$) This indicates that different stocking densities (25, 50 and 75 shrimp/m^3) did not have any effect on the growth rate of the shrimp. Average growth rate was on gram per week.

Discussion

Shrimp is known to be nocturnal, which means that their feeding activities are throughout the night. However, feeding is during the daylight in most shrimp farms, that cause some level of cannibalism. depending on species. Cannibalism was found to be high in *P. semisulcatus* species. Additionally, shrimp, unlike fish which will engulf large quantities of food and have a relatively elastic stomach, externally masticate their food and have a relatively inelastic stomach. Under natural conditions penned shrimps are considered to be omnivorous scavengers or detritus-feeder that appear to have a frequent or continuous feeding pattern when active (Wickins, 1976). Therefore, if shrimp were fed during the night in frequent meals, the inelastic stomach will always be full during the high feeding activity and the problem with cannibalism would be eliminated. This was clear in our study, when *P. semisulcatus* were fed five times during the night, cannibalism was eliminated. Furthermore, feeding during the night at a lower water temperature (27°C) reduced the stress of feeding during the daylight at higher water temperature 33°C during summer months.

Many studies have shown shrimp growth performance is reduced, as the stocking rate is increased (Brown, Wilson, Wetzei and Hoene, 1995; Reid and Arnold, 1992 Sandifer, Hopkins and Stokes, 1987). In our study, however, growth performance was not affected by increasing the stocking rate (25, 50 and 75 shrimp/m^3) ($P>0.05$). This is probably due to the increase in water exchange rates (1.8, 3.6 and 5.4 times/day) as the stocking rate increases (25, 50 and 75 shrimp/m^3) respectively. This is in addition to the daily 50% water flushing of the experimental tanks technique. This would probably lead to a significant reduction in waste (NH_3, H_2S, organic matter ... etc) and an increase in Do in tanks as the stocking density increased (Another study by Heinen and Mensi (1991), showed that feeding *Macrobrachium rosenbergii* more than once reduced the growth rate. That was probably, because of poor water quality. The researchers used insufficient filtration system to be able to feed more than once.

P. semisulcatus growth rate observed in this study as compared other previous studies was higher than that of *P. indicus* and *P.vannamei*) and lower than that of *P. mondon.* (Reid and Arnold 1992, Arnold , Reid and Brawner 1990, and Bukhari, Carlos and Cas 1989).

In summary, *P, semisulcatus* was successfully reared under the culture conditions used in this study. Growth rates were similar in the three stocking densities as a result of increasing the water exchange rate with increasing the stocking density, under the experimental conditions.

Future long term studies are needed to determine the maximum sustainable stocking densities.

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Table 1. Percentage of proximate analysis of the test diet1 on a dry weight basis

COMPOSITION	PERCENTAGE
CRUDE PROTEIN	47
CRUDE FAT	7
CRUDE FIBER	1.7
TOTAL ASH	11
CARBOHYDRATE (NFE) [2]	33.3

1 - Type : Shrimp grower PROVIMI B.V. ROT 9791
2 - Determined by difference

Table 2. Stocking densities and growth rates of performance *P. Semisulcatus* attached at different densities

Stocking Densities Shrimp/m3	Mean Initial Weight/Shrimp (gram)	Mean Final Weight/Shrimp (gram)	Mean Net Weight/Shrimp (gram)	Feed Conversion Rate
25	9.95	16.13	6.18 [a]	2.4 [a]
50	10.57	16.61	6.04 [a]	2.6 [a]
75	8.53	13.89	5.36 [a]	2.5 [a]

Column with same superscript are not significantly different (P>0.05)