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# Culture Trial of *Penaeus monodon* in Concrete Tank

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## ABSTRACT

Culture trial of the Tiger Shrimp (*Penaeus monodon*) was carried out in one of the grow-out concrete tanks at Nigerian Institute for Oceanography and Marine Research, Victoria Island, Lagos. A total of 264 post larvae of *P. monodon* (PL 30) produced at the Institute's shrimp hatchery complex were used for the experiment which lasted for 157 days. Coppens Catco feed of 0.8-1.2 mm size was used to feed the post larvae throughout the duration of the experiment. The results showed that the shrimps grew from an initial mean body weight of 1.763±0.647 g at stocking to 19.538±2.293 g at the end of the experiment. The daily growth rate was 0.113 g day$^{-1}$ while specific growth rate was 1.532%. Food Conversion Ratio (FCR) was 3.36 while survival rate was 90%. The study has shown that *P. monodon* can be successfully cultured in concrete tanks. However, further studies aimed at improving growth rate will be undertaken.

**Key words:** Farmed shrimp, culture systems, water quality, NIOMR

## INTRODUCTION

Farmed shrimp products are becoming important in the world market accounting for nearly 30% of total world shrimp output in 1990 (FAO, 2003). Cultured shrimp is more valued in the world seafood market being traceable than from the wild and these marine shrimps continue to dominate crustacean aquaculture production globally (FAO, 2003). In recent years, a lot of development has been made in the farming of shrimp all over the world. The Tiger shrimp (*Penaeus monodon*) is the major species cultured accounting for 58% of total global farmed shrimp production (Rosenberry, 1998). It has the fastest growth rate among all penaeid species and it is the largest species of shrimp globally. The leading countries in shrimp production include China, Thailand, Indonesia and other Asian countries with over 1.2 million hectares of shrimp ponds (Chemonics, 2002). Culture systems for shrimp farming range from earthen ponds, concrete tanks to closed intensive water recirculation systems. However, earthen ponds are the most conventional systems used in Asian countries (FAO, 2009).

Shrimp farming is not yet developed in Nigeria although members of the penaeid family especially *P. monodon* which is the most widely cultured species globally occur in the coastal waters (Dublin-Green and Tobor, 1992; Ebonwu *et al*., 2007; Adetayo, 2008; Ayinla *et al*., 2009). The capture of shrimp from the wild in Nigeria is fast depleting as a result of overexploitation, destruction of breeding ground, oil spillage and other pollutants which have resulted in lowering catch per unit effort. To ensure that there is availability of enough shrimps/prawns and their

products for local consumption and also for export, it is urgent to develop technologies for the production of black tiger shrimp *P. monodon* in Nigeria (Ebonwu *et al.*, 2007). This study was carried out to ascertain the feasibility of commercial shrimp farming in Nigeria using concrete tank.

## MATERIALS AND METHODS

**Preparation of concrete tank:** The study was conducted at the newly re-constructed shrimp grow-out concrete tank of the Nigerian Institute for Oceanography and Marine Research (NIOMR), Victoria Island, Lagos. The out-door concrete tank measuring 5.3×2.5×1.15 m was washed and painted with epoxy paint to provide smooth interior surface. Rows of PVC perforated pipes were laid on the tank bottom to serve as water-air-lift aeration system and then covered with a layer of granite followed by a layer of marine sharp sand. The sand was treated with hydrated lime to kill unwanted organisms. The tank was filled with treated and filtered full strength sea water and continuously aerated. Shelters constructed of mosquito nets were installed inside the tanks to provide hiding areas for molted shrimps. Three feeding trays were also installed inside the tanks for monitoring feeding behavior of the shrimp.

**Stocking and feeding:** Post larvae of *P. monodon* used for this culture trial were collected from NIOMR shrimp hatchery. A total of 264 post larvae at size $PL_{30}$ were stocked in the grow-out tank at a density of 26 post larvae (PL30) $m^2$ for table shrimp production. The mean b.wt. at stocking was 1.763±0.647 g while the total length was 5.8±1.0 cm. The shrimp larvae were fed 0.8-1.2 mm imported extruded COPPENS feed twice daily at 3% b. wt. The amount of feed given was adjusted every two weeks. Uneaten feed and other solid wastes were removed daily.

