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WATER QUALITY CONSIDERATIONS FOR THE CULTURE OF TROPICAL EDIBLE FROG (*HOPLOBATRACHUS OCCIPITALIS*) FROM TADPOLE STAGE TO FULL METAMORPHOSIS

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Good water quality is necessary for artificial cultivation of frogs. There has not been a recommended value for water quality in frog culture.

This study was undertaken to determine the ranges of some water quality parameters for the culture of Hoplobatrachus occipitalis from tadpole stage to full metamorphosis. 180 tadpoles were distributed into 3 tanks each filled with 60 litre water and renewed through a flow-through system. Water quality parameters were measured for 16 weeks during which the tadpoles fully metamorphosed with only about 10 % mortality. Results showed temperature ranged between 24.1 and 27.2 °C, pH 6.8–7.2. Conductivity varied between 240 and 280 µS/cm, Total Dissolved Solids 161–188 mg/l, Alkalinity 225–200 mg/l, Calcium, Magnesium and Total Hardness were in the ranges of 80–100 mg/l, 40–60 mg/l and 120–160 mg/l, respectively. Phosphate and Nitrate varied between 0.3–0.8 and 0.8–1.3 mg/l, respectively. Dissolved oxygen was between 6.2 and 6.9 mg/l, while Ammonia ranged between 0.10 mg/l and 0.22 mg/l. These ranges were good water quality values for the rearing of the species, because of the full metamorphosis of the frog and the low (10 %) mortality rate recorded in 16 weeks. The flow through system which allowed frequent change of water and the ground (borehole) water used for culture helped in achieving the good water quality in the tanks.

Keywords: EDIBLE FROGS, WATER QUALITY, TADPOLES, METAMORPHOSIS, CULTURE, FLOW-THROUGH, GROUND WATER

ПАРАМЕТРИ ЯКОСТІ ВОДИ ДЛЯ ВИРОЩУВАННЯ ТРОПІЧНОЇ ЖАБИ ЇСТІВНОЇ (*HOPLOBATRACHUS OCCIPITALIS*) ВІД СТАДІЇ ПУГОЛОВКА ДО ПОВНОГО МЕТАМОРФОЗУ

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Для штучного вирощування жаб необхідна належна якість води. Проте в наш час немає рекомендованих норм складу води для утримання жаб.

Проведено дослідження з метою встановлення допустимих меж коливання параметрів води для утримання жаб виду Hoplobatrachus occipitalis від стадії пуголовка до формування зрілої особини. 180 пуголовків було розміщено у 3 акваріуми з проточною системою водопостачання, місткістю 60 л кожен. Параметри якості води вимірювали впродовж 16 тижнів, протягом яких пуголовки пройшли повний метаморфоз. Смертність становила лише 10 %. Параметри води під час досліду коливались у межах: температура 24,1–27,2 °С, pH 6,8–7,2, електропровідність 240–280 мкСм/см, загальний вміст твердих частинок 161–188 мг/л, лужність 225–200 мг/л, загальна жорсткість 120–160 мг/л, концентрація Кальцію 80–100 мг/л, Магнію 40–60 мг/л, фосфатів 0,3–0,8 мг/л, нітратів 0,8–1,3 мг/л, розчиненого кисню 6,2–6.9 мг/л, аміаку 0,10–0,22 мг/л. Такий діапазон показників якості води виявився придатним для вирощування жаб цього виду, про що свідчить нормальний метаморфоз і низька смертність (10 % за 16 тижнів). Проточна система водопостачання з використанням підземних вод зі свердловини забезпечила сприятливі умови для вирощування жаб.

Ключові слова: ЖАБА ЇСТІВНА, ЯКІСТЬ ВОДИ, ПУГОЛОВКИ, МЕТАМОРФОЗ, ВИРОЩУВАННЯ, ПРОТОЧНА СИСТЕМА ВОДОПОСТАЧАННЯ

ПАРАМЕТРЫ КАЧЕСТВА ВОДЫ ДЛЯ ВЫРАЩИВАНИЯ ТРОПИЧЕСКОЙ ЛЯГУШКИ СЪЕДОБНОЙ (*HOPLOBATRACHUS OCCIPITALIS*) ОТ СТАДИИ ГОЛОВАСТИКА ДО ПОЛНОГО МЕТАМОРФОЗА

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Для искусственного выращивания лягушек необходимо надлежащее качество воды. Однако в настоящее время нет рекомендуемых норм состава воды для содержания лягушек.

