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The rearing of African river prawn, *Macrobrachium vollenhovenii* in concrete tank using locally formulated diet.

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Abstract
200 live juveniles of African river prawn (*Macrobrachium vollenhovenii*) with an average initial weight of (0.7±0.02 g) and an average initial length of (46.34±0.23 mm) were collected from Epe Lagoon and cultured in a rectangular concrete tanks for 56 days. The prawns were fed with 2mm pelletized feed of 35% crude protein at 5% body weight. The Growth parameters were determined and the Weight Gain (WG) at the end of the experiment was 2.5 g, Percentage Weight Gain (PWG) was 31.25%, Specific Growth Rate (SGR) was 0.21%, Feed Conversion Ratio (FCR) was 1.04, Feed Efficiency Ratio (FER) was 0.962, Protein Efficiency Ratio (PER) was 7.14% and Condition factor (K) was 1.35. The equation of the length-weight relationship was $W=0.57L^{1.33}$, a = 0.547, b = 1.33 which shows a negative allometric growth. The Linear correlation coefficient (R) was 0.58. The range of water quality variables analyzed weekly were 6.74–7.90 for pH, 25.7- 30.3 ^{0}C for the temperature, 6.71–8.01 mg/L for dissolved oxygen, 0.00–0.03% for salinity, 0.199–0.725 mS/cm for conductivity, 24-48 NTU for turbidity, nitrite was 0.07-0.50 mg/L, nitrate was 1.32-6.63 mg/L and 0.32–1.65 mg/L was recorded for Ammonia. The study has helped developed a method of collection, transportation, culturing in concrete tanks and feeding of prawns with locally formulated diet with prompt check on the water quality. Subsequent work can be carried out in concrete tanks to yield the desired result and serve as a yardstick in subsequent culture using other forms of culture medium.

Keywords: Prawn, rearing, tank, growth rate, increase, length, weight.

1. Introduction
Prawn farming is fast developing into big business, thus becoming the most important sea food products traded internationally [1]. The high demand for prawns and shrimps makes their culture a lucrative business. Prawn culture is a relatively recent activity, when compared to fish culture. In Nigeria, as indeed in most countries of the Africa region, prawn culture has not been attempted on any serious scale.

In Nigeria, there are many freshwater prawns of economic importance such as: *Macrobrachium vollenhovenii, M. dux, M. felicinum, M. macrobrachion, Atya gabonensis, Caridina africana* etc. Among these, *M. vollenhovenii* has being discovered to have the highest aquaculture potential [2, 3, 17]. *M. vollenhovenii* have the greatest potential for cultivation [4, 5].

Many attempts have been made to grow freshwater prawns under highly intensive conditions in tanks. The successful culture of the African river prawn *M. vollenhovenii* in captivity will depend on the optimum range of the water quality found in its natural habitat where it thrives very well. These can now be used to formulate a monitoring policy for the water quality parameters in laboratory. In order to have a successful culture of any prawn specie, it is important to study their feeding rate, water quality parameter which will ensure its survival and growth rate. Thus, this work seeks to address the growth performance of African river prawn *M. vollenhovenii* in captivity with the monitoring of the water quality of the culture medium.

2. Materials and Methods
2.1 Collection of Prawns
Two hundred (200) juvenile sized *Macrobrachium vollenhovenii* were collected from Epe lagoon in Lagos State.

They were transported in vacuum thermo flasks (50 litre each) ¾ filled with oxygenated water and the temperature was maintained between 20 ºC and 25 ºC with the addition of iced-water intermittently during transportation. They were brought to the Fish farm in the Department of Fisheries and Wildlife, Federal University of Technology, Akure. In the farm, they were acclimatized for 7 days. One hundred and sixty (160) agile and healthy prawns of almost equal size ranging between 42.24 mm and 51.03 mm, averaged 46.34±0.23 mm were selected, grouped into two and cultured in two concrete tanks (1.5 m x 1.5 m x 0.8 m) at eighty per tank, to allow better distribution during rearing and reduce cannibalism associated with overcrowding. Tanks were filled with filtered pond water with bamboo trunk (between 25 and 32 cm height and 17.0 cm diameter) evenly distributed underneath the tanks as hide out for the prawns and plant leaves was used as a form of shade in covering the surface water of the tank. However, part of the leaves drip down onto the sticks below, serving as a hide out for the prawns. They were fed 35% crude protein (CP) formulated diet using locally available feed ingredient (Table 1) at 5% body weight, twice in a day (0800 hrs and 1700 hrs GMT) to satiation. The locally prepared diet was stored in bags at room temperature (27 - 29 ºC).