**Water quality monitoring and shrimp sampling:** Water quality was monitored daily during the culture period. Ammonia, nitrite and alkalinity were monitored using LaMotte water kit while water temperature and pH were monitored with the use of portable temperature/pH-009 (111) ATC meter. Air temperature was monitored using mercuric in glass thermometer and salinity was measured using Refractometer (Atago model). Dissolved oxygen was maintained at saturation level using 1.5 hp GF 180 electric air blower which provided an air-water-lift system. Sampling for growth measurements and calculation of feed rations were carried out every two weeks. The total length was measured from the tip of the rostrum to the tip of the telson using a transparent ruler while Sartorius analytical sensitive balance was used for body weight measurement. Other measurements taken were carapace, abdominal and telson lengths. The shrimps were harvested after a culture period of 157 days.

## RESULTS

Data obtained from the study showed that *P. monodon* grew from an initial body weight range of 1.068-2.450 g (Mean = 1.763±0.647 g) at stocking to 17.301-24.704 g (Mean = 19.538±2.293 g) at the end of the culture trial. Similarly the total length ranged from 4.5-6.8 cm (Mean = 5.8±1.0 cm) at stocking and 13.5-16.2 cm (Mean = 14.6±0.7 cm) at harvest. The details of size measurements are presented in Table 1. The summary of growth parameters presented in Table 2 indicated that daily growth rate was 0.113 g $day^{-1}$ while specific growth rate was 1.532%. Food Conversion Ratio (FCR) was 3.36 while survival rate was 90%. A yield of 4.69 kg was obtained at harvest which by extrapolation gave 3539 kg $ha^{-1}$. Water quality parameters measured during the study period showed that pH ranged from 7.15-7.78, salinity 30-38 ppt,

Table 1: Size measurements of *P. monodon* reared in concrete tank

| Date of sampling | Body weight range (g) | Mean body weight (g) | Total length range (cm) | Mean total length (cm) | Carapace length (cm) | Abdominal length (cm) | Telson length (cm) |
|---|---|---|---|---|---|---|---|
| 23-04-09 (stocking) | 1.068-2.450 | 1.763±0.647 | 4.5-6.8 | 5.8±1.0 | 1.8-2.7 | 2.0-3.2 | 0.8-1.2 |
| 19-05-09 | 1.282-5.008 | 2.810±1.091 | 5.0-8.0 | 6.6±1.1 | 1.8-3.5 | 2.0-3.5 | 0.8-1.5 |
| 10-06-09 | 3.639-6.071 | 4.865±0.881 | 8.4-9.8 | 9.1±0.4 | 2.6-4.4 | 3.5-4.6 | 1.6-2.0 |
| 25-06-09 | 4.222-10.362 | 7.293±1.747 | 8.7-10. | 9.9±0.7 | 3.4-4.7 | 3.4-4.8 | 1.7-2.2 |
| 13-07-09 | 6.743-13.585 | 9.475±1.939 | 4.5-13.0 | 10.5±2.3 | 4.1-5.5 | 4.3-5.8 | 1.7-2.3 |
| 30-07-09 | 8.991-14.400 | 12.658±1.600 | 10.9-12.8 | 12.3±0.6 | 4.4-5.4 | 4.5-5.6 | 1.9-2.5 |
| 14-08-09 | 10.054-17.134 | 14.083±2.235 | 11.4-15.1 | 12.9±1.1 | 4.9-6.4 | 5.0-6.3 | 1.5-3.0 |
| 31-08-09 | 13.540-17.726 | 16.011±1.631 | 12.2-13.8 | 13.0±0.5 | 4.5-5.4 | 5.2-6.4 | 2.0-2.6 |
| 29-09-09 (harvest) | 17.301-24.704 | 19.538±2.293 | 13.5-16.2 | 14.6±0.7 | 5.3-6.5 | 5.1-6.7 | 2.6-3.9 |