Проведено исследование с целью определения допустимых пределов колебания параметров воды для лягушек вида Hoplobatrachus occipitalis от стадии головастика до формирования зрелой особи. 180 головастиков были помещены в 3 аквариумы с проточной системой водоснабжения, вместимостью 60 литров каждый. Параметры качества воды измеряли в течение 16 недель, в течение которых головастики прошли полный метаморфоз. Смертность составила всего 10 %. Параметры воды во время опыта колебались в пределах: температура 24,1–27,2 °C, pH 6,8–7,2, электропроводность 240–280 мкСм/см, общее содержание твердых частиц 161–188 мг/л, щелочность 225–200 мг/л, общая жесткость 120–160 мг/л, концентрация кальция 80–100 мг/л, магния 40–60 мг/л, фосфатов 0,3–0,8 мг/л, нитратов 0,8–1,3 мг/л, растворенного кислорода 6,2–6.9 мг/л, аммиака 0,10–0,22 мг/л. Такой диапазон показателей качества воды оказался пригодным для выращивания лягушек этого вида, о чем свидетельствует нормальный метаморфоз и низкая смертность (10 % за 16 недель). Проточная система водоснабжения с использованием подземных вод из скважины обеспечила надлежащие условия для выращивания лягушек.

Ключевые слова: ЛЯГУШКА СЪЕДОБНАЯ, КАЧЕСТВО ВОДЫ, ГОЛОВАСТИКИ, МЕТАМОРФОЗ, ВЫРАЩИВАНИЕ, ПРОТОЧНАЯ СИСТЕМА ВОДОСНАБЖЕНИЯ

Frog culture/farming is becoming a promising and profitable venture especially in developing tropical countries of sub-Saharan Africa. This is due to the increasing demand of frog as alternative source of animal protein, the increasing cost of traditional sources of animal protein such as beef, chicken and fish as well as its competitive edge in terms of production, affordability and nutritive value over fish, beef and chicken. In later time, frog culture will overtake fish culture as a sustainable aquaculture industry.

However, the success of frog culture largely depends on the operational water quality of the pond where the frog is raised. This is even more pertinent as frogs though amphibious spend most of their life cycle in water. According to [14, 11] breeding frogs under artificial farm-like conditions have often failed. This is mainly due to inadequate considerations of the water quality of the farms. [3] had reported that successful rearing of tadpoles mainly depends on the water quality used in the culture.

Water quality considerations in frog ponds includes all physical, chemical, biological and aesthetic factors of water that operate synergistically to maintain the survival and production of frogs. High quality water must be readily available to frogs during their breeding as their development or metamorphosis depend among other things the water quality of the pond. Most important water quality parameters in frog culture pond include temperature, dissolved oxygen, pH, alkalinity, ammonia, nitrate, phosphate, calcium hardness, magnesium hardness, total hardness, transparency, conductivity, and total dissolved solids.

There has not been a standard or recommended value or range for good water quality in frog culture. This is because researches on water quality in frog culture are scarce. The few studies in this area include those of [4, 10, 1, 8, 13].

The objective of this study was to determine the ranges of some water quality parameters for successful tropical edible frog *(Hoplobatrachus occipitalis*) culture from tadpole stage to full metamorphosis. This is with a view of establishing ranges of some physic-chemical factors and recommending same as standard for frog culture in ponds.

Materials and methods

Experimental design. 180 *Hoplobatrachus occipitalis* tadpoles with average length and weight of 5.8 cm and 1.93 g respectively were obtained from a local fish farm pond in Ilorin, Nigeria during their breeding season. The tadpoles were transported in 3 open tanks, each containing 60 tadpoles that were filled with 60 litres of well oxygenated water of the pond early in the morning at a temperature of 21 °C to the Laboratory of the Department of Zoology, University of Ilorin, Ilorin, Nigeria.

In the laboratory, the tadpoles were distributed into 3 experimental tanks measuring 1×1×0.2 m (length, width and depth) and labelled T_1-T_3, each containing 60 tadpoles. Each tank had 60-litre water capacity, well aerated, with water supply from borehole (ground water) and constantly renewed through a flow-through system. The tanks were covered with nets to prevent escape of the frogs during the rearing period.

