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Male organs of African catfish (*Clarias gariepinus*) in spawning and non-spawning periods in Maiduguri, Borno State, Nigeria

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Abstract

The study was undertaken to investigate the gross reproductive organs of wild male *Clarias gariepinus* in spawning and non-spawning periods. Twenty mature males of *C. gariepinus* comprising of ten each during both periods were used. They weighed an average of 532 ± 8.32 gm during spawning and 510.8 ± 9.27 gm during non-spawning season and measured a standard body length of 43.2±4.72 cm and 42.1±2.48 cm during spawning and non-spawning seasons respectively. All fish were sourced from Gamboru fish market, Maiduguri and transported live to the gross Anatomy laboratory, Department of Veterinary Anatomy University of Maiduguri. Each fish was euthanized using tricaine anaesthetic at 8 drops/litre of water. The reproductive organs were removed en mass using scalpel, forceps, and scissors. Then the number of seminal vesicles were determined during spawning (37.8 ± 4.53) and non-spawning (36.32 ± 3.68) periods. The organs were seen consisting of lobular testes, milt duct, seminal vesicles, bulbourethral gland and papilla, which are whitish and milky colour appearances in spawning and non-spawning periods respectively. The milt duct which have the paired and unpaired part were also seen clearly in non-spawning period but relatively invisible in spawning period.

Keywords: Bulbourethral gland, Maiduguri, seminal vesicles, testes, Wild African catfish

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Introduction

African catfish (*Clarias gariepinus*) belongs to the family *Claridae* that is divided into two major genera *Clarias* and *Heterobronchus*. Over 100 species of *Clarias* have been described, but Teugel *et al.* (1982) established only 32 valid species (these are species that can be easily differentiated from one another using structures like gill rakers and vomerine teeth) of which *C. gariepinus* is the most important species for aquaculture. This is because of their ability to withstand handling stress, high resistance to disease, fast growth rate, high fecundity and palatability.

Although fish farming activities in Nigeria started over 50 years ago (Olagunju *et al.,* 2007), Nigeria has not been able to meet protein requirement of its populace. According to Ekunwe & Emokaro (2009), statistics indicate that Nigeria was the largest in aquaculture in African, with production output of over 15,489 tonnes per year; this is closely followed by Egypt with output of about 5,645 tonnes. Only few countries in Africa apart from Nigeria and Egypt can boast of producing more than 1,000 tonnes of fish per year. This result shows that Africa in general is far behind in aquaculture production. However, according to FAO (2012) report, Egypt is the highest producer of aquaculture in 2010 with 919585 tonnes of total Africa production followed by Nigeria with 200535 tonnes. This indicates that Nigeria is no longer the leader in aquaculture even though the total output has increased significantly from 2009 to 2010.

In Nigeria, there is dare need for animal protein to meet the demands of its teeming population and fish contributes significantly to this requirement. However, despite efforts made by Nigerian government to increase fish production, Nigeria is still considered as a protein deficient country (FAO, 2007). Several attempts to collect milt from male *Clarias* have not been successful, which is speculated to be as a result of seminal vesicles and the position of the testes that are located deep within the abdominal cavity (Diyaware *et al.,*

2010). These researchers also developed a technique of milt (sperm) collection from *Clarias* species via ablation. Some reports have speculated about the difficulty of milt collection in Afrcan catfish species due to the position of testes and the seminal vesicles but the gross pictures of these organs have not been documented in Nigeria. Also, literature search revealed lack of information on these organs especially during non-spawning period which necessitated this study.

Materials and Methods

Twenty adult male African catfish (*Clarias gariepinus*) were procured from Gamboru fish market in Maiduguri, and transported live in a plastic trough to the Gross Anatomy Laboratory of the Department of Veterinary Anatomy, University of Maiduguri. The weight and length of fish were determined using weighing scale and measuring tape respectively. They weighed an average of 532 ± 8.32 gm during spawning and 510.8 ± 9.27 gm during non-spawning season and measured a standard body length of 43.2 ± 4.72 cm and 42.1 ± 2.48 cm during spawning and non-spawning seasons respectively.