Table 1: Composition of experimental diets (% dry weight)

Ingredients	Quantity (g)
Fishmeal (FM)	11.984
Groundnut cake (GNC)	23.968
Soya bean meal (SBM)	23.968
Maize	33.080
Premix	2.000
Di Calcium Phosphate (DCP)	2.500
Flour (Binder)	1.000
Lysine	0.500
Methionine	0.500
Iodized salt	0.500
Proximate analysis of diets (dry matter basis)	**%**
Crude protein	35.58
Crude lipid	10.00
Ash	9.50
Crude fibre	1.42
NFE	34.90
Gross energy	ND
Cost/Kg feed	**N75(**N **0.6)/kg**

2.2 Sampling

Once every week, the water in the concrete tank was drained off through the outlet pipe to 20 cm depth to take the prawn samples for length, weight measurement, after which the tanks were refilled with cleaned filtered pond water. Ten (10) prawns were randomly selected from the tanks, each prawn was weighed in grams (g) using a triple beam model (Ohaus, 800 series) and the total body length (from the base of rostrum to the telson) was measured using a measuring board.

The length-weight relationship was estimated using the equation:

$W = aL^b$

The value of constants **a** and **b** were computed from the log transformed values of length and weight (Log W=Log a + b Log L, where W = Weight of prawns (g), L= Total length of prawn (cm), a is a constant and b is the exponent) and using the linear regression routine of the Microsoft Excel Software Programme (2003). The condition factor (K) was calculated to determine the well-being of the prawns by the Bagenal (1978)'s [6] formula: $K=100W/L^3$

The following growth parameters were determined:

Weight Gain (WG) = difference between the final weight (W_2) and the initial weight (W_1), Percentage Weight Gain (PWG) = Mean weight gain/Mean weight initial x 100, Specific Growth Rate (SGR) = Log W_2 - Log W_1/ Number of days x 100. Food Conversion Ratio (FCR) = Total feed consumed/Weight gain, Food Efficiency Ratio (FER) = 1/FCR and the Protein Efficiency Ratio (PER) = Weight gain/Protein intake was also determined.

The physico-chemical parameters of water quality variables which are of paramount interest in pollution control, to the survival of the prawn are temperature (ºC), dissolved oxygen (ppm, mg/l), salinity (%), turbidity (NTU), pH, conductivity (mS/cm), Nitrite (NO_2), Nitrate (NO_3), Ammonia (NH_3) level were determined on a weekly basis between 8:00 and 9:00 GMT, according to Standard methods [7]. All determinations were done in triplicate. The Proximate Analysis of the 2mm pelleted feed and the cultured prawn sample were carried out according to the method of [8].

Data on survival and growth (Length and Weight) of juvenile, fed formulated diet were analyzed by one-way ANOVA with Tukey multiple comparison. Homogeneity of variance was tested using Bartlett's test.