Measurement of the water quality parameters was done weekly for 16 weeks during which the tadpoles grew and fully metamorphosed with only about 10 % mortality in each tank. 50 ml plastic water bottle was used for the collection of water samples for the analysis of the following water quality parameters: Alkalinity, calcium and magnesium hardness which were measured using colometric method, phosphate measured using amino acid method, nitrate measured by cadmium reduction method, ammonia measured using nessler method and dissolved oxygen measured by azide modification of winkler's method. All measurements were done according to [17] standard procedures. All the parameters were analyzed with the aid of *Hanna Multiparameter Bench Photometer for Laboratories Model HI 83200-02*. Temperature, pH, electrical conductivity and total dissolved solids were measured *in situ* in the tanks using *Hanna Portable pH/EC/TDS/Temp combined waterproof tester Model HI 98129*. Triplicates water samples of the tanks were obtained and measured for all the chemical parameters, while pH and temperature, electrical conductivity and total dissolved solids measurements were also measured in triplicates *in situ*.

Statistical Analyses. GLM procedure of statistical analysis system 9.1.3 [15] was used to analyze the results. Weekly mean difference of each triplicate parameter was compared using two way ANOVA at $P<0.05$ to see the variations due to weeks (temporal variations) and tanks (spatial variations).

Results and discussion

The mean weekly results of the water quality variables in each tank are presented in tables 1, 2 and 3. The overall mean of all the water quality parameters for the culture of tropical edible frog (*Hoplobatrachus occipitalis*) from tadpole stage to full metamorphosis is shown in table 4. Temperature in the tanks ranged between 24.1 and 27.2 °C with the lowest and highest recorded in week 1 and 16 respectively. There was no significant differences ($P>0.05$) in temperature variations among the 3 tanks, however, there was significant differences ($P<0.05$) in the temporal variations in the tanks. The overall mean of temperature measurements in the 3 tanks was 26.05 °C. Temperature ranges for the best culture of tropical edible frog *Hoplobatrachus occipitalis* is between 24 and 28 °C, with the average being 26 °C. This temperature ranges has been reported by [8, 3, 13] as ideal for the growth of frog tadpoles in ponds. This temperature which is ideal should be maintained during culture especially in tropical climate since growth of frogs is related to temperature [9].

pH variations was from the lowest of 6.8 recorded in the first week in all the tanks to the highest of 7.2 recorded in week 16 in all the tanks. There was no significant difference ($P>0.05$) in the spatial and temporal variations in the pH in the tanks. The overall mean pH recorded in the tanks was 6.99. Recommended pH ranges for culture is from slight acidity to slight alkalinity, with a range of 6.8 to 7.2 and an overall average of 6.9 (slight acidity). [6] reported pH values around 7.33, towards the alkaline range, [7] recommended mild acidity, while [16] suggested a pH range between 6.5 to 7.0 as ideal for frog culture.

Electrical conductivity (EC) varied between a minimum of 240 μS/cm recorded in week 1 in all the tanks and maximum of 280 μS/cm recorded in week 16 in tanks 1 and 3 respectively. There was no significant differences ($P>0.05$) in the variations of electrical conductivity in the 3 tanks, but, there was significant differences ($P<0.05$) in

Table 1

Mean weekly variations in water quality parameters in Tank 1

Week	Temp, ° C	pH	EC	TDS, mg/l	AIK, mg/l	Ca, mg/l	Mg, mg/l	TH, mg/l	PO_4, mg/l	NO_3, mg/l	DO, mg/l	NH_3, mg/l
1	27.1	6.8	240	161	200	80	40	120	0.3	0.8	6.2	0.11
2	27.1	6.8	240	161	200	80	40	120	0.3	0.8	6.2	0.11
3	27.0	6.8	244	163	200	80	40	120	0.3	0.9	6.3	0.12
4	27.0	6.9	248	166	205	85	45	130	0.3	0.9	6.4	0.14
5	26.8	6.9	250	168	205	85	45	130	0.4	0.9	6.4	0.14
6	26.8	6.9	252	169	205	85	45	130	0.4	1.0	6.5	0.16
7	26.7	6.9	255	171	210	90	50	140	0.4	1.0	6.5	0.16
8	26.6	7.0	260	174	210	90	50	140	0.5	1.0	6.6	0.18
9	26.6	7.0	260	174	210	90	50	140	0.5	1.1	6.6	0.18
10	26.2	7.1	266	178	215	90	50	140	0.6	1.1	6.6	0.18
11	25.9	7.1	268	180	215	95	55	150	0.6	1.1	6.8	0.18
12	25.8	7.2	272	182	215	95	55	150	0.6	1.2	6.8	0.19
13	25.0	7.2	275	184	220	95	55	150	0.7	1.2	6.9	0.20
14	24.6	7.2	278	186	220	100	60	160	0.7	1.2	6.9	0.20
15	24.4	7.2	278	186	220	100	60	160	0.8	1.2	6.9	0.20
16	24.2	7.2	280	188	220	100	60	160	0.8	1.3	6.9	0.20
Overall total mean	26.11±0.1	7.01±0.1	260.25±0.1	174.38±0.1	210.63±0.1	90.00±0.1	50.00±0.1	140.00±0.1	0.51±0.1	1.04±0.1	6.59±0.1	0.16±0.1

