

Comparative Anatomy of Wild Adult African Catfish (*Clarias gariepinus*) Ovary During Rainy and Dry Periods in Zaria, Nigeria

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With 4 figures and 1 table. Received April, accepted for publication September 2021

Abstract

The study investigated effects of rainy and dry periods on the ovaries of wild adult *Clarias gariepinus* in Zaria, Kaduna State Nigeria. Twenty-four wild adult catfish with average weight of 1000.00 ± 0.00 gm was used during both periods. They measured a standard body length of 50.17 ± 1.01 cm (rainy) and 44.83 ± 2.09 cm (dry). The fish were sourced from Zaria dam and transported live to Gross Anatomy Laboratory in Ahmadu Bello University Zaria. Each fish was euthanized using tricaine anaesthetic at 8 drops/litre of water. The ovaries were extracted, weighed and fixed in Bouin's fluid for 24 hours, and processed histologically. Grossly, the ovaries were observed to be well-developed and highly vascularized during rainy period while, regressed and poorly vascularized ovaries were seen during dry period. The mean weight of the ovaries (0.025) and Gonado-somatic index

(GSI) value (0.034) were significantly higher during rainy period. Histologically, the ovaries were predominated by vitellogenic and post-vitellogenic follicles during rainy period while, pre-vitellogenic follicles predominates dry periods. The tunica albuginea and interstitial connective tissues were thin during rainy period but thick during dry period. Hence, the result of this study revealed that wild adult catfish spawns during rainy period while, dry period is characterized by low gonadal activities in Zaria, Nigeria.

Keywords: Follicles, Gonado-Somatic Index (GSI), Ovary, Wild catfish, Zaria dam.

Introduction

Catfish (order siluriformes) is a diverse and widespread fresh water group of Ostariophysan fish (Michael, 1996). Catfish is the most diverse fish order and the second or third order among

vertebrates; it represents 1 in 10 of the fish and 1 in 20 of the vertebrates (Van Dyk and Pieterse, 2008). Fish forms an important source of human diet as they provide proteins, fats, and especially vitamins A and D (Oguntuase and Adebayo, 2014). Special importance of fish is that they contain vitamin B which is not present in plant food (Oguntuase and Adebayo, 2014). The ovaries of African catfish are paired sac-like organs located in the peritoneal cavity into which extend numerous ovigerous folds lined by germinal epithelium (Anil kumar and kanika, 2017). Like in other teleost, oogonia of *C. gariepinus* proliferate into primary oocytes which develops within the follicle, formed cortical alveoli, entered vitellogenesis, undergoes maturation, and finally release (ovulation) (Babatunde and Olanike, 2015).

Although, aquaculture activities in Nigeria started about 50 years ago (Olagunju *et al.*, 2007), Nigeria has not been able to meet protein requirement of its populace. Thus, the study of the gross and histological variations in the ovary of wild adult *Clarias gariepinus* during rainy and dry periods will enrich the existing data on the growth and production of African catfish in Nigeria.

Materials and Methods

Study Area

The study was carried out in Zaria, Kaduna State of Nigeria. Zaria is located at Latitude 11° 4' 0" North, 7° 42' 0" East (Tanko *et al.*, 2012). Zaria is

situated in the northern Guinea Savannah Zone with a tropical continental climate possessing distinct rainy (May-October) and dry (November-April) seasons. Zaria has an average annual temperature of 24.9 °C/ 76.8 °F and rainfall of 1050 mm/ 41.3 inch (Climate office IAR-ABU Zaria, Kaduna-Nigeria). Zaria Dam is located in Zaria city, it was constructed in 1975 on the river Galma to cater for Zaria township water supply and other benefits. The dam has a designed live reservoir capacity of 15.875 million m³, length of 900 meters and a maximum height of 15 meters from the river bed (Tanko *et al.*, 2012). Zaria dam is located on latitudes 11°07'45"E to 11°08'20"E and longitudes 07°46'N to 07°48'N (Tanko *et al.*, 2012).

Experimental animals

Twenty-four (24) wild adult *C. gariepinus* were sourced from Zaria Dam, Kaduna State, Nigeria during rainy and dry periods of the year 2017/2018. Twelve each were obtained during rainy period (May-October) and dry period (November-April). The fishes were transported live in open plastic troughs containing clean water to the Gross Anatomy Laboratory in the Department of Veterinary Anatomy, Ahmadu Bello University Zaria.

Morphometric parameters

The weight and length of each fish was determined using Mettler Toledo balance with sensitivity of 0.01 gm (Vastro India) and measuring tape, respect-

tively. The weight and dimensions of the ovaries were determined using Mettler Toledo balance with sensitivity of 0.001 gm (Vastro India) and Vernier caliper (model number Y308 Henny), respectively. Photographs were taken using canon digital camera power shot (SX170 IS) with 64-megapixel sensor (focal length: 28-448mm, 7.5cm (3.0") TFT.

The Gonado-somatic index was used for following up periodic variations in the gonads weight as related to the body weight of each fish in gram by the formula:

$GSI = \text{Gonad weight} / \text{Fish body weight} \times 100$ (Mahmoud and Badia, 2014).

Harvest of Ovaries

Each fish was euthanized using tricaine MSS anaesthetic at 8 drops/liter of water (Bowser, 2001). A mid-ventral incision was made between the pectoral fins to about one centimeter to the genital opening (a cylindrical opening situated caudal to the anal opening) and the ovaries were carefully extracted using scalpel blade, pair of scissors and forceps.