3. Results and Discussion

The initial, final and mean length/weight, SGR, PWG, FCR, PER and FER measured for the whole 8 weeks are shown in Table 2. The equation of the length-weight relationship was $W=0.57L^{1.33}$, a=0.547 (intercept), b=1.33 (regression coefficient). The linear correlation coefficient (R) = 0.58 and the Coefficient of determination (R^2) =0.3313, the condition factor (K) =1.35. The results for the water test analysis for the eight weeks are shown in Table 3. The mean length and weight analyzed for the 8weeks are shown in Fig. 1 which indicated a positive correlation (r^2 = 0.77) between the length and the weight. In weeks 2, 4 and 8, the weight showed slight increase when compared to the length. In other words, the increase in weight is not a function of length increment. As such, the WG at the end of the experiment was 2.5 g. The condition factor (K) of 1.35 and correlation value (r^2 = 0.3313) was similar to what was recorded by [3]. Since 'b' was 1.33, then the growth is negative allometric, meaning that dimensions change with growth. Increment in weight was obvious in the 7th week where the largest weight (13.0 g) was recorded and in the 7th week the highest length (9.4 cm) was recorded. Similar result was observed by [9]. He reported that *M. vollenhovenii* could be cultured twice or thrice in a year from post–larvae (4 cm) and it can grow to size which is greater than 16.98 cm in 20 weeks, when good feed and proper conditions are provided.

The water parameters recorded for the 1st week differed from those in the 2nd, 3rd to the 8th week. Thus, as temperature increases, DO reduces and vice versa. These were similar to the recorded result in Table 3, figure 2 with respect to temperature and DO. The pH ranged between 6.74–7.90, Temperature ranged between 25.7–30.3, DO between 6.71 and 8.01; salinity between 0.00 and 0.03, conductivity from 0.199 to 0.725, turbidity 24–48, nitrite from 0.07 to 0.50, nitrate between 1.32 and 6.63 and between 0.32 and 1.65 for ammonia . However, the pH result supports the report of [10]. He reported that the optimum pH for prawn is between 7 and 8.5. This was also similar to the work of [11] who reported a temperature range of 27.0 –29.5, pH (6.9–7.1), DO (6.95–7.45) in the water quality parameters during an experimental period.

