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Effects of Substrate Material on Hatchability of *Clarias gariepinus Eggs*

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Abstract

In this study, matured *Clarias gariepinus* eggs were incubated on substrate materials- kakabarn, Mosquito net, and Water lily leaf at the Toxicology unit Fish Farm of the Department of Water Resources, Aquaculture and Fisheries Technology, Federal University of Technology, (F.U.T.), Bosso Campus, Minna. Each treatment was replicated three times. Fecundity increased with body weight and hence larger fish had higher fecundity and differed significantly ($P<0.05$) from each other. Mean fecundity was (28722±4259). Percentage fertilization and hatching differed significantly ($P<0.05$) among the treatment levels. Percentage survival and mean weight gain was highest in kakabarn (74.40 %) and (0.20) respectively, Eggs incubated on water lily leaf has the highest percentage fertilization and hatching hence most effective and therefore is recommended as substrate for use to incubate eggs of *Clarias gariepinus* for breeding.

Keywords: Substrate, *Clarias Gariepinus*, Water Lily, Mosquito Net and Breeding.

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Introduction

The awareness on aquaculture practice and its tremendous benefits has led to high demand of fish seed by fish farmers to stock ponds and other enclosures. This scenario has made hatchery propagation of culturable fish species important. Eggs of different fish species are incubated on different substrate materials both natural and artificial. For example *Clarias gariepinus* spawn on floating plants (*hornwort*), aquatic weeds and grasses in their natural environment which is simulated by use of *kakabarn* in artificial propagation (Van Oosten, 2012). The substratum spawning cichlids usually excavate pits in the substrate in which to lay their eggs. Most *anabantoids*, like *gouramis* and *betta* fish, are bubble-nest builders. In the aquarium, an upturned butter dish or something similar can serve as the anchor for the nest. *Cichlids* also lay eggs on some portion of the substratum, (including pits dug in the sand, leaves and flat rocks), they take the eggs and fry into their mouths to protect them from predators. In artificial spawning of gold fish which are typically shoal, it is best when oxygenating plants such as *anacharis* are added in the aquarium for the spawning process and for eggs to adhere to (Omitogun, *et al.*, (2010). The eggs stick to the plants by sticky threads. *Killi* fish are bottom spawners, pushing or burying their eggs in the substrate, some spawn on plants to which the eggs adhere to. In the case of *cyprinids*, the eggs adhere to whatever they come in contact with: leaves, decorations, gravel etc. Most artificial substrates have recorded some degree of successes in terms of hatching, spawning and incubation of eggs for different fish species in artificial breeding Sule (1991).

Generally, substrate helps to remove pollutants such as ammonia from the water to improve the water quality and enhance hatching rate. It also serves as adhesive agent to eggs to avoid being flooded away during incubation. The aim of this study therefore is to determine the effect of these substrate materials on hatchability and survival of *Clarias gariepinus* fry and recommend the best among them.

Materials and Methods

Twelve (12) samples, (6 males and 6 females) sexually matured brood stocks of *Clarias gariepinus* with size range (350-650 g) Total Body Weight (TBW) were purchased from private fish farm in Minna and transported to the indoor hatchery of Federal University of Technology, (F.U.T.), Bosso Campus Minna. Before stocking, the brood stocks were disinfected with 0.5 % salt bath (5 g NaCl/1 litre of water at temperature of 25-27^0 C) for fifteen minutes. After disinfection, the fish were acclimatized in the indoor nursery concrete ponds for 2 weeks. They were maintained under optimum temperature and fed with 40 % crude protein commercial diet. The brood stocks were examined for gonad development according to the method of Blythe *et al.* (1994) as reported by Yisa *et al.* (2010). Males were examined for rigid and reddish infusion of the genital papilla and for females, genital papilla for reddish infusion, distension of the belly and release of eggs when gentle pressure was applied on the abdomen. The selected samples were properly maintained separately before being used for breeding. Matured female brood fish were treated with a single dose of hormone (Ovaprim) according to the method of Goudie *et al.* (1992) and hand stripped for eggs after a minimum latency period of eleven hours at water temperature of between 25-29^0 C. Fifteen and half grams (15.5 g) of total eggs stripped was used to fertilize eggs shared evenly among the treatments. Injection was administered intraperitoneally. Milt was obtained by sacrificing the male and testis removed, cleaned with cotton wool to remove all the stained blood and then kept in a clean Petri dish and thereafter macerated to squeeze out milt. The milt and eggs were mixed together gently with a plastic spoon for 2-3 minutes. Small quantity of saline solution was then pour onto the eggs to avoid sticking together. The fertilized eggs were rinsed with distilled water and taken to the incubator for incubation. Incubators made of incubating net hapa with kakabarns, mosquito net and water lily leaf placed inside glass aquarium tanks filled with clean water were used for the purpose. Fertilized eggs were divided into three equal portions and spread in a monolayer on the treatments (T_1) (kakabarns), (T_2) (Mosquito net) and (T_3) (Water lily leaf) in the incubator. Aeration was maintained by flow through system. The hapa was constructed from a coated nylon net with 1.5 mm mesh size. When hatching was completed the hapa with un- hatched eggs and shells was lifted out of the incubation tank and washed. 170 fry were stocked per glass aquaria tanks and reared for 8 weeks. After yolk absorption, the hatchlings were fed with decapsulated artemia. Water quality parameters including temperature, Dissolved Oxygen, pH and conductivity were monitored and maintained at optimum level.