Table 2

Mean weekly variations in water quality parameters in Tank 2

Week	Temp, ° C	pH	EC	TDS, mg/l	AIK, mg/l	Ca, mg/l	Mg, mg/l	TH, mg/l	PO_4, mg/l	NO_3, mg/l	DO, mg/l	NH_3, mg/l
1	27.1	6.8	240	161	200	80	40	120	0.3	0.8	6.2	0.10
2	27.1	6.8	241	161	200	80	40	120	0.3	0.8	6.3	0.10
3	27.0	6.8	242	162	200	80	40	120	0.3	0.8	6.3	0.10
4	26.9	6.9	244	164	205	85	40	125	0.3	0.9	6.4	0.11
5	26.9	6.9	248	166	205	85	45	130	0.4	0.9	6.4	0.11
6	26.8	6.9	250	168	205	85	45	130	0.4	0.9	6.4	0.12
7	26.7	6.9	254	170	205	85	45	130	0.5	1.0	6.5	0.14
8	26.5	6.9	258	173	210	90	50	140	0.5	1.0	6.5	0.15
9	26.2	7.0	260	174	210	90	50	140	0.5	1.0	6.5	0.16
10	26.0	7.0	262	176	210	90	50	140	0.6	1.1	6.6	0.16
11	25.8	7.0	266	178	215	95	55	150	0.6	1.1	6.6	0.18
12	25.6	7.0	270	181	215	95	55	150	0.6	1.1	6.7	0.18
13	24.7	7.1	272	182	215	95	55	150	0.6	1.2	6.8	0.20
14	25.6	7.2	275	184	220	100	60	160	0.6	1.2	6.8	0.20
15	24.2	7.2	278	186	220	100	60	160	0.8	1.2	6.9	0.20
16	24.1	7.2	278	186	220	100	60	160	0.8	1.3	6.9	0.22
Total mean	26.05±0.1	6.97±0.1	258.63±0.1	173.25±0.1	209.69±0.1	89.69±0.1	49.38±0.1	139.06±0.1	0.51±0.1	1.04±0.1	6.60±0.1	0.15±0.1

Table 3

Mean weekly variations in water quality parameters in Tank 3

Week	Temp, ° C	pH	EC	TDS, mg/l	AIK, mg/l	Ca, mg/l	Mg, mg/l	TH, mg/l	PO_4, mg/l	NO_3, mg/l	DO, mg/l	NH_3, mg/l
1	27.2	6.8	240	161	200	80	40	120	0.3	0.8	6.2	0.11
2	27.1	6.8	244	164	200	80	40	120	0.3	0.8	6.3	0.11
3	27.0	6.9	249	164	205	80	40	120	0.3	0.8	6.3	0.12
4	27.0	6.9	246	165	205	85	45	130	0.4	0.9	6.3	0.12
5	26.9	6.9	246	165	205	85	45	130	0.4	0.9	6.4	0.12
6	26.9	6.9	250	168	210	85	45	130	0.4	0.9	6.4	0.13
7	26.8	7.0	254	170	210	90	50	140	0.4	1.0	6.4	0.14
8	26.6	7.0	256	172	210	90	50	140	0.5	1.0	6.5	0.16
9	26.2	7.0	260	174	210	90	50	140	0.5	1.0	6.5	0.16
10	26.0	7.1	264	177	215	90	50	140	0.5	1.2	6.5	0.18
11	25.8	7.1	268	180	215	95	55	150	0.6	1.2	6.6	0.18
12	25.2	7.1	272	181	215	95	55	150	0.6	1.2	6.7	0.19
13	24.8	7.1	278	186	220	95	55	150	0.7	1.2	6.8	0.20
14	24.5	7.2	278	186	220	100	60	160	0.7	1.2	6.8	0.20
15	24.2	7.2	280	188	220	100	60	160	0.8	1.2	6.9	0.20
16	24.1	7.2	280	188	225	100	60	160	0.8	1.3	6.9	0.20
Total mean	26.01±0.1	7.01±0.1	260.05±0.1	174.20±0.1	211.56±0.1	90.00±0.1	50.00±0.1	140.00±0.1	0.51±0.1	1.04±0.1	6.59±0.1	0.16±0.1