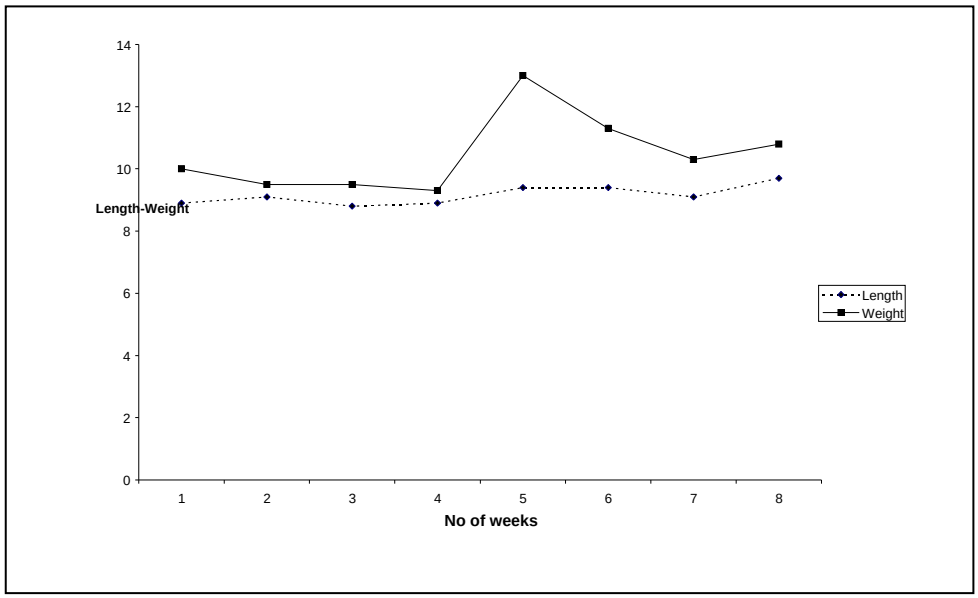

Fig 1: Length-Weight relationship for 8weeks

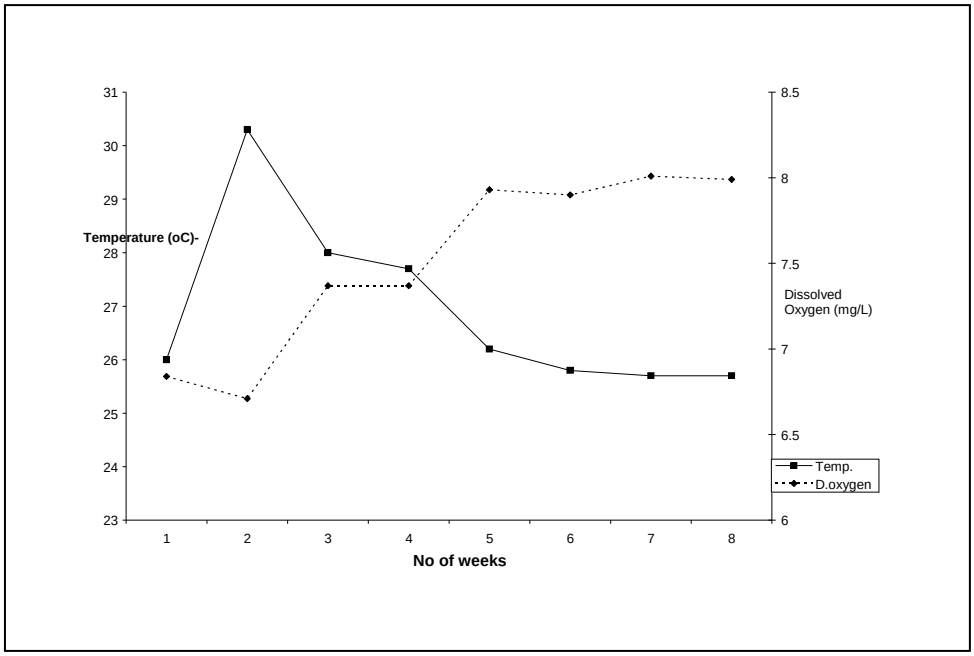

Fig 2: Observation in temp. and dissolved oxygen for 8weeks

The survival rate was 98% showing that the animal can adapt to freshwater environment without any problem supporting the reports of [3, 5] and [12] that *M. vollenhovenii* is a freshwater animal, though it can tolerate 0–20ppt salinity. These support their survival throughout the cultured period in salinity range of 0.00–0.03%. It was also reported that the specie can do well at a temperature ranging between 23 ^{0}C and 29 ^{0}C, DO_2 ranging between 5.11 and 7.1mg/L. These results were similar to the data recorded in Table 3.

Figures 3, 4 and 5 showed that the nitrite, nitrate and the ammonia level fluctuate on weekly basis, though increased in amount were recorded from 6th to 8th week. The observed mean were 0.285, 3.975 and 0.985 for nitrite, nitrate and ammonia respectively. This also support the view of [13], that the prospects for the successful culture of freshwater prawns in tank using artificial habitats to increase surface area, aerations are good. [14] Also reported that concrete tanks may be successfully used to grow freshwater prawns at least at low densities. It was reported that *M. vollenhovenii* can complete its life cycle in purely freshwater habitats [15]. All these are in line with the adaptability of the prawns in freshwater tanks. In lieu of this, subsequent work can be carried out in concrete tanks to yield the desired result.

Mortality of 2.08% was recorded after the fifth week of stocking. Dying animals were noticed to be sedentary and inactive, not keen on food. Survival rate of 97.92% was recorded after harvesting. No significant difference in survival and growth (body weight and length) was observed between the prawn and the diet (P>0.05). The prawn showed a better FCR (0.36 - 0.45). The increase in SGR may be due to increase in efficiency (for example the development of internal structures, the gonads system). Similar result was observed by [16] on *Oreochromis aureus.*