Percentage mortality and survival rates were determined with the following formula:

$$\text{Percentage Mortality} = \frac{\text{Cumulative Mortality X 100}}{\text{Total number stocked}}$$

$$\text{Percentage Survival} = \frac{\text{Cumulative Survival X 100}}{\text{Total number stocked}}$$

(After Bargenal, 1978) as adopted by Yisa *et al.* (2010).

The weight of the hatchlings was determined using sensitive electronic balance (P.E. mx Rady).

Percentage fertilization, hatchability and fecundity were determined according to method described by (Oyelese, 2006) using the formulae:

$$\text{Fecundity} = \frac{\text{Total weight of stripped eggs x Total No. of eggs in sub-sample}}{\text{Weight of eggs in sub-sample}}$$

$$\text{Percentage Fertilization} = \frac{\text{No. of fertilized eggs} \times 100}{\text{No. of eggs stripped}}$$

$$\text{Percentage Hatchability} = \frac{\text{No. of fry} \times 100}{\text{No. of fertilized eggs}}$$

And

$$\text{Specific Growth Rate (SGR)} = \frac{\text{Log Mean Final weight - Log Mean Initial weight} \times 100}{\text{Time } (T_2 - T_1)}$$

(After Bargenal, 1978 as reported by Yisa *et al.*, 2010).

One way Analysis of Variance (ANOVA) was used as statistical package for the analysis. Data obtained per treatment and control experiments was pooled from the replicate and mean values, standard deviation as well as standard error of mean were calculated per treatment. Also Duncan Multiple range Test was used for mean separation. All differences in mean values of parameters were determined at P = 0.05 level of significance.

Results and Discussion

Induced breeding of *Clarias gariepinus* using three different substrate materials was successfully carried out at three levels including control. The fecundity, percentage fertilization and hatching from the broad stocks *Clarias gariepinus* are presented in Table 1. The table showed that fecundity, percentage fertilization and hatching differed significantly ($P<0.05$) among the treatments. The highest percentage fertilization and hatching in T_3 86.21 ± 0.658^a and 66.32 ± 0.189^a respectively was attributed to egg and milt quality as similarly observed by Yisa *et al.* (2010) in their study effect of nematode infection on the breeding potential of *Clarias gariepinus*. Nwadukwe (1993) obtained mean percentage fertilization of 73.50±9.30 % and mean hatching of 63.08±7.08 %. The high fertilization and hatchability could also be attributed to optimum water temperature. Oyelese, (2006) stressed the importance of water temperature as a determinant of fertilization and hatchability rates in artificially induced breeding of *Clarias gariepinus*. Before stripping, latency period was between 10 and 11 hours at temperature of 25-29^0 C. This corroborates the report of Dupree and Hurner, (1984) that warm water fishes spawn best at temperatures of 25-32^0 C.

Table 2 shows the comparison of mean lengths, weights, and specific growth rate and percentage survival of *Clarias gariepinus* fry post-incubation on three different substrate materials. The mean weight gain (3.55), specific growth rate (13.0125) and percentage survival (74.40) was highest in T_1 as indicated in the table. The aerator settings in other aquarium species were high which was not noticed in good time hence powerful aeration with vigorous water movements made the fry to consume much more energy than in a calm aquarium. Energy that could have been used for growth was wasted on swimming. This was similar to observation made by Van Oosten, (2012) that vigorous water movements made the fry to consume much more energy on swimming than on growth.

The results of water quality parameters analysis during incubation, hatching and rearing of the fry are presented in Table 3. The water parameters measured were not differed significantly ($P>0.05$) among the treatments. Values of all the water quality parameters measured were ideal and within the tolerance range for hatching, survival and growth of warm water fishes as similarly reported by Viveen, *et al.* (1986) and Ayinla, (1991). The result also corroborates the observation of Pandey (2004) that pH range 6.5-9.5 is suitable for fish growth and production. Dissolved Oxygen pattern corroborates the report of Adekoya, *et al.*, (2004) that dissolved oxygen less than 3ppm causes discomfort to fish and lead to death. Ayinla, (1991) recommended 22-30^0 C for fish larval rearing.

Conclusion and Recommendation

From the foregoing, water lily leaf performed best in term of hatching among the substrates to incubate eggs of *Clarias gariepinus* and therefore recommended for use.

References

Adekoya, B. B., Olunuga, O.A., Ayansanwo, T. O., Omoyinmi, G.A.K. (2004). Hand book on Manual of the second annual Fish seminar and training workshop held at Ogun State Agricultural Development Programme (OGADEP), Abeokuta, Published by Fisheries Society of Nigeria (FISON), Ogun state chapter. 19-25pp.

Ayinla, O.A. (1991). Proceedings of the fish seed propagation course conducted by African Regional Aquaculture Centre (ARAC), Aluu, Nigerian Institute for Oceanography and Marine Research (NIOMR), 14th -28th August, 1991, 104 pp.