Each fish was euthanized using tricaine MSS anaesthetic at the dose rate of 8 drops/litre of water (Bowser, 2001). A mid-ventral incision was made between the pectoral fins to about one centimetre to the conical papilla and the reproductive organs were exteriorized using scalpel, scissors and forceps. Photographs of the reproductive organs were taken using canon digital camera power shot (A470). The dimensions of the reproductive organs were determined using sensitive weighing balance and digital vernier calliper (model number Y308 Henny).

Statistical analysis

The weight and length of fish and its reproductive organs were presented as means ± standard deviation (n=20). Statistical comparison between the spawning and non-spawning seasons was made using student t-test. The analysis was conducted using JMP version 11 (SAS institute INC., Cary NC). Analyses were considered significant at P<0.05.

Results

The results are presented in Table 1. The mean length of reproductive organ (LRO) during spawning season was significantly higher (P<0.05) than during non-spawning season. Also, the mean diameter of reproductive organ (DRO) in spawning was significantly higher (P<0.05) than in non-spawning season.

As shown (Plate IA) the papilla of male *Clarias* was observed to be reddened which indicates maturity and often referred as ''ready to spawn'' males. During non-spawning period, the papilla was seen as pinkish (Plate IB). The paired testis, paired and unpaired part of the milt duct and the seminal vesicles were seen located deep within the abdominal cavity lying along the long axis of the body. They were whitish with no clear demarcation of the milt duct during spawning period (Plate IIA). During non-spawning period, they were milky coloured with visible milt duct (Plate IIB).

Discussion

Fish like other vertebrates, exhibits disproportionate growth; this is a situation whereby some parts of the body show different growth rates from other parts (Martins *et al*., 2005). The mean values of length and weight of *C. gariepinus* obtained in this study which are often used for determining maturity of fish agrees with the reports of Nwokoye *et al.* (2007) and Ikpegbu *et al*. (2012). However, unlike other vertebrates that stop growth at certain ages due to heredity, fish does not really lose the capacity to grow (Pauly, 1992) although as the fish grows older, the growth rate decreases. Ben (2003) reported that environmental factors such as food, temperature,

Table 1: Mean± SD, difference in weight and length of fish and its reproductive organ dimensions during spawning/non-spawning seasons in male African catfish (*Clarias gariepinus*)

Parameters	Mean± SD		P-value
	Spawning season	Non-spawning season	
WF gm	532.8±8.32	510.8±9.27	0.31
LF cm	43.2±4.72	42.1±2.48	0.46
LRO cm	7.76±3.75	6.11±0.74	0.04*
WRO gm	3.00±0.48	2.69±0.74	0.82
DRO cm	2.18±0.23	1.98±0.41	0.04*
NSV	37.8±4.53	36.32±3.68	0.21

Key: WF=Weight of fish, LF=Length of fish, WRO=Weight of Reproductive Organ, LRO=Length of Reproductive Organ, DRO=Diameter of Reproductive Organ and NSV=Number of seminal vesicles

* Significantly different at (p< 0.05)