Table 4

Overall mean values of water quality parameters for the culture of tropical edible frog (*Hoplobatrachus occipitalis*) from tadpole stage to full metamorphosis

Water quality parameters	Overall mean value
Temperature (°C)	26.05±0.1
pH	6.99±0.1
Electrical conductivity (EC) (µS/cm)	259.64±0.1
Total Dissolved Solids (TDS) (mg/l)	173.94±0.1
Alkalinity (mg/l)	210.63±0.1
Calcium hardness (mg/l)	89.90±0.1
Magnesium hardness (mg/l)	49.79±0.1
Total Hardness (mg/l)	139.69±0.1
Phosphate (mg/l)	0.51±0.1
Nitrate (mg/l)	1.04±0.1
Dissolved Oxygen (DO) (mg/l)	6.59±0.1
Ammonia (mg/l)	0.16±0.1

weekly variations in the tanks. The overall mean of the electrical conductivity measurements in the 3 tanks was 259.64 µS/cm. Total Dissolved Solids (TDS) varied between a minimum of 161 mg/l recorded in week 1 in all the tanks and maximum of 188 mg/l recorded in week 16 in tanks 1 and 3 respectively. There was no significant differences (P>0.05) in the variations of TDS in the 3 tanks, but, there was significant differences (P<0.05) in weekly variations in TDS among the tanks. The overall mean of the total dissolved solids measurements in the 3 tanks was 173.94 mg/l. The electrical conductivity and total dissolved solids which were positively correlated were in the ranges optimal for *Hoplobatrachus occipitalis* production in tropical artificial conditions. The high conductivity and total dissolved solids in the ponds probably came from the ground water which was the source of water for the ponds, and the effects of residual feed in water which on decomposition added some mineral salts and suspended particles into the water. [18] had reported that aquafeeds promote increase of ions and suspended particles in culture ponds. [12] reported that high conductivity water supports frog breeding. [2] recommended a conductivity value of 249 µS/cm for Bull frog culture. Mean conductivity of 259.64 µS/cm and mean TDS of 173.94 mg/l will be the most ideal water quality values for the culture of tropical edible frog *Hoplobatrachus occipitalis.*

Tank 3 recorded the highest alkalinity measurement of 225 mg/l in week 16 and lowest of 200 mg/l of alkalinity was measured in week 1 in all the tanks. There was no significant difference (P>0.05) in the variations of alkalinity in the 3 tanks, but, there was significant differences (P<0.05) in weekly variations in the tanks. The overall mean alkalinity recorded in the 3 tanks was 210.63 mg/l. The flow through system of culture which allowed frequent change of water and the source (ground) water used for culture may be responsible for the high alkalinity. In spite of the high alkalinity, the frogs were able to survive, fully metamorphosis and grow in the tanks. This showed that alkalinity ranges of 200–225 mg/l could be recommended for the culture of edible tropical frog *Hoplobatrachus occipitalis.* A positive correlation was noted between hardness and alkalinity. The high alkalinity and total hardness of collapsible and concrete ponds allowed for good buffering capacity of the tanks thereby making the tanks to be slightly alkaline.

Calcium, magnesium and total hardness of the tanks were in the ranges of 80–100 mg/l, 40–60 mg/l and 120–160 mg/l, respectively. All the three factors recorded the lowest and highest concentrations in week 1 and 16 in all the tanks, respectively. No significant difference (P>0.05) was found in the concentrations of the three factors among the tanks; however there was a significant difference (P<0.05) in the concentrations among the weeks. The overall mean of calcium, magnesium and total hardness was found to be 89.90 mg/l, 49.79 mg/l and 139.69 mg/l respectively. Soft to moderate hardness water is good for the breeding of *Hoplobatrachus occipitalis*. This is evident from the ranges of the calcium, magnesium and total hardness recorded in the 3 tanks. The conductivity and TDS ranges of the ponds also supported the soft to moderate hardness of the tanks for the species breeding. The total hardness values (120–160 mg/l) for the breeding of *Hoplobatrachus occipitalis* in tropical aquaculture was however higher than the range of 10–80 mg/l recommended [7].