Bargenal, T.B. (1978). Methods of assessment of fish production. Oxford Blackwell,Science Publication 352pp.

Blythe, W.G; Helfrich, L.A. and Libey, G. (1994). Induced maturation of striped bass, *Morone saxatilis* exposed to 6, 9 and 12 months photothermal regimes. *Journal of World Aquaculture Society* 25:183-192.

Dupree, H. K. and Hurner, J.V. (1984). The status of warm water fish farming and progression fish farming research. Third report to the fish farmers. U.S.Dept. of the interior fish and wild life services, Washiton. D.C. 270 PP.

Goudie, C.A., Scinco, B.A., Davis, K.B. and Parker, N.C. (1992). Reproductive performance of pigmented and Albino female Channel catfish induced to spawn with HCG or Ovaprim. *Journal of World Aquaculture Society*, Vol. 23 No.2. 138-145.

Nwadukwe, F.O. (1993). Induced oocyte maturation, ovulation and spawning in the African catfish, *Heterobranchus longifilis* using frog pituitary extract. *Journal of Aquaculture and Fisheries Management*. 24: 625 – 630.

Omitogun, O.G, Olaniyan, O.F. and Oyeleye, O.O. (2010). Potential of short term and long term cryopreserved sperm of the African giant catfish (*Clarias gariepinus* Burchell, 1822) for Aquaculture. *African Journal of Biotechnology* 9(41), 6973-6982.

Oyelese, O.A. (2006). Water temperature a determinant of fertilization and hatchability rates in artificially induced breeding of *Clarias gariepinus* (Teleostei: Clariidae). *Research Journal of Biological Sciences* 1(4) 83-87.

Pandey, G. (2004). General and Applied Itcthyology, Fishery Research. S. chad and Comparry Ltd. 1st Edition 2006. p.6.

Sule, O. D. (1991). Preliminary Studies on Induced Breeding Technique of *Clarias gariepinus*. National Institute for Freshwater Fisheries Research. Annual Report. 74-78.

Van Oosten, J, (2012). Factors Affecting the Growth of Fish. *Journal of transactions of the North American Wild life*. 9: pp173-183.

Viveen, W.J.A.R., Richter, C.J.J., Van Oardt, P.G.W.J., Jassen, J.A.L., Huisman,E.A. (1986). Practical manual for culture of the African catfish, *Clarias gariepinus*. Joint Publication. Ministry for Foreign Affairs, Netherlands; Dept. of Zoology University of Utrecht, The Netherlands. 94pp.

Yisa, T.A., Tsadu, S.M. and Musa, A. (2010). Effect of Nematode infection on the breeding potential of *Clarias gariepinus*. *Journal of Agriculture, Forestry and the Social Sciences*. 8 (1) 141-147.

Tables

Table 1: Comparison of fecundity, percentage fertilization and hatching for *Clarias gariepinus*, incubated on three (3) different substrate materials with fry reared for 8 weeks.

	TREATMENTS		
Parameters	**Kakabarn**	**Mosquito net**	**Water lily leaf**
Fecundity	28722±4259^{a}	31923±3926^{c}	34724±44728^{b}
Fertilization (%)	72.20±0.156^{b}	86.30±0.678^{a}	86.21±0.658^{a}
Hatching (%)	61.61±0.169^{a}	56.72±0.099^{b}	66.32±0.189^{a}

abc: means denoted by different superscripts along the same row differ (P<0.05) significantly.

Table 2: Comparison of mean lengths, weights, specific growth rate and percentage survival for *Clarias gariepinus* fry, eggs incubated on three (3) different substrate materials and reared for 8 weeks.

	TREATMENTS		
Parameters	**Kakabarn**	**Mosquito net**	**Water lily leaf**
Mean Initial Length (cm)	1.10	1.10	1.00
Mean Final Length (cm)	2.80	2.70	2.70
Mean Length gain (cm)	1.70	1.60	1.70
Mean Initial Weight (g)	0.13	0.11	0.12
Mean Final Weight (g)	3.68	3.08	3.61
Mean Weight gain (g)	3.55	2.97	3.49
Specific Growth Rate	13.0125	12.765	12.765
Percentage Survival	74.40	56.80	64.80

Table 3: Analysis Of Variance (ANOVA) Of Water Quality Parameters for *Clarias Gariepinus* Fry Reared For 8 Weeks Post-Incubation on Three (3) Different Substrate Materials

	TREATMENTS		
Parameters	**Kakabarn**	**Mosquito net**	**Water lily**
Temperature (^{0}C)	28.52±0.83^{a}	28.92±0.89^{a}	28.46±0.63^{a}
Conductivity (µs/cm)	228.70±12.05^{ab}	234.10±7.89^{b}	223.60±12.04^{a}
pH	7.26±0.09^{a}	7.29±0.09^{a}	7.18±0.13^{a}
Dissolved Oxygen (mg/l)	4.92±0.70^{a}	4.76±0.09^{a}	5.06±1.25^{a}

Data in the same row carrying the same superscript do not differ significantly (P>0.05) from each other.