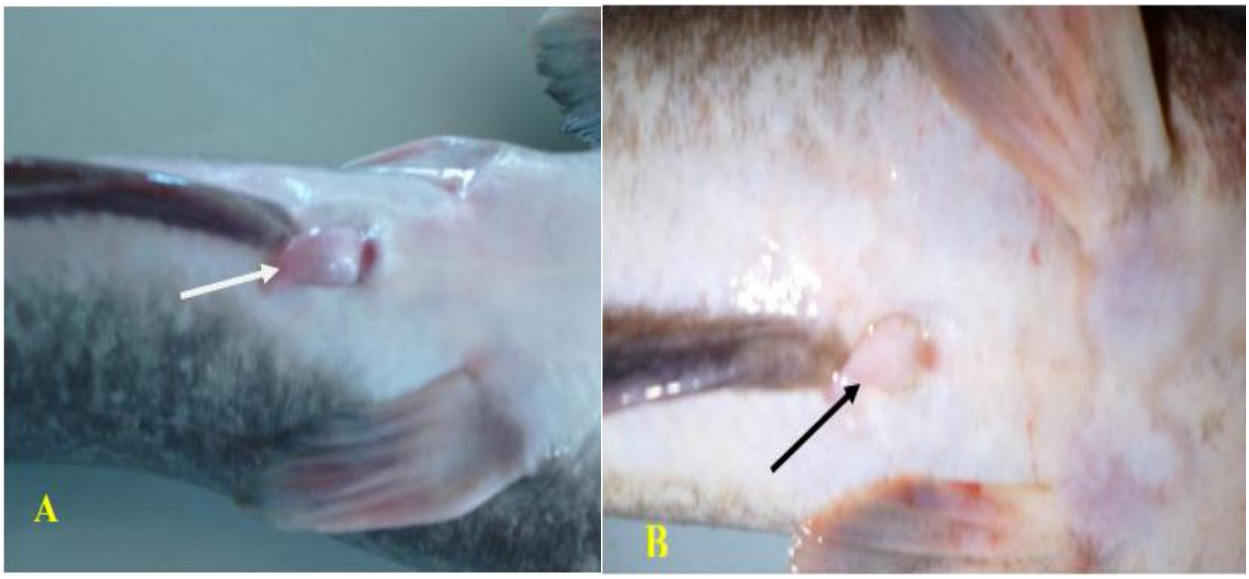

Plate I: Ventral view of male African catfish *C.gariepinus* showing the conical papilla (arrows) in breeding (A) and non-breeding (B) seasons

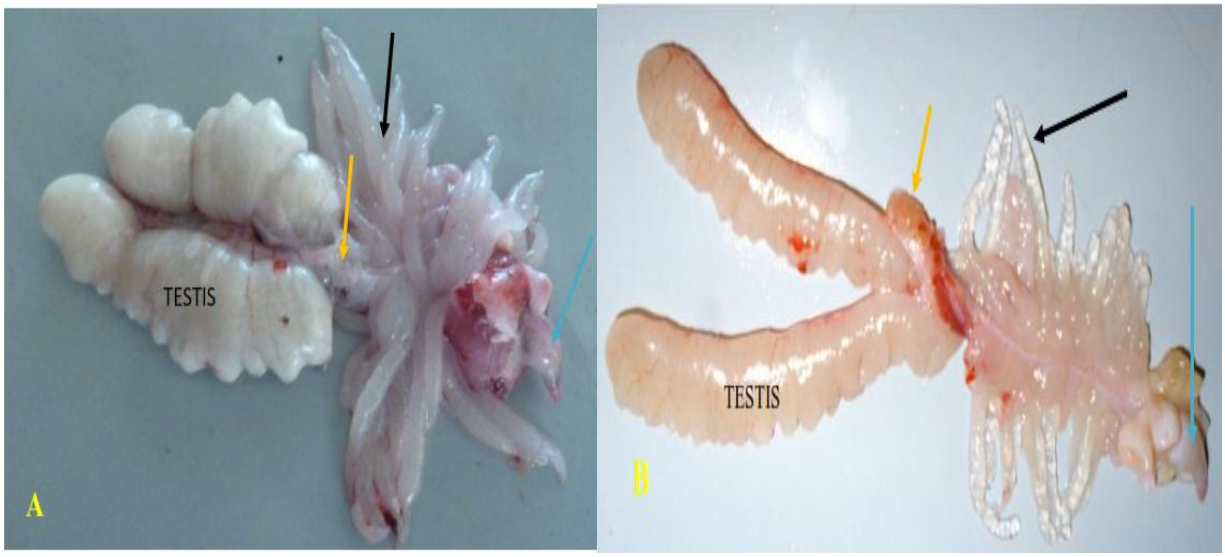

Plate II: The reproductive organs of male *C. gariepinus* showing the testis, bulbourethral gland (yellow arrow), seminal vesicles (black arrow) and papilla (blue arrow) that are whitish in colour during breeding (A) and milky colour appearance during non-breeding (B) seasons

pH and dissolved substances generally affect fish growth, but the most important factor is population density.