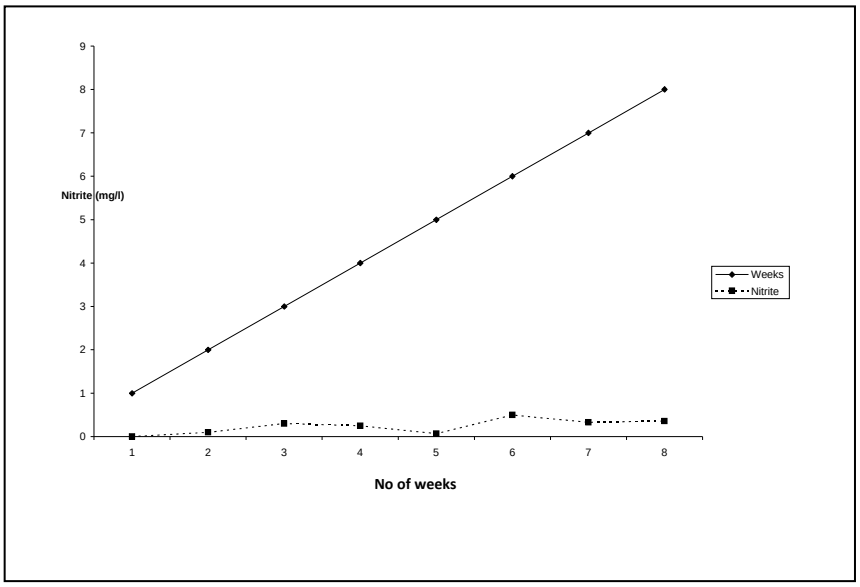

Fig 3: Observed changes in Nitrite level for 8weeks

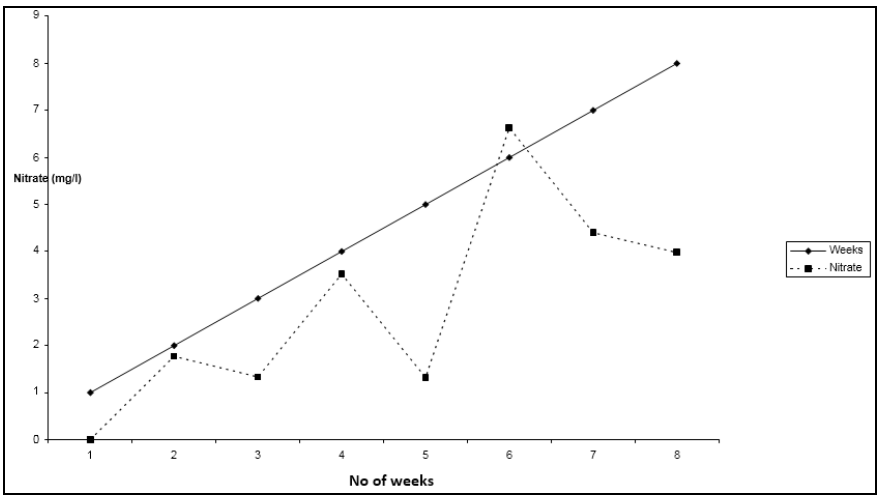

Fig 4: Observed changes in Nitrate level for 8weeks

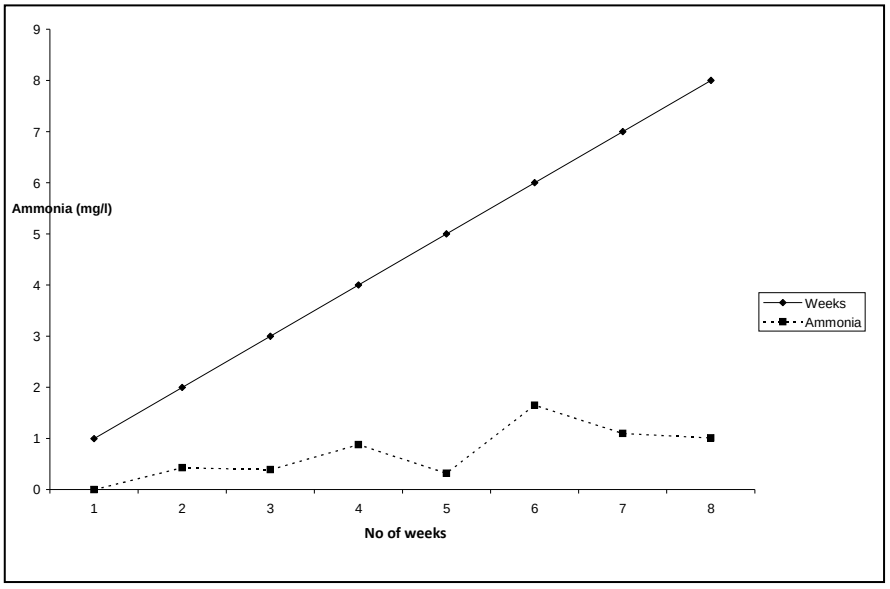

Fig 5: Observed changes in Ammonia level for 8weeks

Table 2: Values of growth Parameters

Parameters	Results
Mean Initial Length (cm)	4.63±0.23
Mean Final Length (cm)	9.2±2.01
Mean Initial Weight (g)	8.0±1.21
Mean Final Weight (g)	10.5±3.01
Mean Weight Gain (g)	2.5±1.92
Specific Growth Rate (SGR)	0.21±0.2%
Percentage Weight Gain (PWG)	31.25%
Feed Conversion Ratio (FCR)	1.04
Feed Efficiency Ratio (FER)	0. 962
Protein Efficiency Ratio (PER)	7.14%

Table 3: Water parameters tested on a weekly basis

Weeks	pH	Temp. (^{0}C)	DO (mg/l)	Salinity (%)	Conductivity. (mS/cm)	Turbidity (NTU)	Nitrite NO_2 (mg/l)	Nitrate NO_3 (mg/l)	Ammonia NH_3 (mg/l)
1	7.90±3.02	26.0±5.32	6.84±2.40	0.00±0.01	0.235±1.20	24±4.90	ND	ND	ND
2	7.25±1.12	30.3±1.03	6.71±1.08	0.01±0.01	0.257±1.08	31±3.07	0.01±1.10	1.77±1.03	0.43±0.05
3	7.16±2.23	28.0±2.65	7.37±2.43	0.00±0.01	0.212±0.12	48±4.66	0.30±1.02	1.33±2.01	0.39±1.02
4	7.07±2.12	27.7±2.22	7.37±2.21	0.00±0.01	0.199±1.09	41±6.07	0.25±0.22	3.52±1.20	0.88±1.54