Table 2: Growth parameters obtained for *P. monodon* reared in concrete tank

| Parameters | Values |
|---|---|
| Initial mean body weight at stocking (g) | 1.763±0.647 |
| Final mean body weight at harvest (g) | 19.538±2.293 |
| Mean weight gain (g) | 17.775 g |
| Size of tank used for culture ($m^2$) | 13.25 $m^2$ |
| Total weight of shrimp harvested (kg) | 4.69 |
| Yield of shrimp (kg $ha^{-1}$) | 3539 kg $ha^{-1}$ (by extrapolation) |
| Daily growth rate (g $day^{-1}$) | 0.113 |
| Specific growth rate (SGR%) | 1.532 |
| Total feed given (kg) | 15.78 |
| Food Conversion Ratio (FCR) | 3.36 |
| Total number of post larvae stocked | 264 |
| Total number of table shrimp harvested | 238 |
| Survival rate (%) | 90 |
| Culture period (days) | 157 |

ammonia 0.2-1.1 ppm, nitrite 0.04-0.60 ppm and alkalinity 114-135 ppm. Air and water temperatures ranged from 27.2-29.2 and 26.4-30.1°C, respectively.

## DISCUSSION

The Tiger shrimp *P. monodon* although indigenous to the Indo-Pacific region is a new entrant to the Atlantic Ocean in the Gulf of Guinea area. The species are now well established in Nigerian marine waters as the broodstock are available in most months of the year (Ebonwu *et al*., 2007; Adetayo, 2008; Ayinla *et al*., 2009). Concrete tanks have successfully been used to grow shrimps and prawns. New and Singhoika (1982) reported that fresh water prawn *Macrobrachium rosenbergii* stocked in 173 $m^2$ concrete tank gave a harvest of 3,800-4,700 kg/ha/year while Boonyaratpalin and New (1982) reported a production rate of 462-820 kg $ha^{-1}$ in 119 days in 50 $m^2$ concrete tank. In this preliminary study, a yield of 4.69 kg was obtained for the 13.25 $m^2$ concrete tank which by extrapolation gave 3539 kg $ha^{-1}$ for the 157 days culture period. Harvests of 2500-5000 kg/ha/year have been reported for earth ponds by Boonyaratpalin and New (1982) and FAO (2009) in semi-intensive systems.

An ideal FCR always results in better growth rate, healthy shrimp and clean pond bottom conditions. FCR of 1.2 has been achieved by many shrimp farmers, although ratios ranging from 1.7-3.0 have also been reported for different shrimp species (Fast, 1991; ASEAN, 2003). FCR

of 3.36 obtained in this experiment was inferior to FCR of 1.2-2.2 reported by ASEAN (2003) but was within the FCR of 1.7-3.0 obtained by Fast (1991) for different shrimp species. The high FCR of 3.36 may be attributed to low feeding rate (3%) and frequency (twice daily) adopted in this study. The shrimps were fed Coppens Catco 0.8-1.2 mm catfish feed with 40% crude protein twice daily at 3% b. wt. Ravichandran and Pillai (2004) recommended the use of shrimp feed containing 38-40% crude protein at a feeding rate of 5-8% body weight for 3-15 g size shrimp and administered 5-6 times daily.

The mean weight gain of 17.775 g obtained from the experiment in 157 days was lower than 24 g reported by Chen (1990) for 180 days. These could be as a result of the variation of the culture periods. Water quality parameters recorded during the period were within the acceptable optimal range reported by ASEAN (2003). The survival rates obtained in this study (90%) was higher than the rates of 79-88% reported by Boonyaratpalin and New (1982) and Chen (1990).

Tank culture of *P. monodon* succeeded for the first time in Nigeria from hatching of the eggs through post larval rearing to table shrimp production. Development of shrimp culture technology will contribute to increasing shrimp production in Nigeria. This will help relieve pressure on capture of wild shrimps. NIOMR is charged with the responsibility of developing technology packages for culture of *P. monodon* and to make the data available to the public for commercial production of the species.

## CONCLUSION

Shrimp farming is a well developed industry in S.E. Asia where *P. monodon* occur naturally. Successful preliminary culture of the species in concrete tanks with appreciable good result has provided baseline data for systematic aquaculture production of the species in Nigeria. This study has proved that commercial shrimp farming in Nigeria is feasible. The major challenges will include regular supply of good quality post larvae, electricity and seawater.

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