Growth is a complex process and can differ between specie, strains or population within the same species and different individuals within the same population. Among cultured animals, fish species exhibit the largest individual variation in growth (Gjedrem, 1997). For most farmed animals and fish, the coefficient of variation (CV) for growth varies between 7 and 10% and 20 and 35% respectively (Gjedrem, 1997). Disparity of individual growth usually results from individual differences in feed intake (Umino *et al*., 1997) or feed efficiency (Qian *et al*., 2002) or a combination of both. More often than not, social hierrhachies have been implicated as the main source of growth disparity, resulting in dominant or large individuals and subordinate or smaller individuals (Kestemont *et al*., 2003). The dominant individuals often monopolize larger share of available resources, bringing about faster growth of these dominant fish with respect to subordinate ones. Other environmental factors that may affect size disparity include stock density, temperature, water current daylight and maternal effect (Kestemont *et al*., 2003), cannibalism and protein turn-over (Bang *et al*., 2004). Apart from environmental factors**,**

genetic factors may play a role in bringing about differences in the growth of individual fish (Qian *et al*., 2002).

The artificial reproduction of the African catfish, as for all fin-fishes, is a chain of activities which is more or less similar to that of natural reproduction. It starts with the selection of matured fish from natural or broodstock. Ideal broodfish weighs between 300–800 gm, and are selected based on swollen or sometimes reddish or rose coloured genital papilla (Ben, 2003); this agrees with the findings in this study regarding the colour of the genital papilla. However, the average weight of the fish obtained in this study contradicts the findings of Ben (2003).

The reproductive organs of male African catfish (*C. gariepinus*) consist of paired testis, paired part of milt duct, unpaired part of milt duct that are surrounded by seminal vesicles and a conical papilla located ventro-cranial to the anal region. Studies on the complete reproductive organ have not been reported in Nigeria to the best of our knowledge. However, the testis as a paired organ in the posterior part of the abdominal cavity as observed in this study has been reported in farmed *C. gariepinus* by Diyaware *et al.* (2010) and Ikpegbu *et al.* (2012) and also in *Parasilurus aristotelis* (Iliadou & Fishelson, 1995). The testes during spawning period as observed in this study were lobular and whitish. This also agrees with the report of Diyaware *et al.* (2010). Attempts to collect milt from this species made by Nguenga *et al.* (1996) and Melo & Godinho (2006) yielded limited success probably because the specie possess accessory sex gland; seminal vesicles located at the unpaired part of the milt duct (Eduardo *et al.,* 2001). These seminal vesicles extension may possibly exert pressure on the milt duct leading to its occlusion, thereby hindering milt from coming out when abdominal pressure is applied. The reproductive organs during non-spawning period are smaller compared to the spawning period. The seasonal differences are not clear but environmental factors such as temperature, food availability, rainfall, and photoperiod are known to be involved in this process (Martins *et al.* 2005). The colour of the organ changed from whitish to milky colour during spawning season in this study. This agrees with the report of Singh & Joy (1999). They observed that during non-spawning season, the reproductive organs of fish including the testis tend to regress and possibly change colour. However, the number of seminal vesicle extension during the spawning and non-spawning seasons in this study, disagree with Fishelson *et al.* (1994). They observed that sperm ducts are surrounded by up to 50 finger-like extensions of the seminal vesicles that may retain sperm flow when pressure is applied on the abdomen (Richter *et al*., 1976). However, the number of seminal vesicles coincides with the report of Van den Hurk *et al* (1987), who reported a wide range in the number of seminal vesicles in clariid species. Nayyar & Sundararaj (1969) reported that seasonal changes especially during spawning season in the weight and histology of the seminal vesicles are characterized by marked increases in size due to proliferation of glandular cells. The collection of seminal fluid in the lumen of seminal vesicles could also lead to their distention thereby increase their size. The testes, seminal vesicle, bulbourethral gland and the conical papilla that is externally located are all somewhat pinkish during spawning season. This agrees with the report of Teugel *et al.* (1982). They established that the colour of both external and internal organs is subject to changes depending on the intensity of the sunlight they are exposed to, their salinity and the water temperature.

In conclusion, the study has provided information on the gross morphology of male organs of wild African catfish (*C. gariepinus*) during the spawning and non-spawning seasons.

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