Phosphate and nitrate varied between 0.3–0.8 mg/l and 0.8–1.3 mg/l in all the tanks. The concentrations of the two ions increased with weeks with the lowest found in week 1 and highest in week 16. There was no significance difference (P>0.05) in the concentrations of the two ions spatially, but significant difference (P<0.05) exists temporally in the tanks among the two ions. The overall mean of phosphate and nitrate in the tanks was 0.51 and 1.04 mg/l. Phosphate and nitrate levels of <1.0 mg/l are desirable and recommended for the culture of *Hoplobatrachus occipitalis*. High nitrogen and phosphorus concentrations can alter the feeding activity, mobility and reduce the growth and development processes of amphibian larvae [1]. The phosphate and nitrate levels in this study were similar to the results of [3, 13] on Bullfrog tadpoles.

The highest dissolved oxygen concentration of 6.9 mg/l was recorded in all the 3 tanks in week 16, while the lowest of 6.2 mg/l was recorded in week 1 also in all the tanks. There was no significant difference (P>0.05) in the concentration of dissolved oxygen among the tanks and in the weeks.

The overall mean of dissolved oxygen concentration in the tanks was 6.59 mg/l. Metamorphosising tadpoles require enough dissolved oxygen which they extract from the water through their gills. It is therefore imperative that water for the breeding of frogs should contain enough dissolved oxygen. Dissolved oxygen values recorded in this work could be described as ideal and recommended for the culture of edible tropical frog *Hoplobatrachus occipitalis*. These values were also similar to the values recorded by [3]. CONAMA Resolution 357/2005 [5] recommends that the minimum limit for dissolved oxygen in frog culture should be 5 mg/l.

Ammonia varied between the lowest concentration of 0.10 mg/l found in tank 2 in week 1 and highest of 0.22 mg/l recorded in week 16 also in tank 2. There was no significant difference ($P>0.05$) in the concentration of ammonia among the tanks and in the weeks. The overall mean ammonia concentration in the tanks was 0.16 mg/l. Ammonia concentration in the tanks was expected to be high due to the artificial feed used.

The efficient water renewal on the account of the flow through system employed in the culture which promoted dilution and nitrification of the ammonia produced was responsible for the lower concentrations of ammonia recorded in the tanks.

The range of ammonia recorded in the tanks was lower than that reported by [3, 13], but was in the range recommended by Ferreira [7]. Thus a range of 0.1–0.25 mg/l of ammonia in tanks is recommended as the water quality value for successful culture of *Hoplobatrachus occipitalis*.

The similarity in the range of water quality found in the 3 tanks was due to source (borehole/ground water) used for the frog culture, the quality and quantity of food used for the rearing as well as the amount of excreted wastes generated into the tanks by the frogs. All these were responsible for the insignificant differences recorded in the parameters among the 3 tanks. The significant differences observed in the temporal variations in the water quality parameters in the tanks was as a result of seasons as seen in the temperature measurements where week 1 was in the dry season with high temperature and week 16 was in the rainy season with low temperature. Similarly, metabolic activities, food intake and utilization, wastes generated into the tanks by the frogs as well as synergistic effects of the parameters on one another may have brought about the significant differences seen in the 16 weeks of culture.

Metamorphosis was deemed to be completed when 99.99 % of the frogs in the tanks have their gills and tail disappeared, mouth widens, eyes bulged while lungs, fore and hind limbs developed.

This work is one of the first to document and establish ranges of water quality factors for the breeding of tropical edible frog (*Hoplobatrachus occipitalis*) from tadpole stage to full metamorphosis in laboratory experimental tanks. The ranges recorded in the water quality parameters in the tanks could be described as good for the rearing of the species in farm ponds. This is because of the full metamorphosis of the frog and the low (10 %) mortality rate recorded in the tanks.

Conclusion

The success of edible frog culture such as *Hoplobatrachus occipitalis* from the tadpole stage depends to a large extent on the good water quality in the culture tanks. This research work has highlighted various water quality parameters and recommended range of values for successful culture of tropical edible frog *Hoplobatrachus occipitalis*. Ground (borehole) water which was free of pollution and a flow through system in the culture of the species which ensures efficient water renewal should be also employed as it helps in achieving and sustaining a good water quality in the frog ponds culture system.

Perspectives for further future researches. More physic-chemical factors aside from the ones studied in this research should be investigated for the culture of *Hoplobatrachus occipitalis* including the effects of water containing heavy metals on the biology of the organism.

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