5	7.02±3.24	26.2±3.30	7.93±1.09	0.00±0.01	0.234±2.01	37±6.77	0.07±0.03	1.32±1.20	0.32±0.56
6	6.74±3.01	25.8±3.01	7.90±2.01	0.03±0.10	0.725±2.03	29±6.06	0.50±1.23	6.63±1.50	1.65±0.70
7	6.98±2.05	25.7±3.22	8.01±1.22	0.01±0.01	0.305±0.07	27±6.06	0.33±2.00	4.40±1.09	1.10±1.25
8	7.26±2.60	25.7±1.22	7.99±0.90	0.00±0.01	0.244±1.02	30±4.16	0.36±1.20	3.98±2.30	1.01±1.22
Range	6.74 – 7.90	25.7 – 30.3	6.71 – 8.01	0.00 – 0.03	0.199 – 0.725	24 – 48	0.07 – 0.50	1.32 – 6.63	0.32 – 1.65
Mean	7.32	28	7.36	0.015	0.462	36	0.285	3.975	0.985

Plate 1: Tank used during the experimental period

Plate 2a.

Plate 2b.

Plate 3: Prawn size at stocking (below) and prawn size after experiment (above).

4. Conclusion

The tank rearing of *M. vollenhovenii* showed that the growth rate was obvious within the 56 days with which they were fed with 2mm fish formulated feed (35% CP). The result implies that there exist a weak correlation between Length and Weight. Moreover, the data reported on water physical and chemical parameters, indicated that the prawns can be reared conveniently in concrete tanks not exceeding these ranges. The result can be used as a foundational works for subsequent research on its culture in tanks and/or other culture medium.

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