Histology

The extracted ovaries were fixed in Bouin's fluid for 24hour, dehydrated through series of ascending concentrations of ethanol (70%, 90%, 100%, 100%, 100%) for 2 hours at each concentration, cleared in xylene, embedded in paraffin wax and sectioned at 5µm. Hematoxylin & Eosin was used

for histological evaluation (Bancroft, 2018).

Data analysis

All data obtained were expressed as mean \pm standard deviation (n=24). Statistical comparison between rainy and dry periods was made by subjecting the data to independent student t-test using GraphPad Prism version 5.0 for windows. Values of $P < 0.05$ was considered significant.

Results

The average body weight was 1000.00 gm during rainy and dry periods, with a standard body length of 50.17 ± 1.01 cm and 44.83 ± 2.09 cm during rainy and dry periods respectively. From (Table 1) The mean weight of the ovaries was significantly higher during rainy period (0.025) compared to dry period. Also, the mean Gonado-somatic index (GSI) value was significantly higher during rainy period (0.034) compare to dry period. Fig (1) shows a well-developed and highly vascularized ovary of 1kg catfish during rainy period while Fig (2) shows a regressed and poorly vascularized ovary of 1kg catfish during dry period. Fig (3) shows predominantly vitellogenic and post-vitellogenic follicles with thin tunica albuginea and thin interstitial connective tissue during rainy period while, Fig (4) shows predominantly pre-vitellogenic follicles with thick tunica albuginea and thick

interstitial connective tissue during dry period.

Discussion

The mean value of length and weight obtained for *C. gariepinus* in this study which was used in determining the maturity of the fish agrees with Babatunde and Olanike, (2015). However, ovarian development in catfish is influenced by several factors which includes environmental factors, hormonal factors and nutrition (Xiao et al., 2014). The ovaries of African catfishes are paired sac-like organs located in the peritoneal cavity into which extends numerous ovigerous folds lined by germinal epithelium (Anil kumar and kanika, 2017). Like in other teleost, oogonia of *C. gariepinus* proliferate into primary oocytes which develops within the follicle, formed cortical alveoli, entered vitellogenesis, undergoes maturation, and finally release (ovulation) (Babatunde and Olanike, 2015).

At maturity, ovaries of *C. gariepinus* are composed of oocytes of different size and stages, ranging from synchronous population of large oocytes defined as a clutch, to previtellogenic and vitellogenic smaller oocytes intermingling with mature ova. Each matured ovum is surrounded by zona radiata which makes them conspicuously bigger in size (Babatunde and Olanike, 2015).

The study of the effects of rainy and dry periods on the ovary of a mature

wild *C. gariepinus* has not been documented in Nigeria to the best of our knowledge. Hence, the results obtain from this study would add to the existing literatures on catfish production in Nigeria. Grossly, during the rainy period, the ovaries were well developed and highly vascularized, this is in agreement with the findings of El-Zoghby et al. (2008). They reported that the weight, size and diameter of the reproductive organs of Catfish are significantly higher during spawning season. While, during dry period the ovaries were regressed and poorly vascularized, this is in line with the findings of Singh and Joy (1999), who reported that, during non-spawning season, the reproductive organs of *Claria batracus* including the testis tend to regress and possibly change color.

The mean weight of both ovaries was significantly higher during rainy period (0.025) compare to dry period, this equally agrees with the findings of El-Zoghby et al. (2008) who reported that the weight, size and diameter of the reproductive organs of Catfish are significantly higher during spawning period compared to non-spawning period.

The mean GSI value was significantly higher during rainy period (0.034) compare to dry period, this agrees the findings of Mahmoud and Badia (2014), who reported a higher GSI value during the spawning season of *Clarias lazera*. Histologically, the

ovaries of *C. gariepinus* was predominated by vitellogenic and post-vitellogenic follicles during rainy period with thin tunica albuginea and interstitial connective tissue, but during dry period the ovary was predominated by pre-vitellogenic follicles with thick tunica albuginea and thick interstitial connective tissue, this agrees with the findings of Mahmoud and Badia (2014) who reported a similar domination of the ovaries of *Clarias lazera* by vitellogenic and post-vitellogenic follicles during breeding season while pre-vitellogenic follicles predominates non-breeding season.

Conclusion

The results obtained in this study revealed that rainy period is the spawning period for wild adult catfish in Zaria, Nigeria, while dry period is characterized by low gonadal activities.

Conflict of interest: No conflict of interest

Ethical Statement

An ethical approval was given by Animal research committee of Ahmadu Bello University Zaria with an approval number of ABU/CAUC/2020/014.

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Authors contributions

All authors contributed substantially to the design, acquisition, and analysis of

the study. Writing and revising for intellectual consumption was also collectively done.

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Table (1): Mean \pm SD values of body weight, length and Ovarian parameters of adult wild African catfish (*C. gariepinus*) during rainy and dry periods.

Parameters	Mean \pm SD (n=24)		p-value
	Dry Period	Rainy Period	
BW (gm)	1000.00 \pm 0.00	1000.00 \pm 0.00	
BL (cm)	44.83 \pm 2.09	50.17 \pm 1.01	0.108
LO (cm)	16.83 \pm 1.48	21.17 \pm 2.03	0.166
DO (cm)	4.83 \pm 1.20	7.17 \pm 2.60	0.497
WO (gm)	43.93 \pm 15.91	138.84 \pm 21.99	0.025*
GSI	4.39 \pm 1.59	13.88 \pm 0.37	0.034*

Key: BW= Body weight, BL= Body length, LO= Length of ovaries, DO= Diameter of ovaries, WO= Weight of ovaries and GSI= Gonado somatic index
P<0.05 are statistically significant

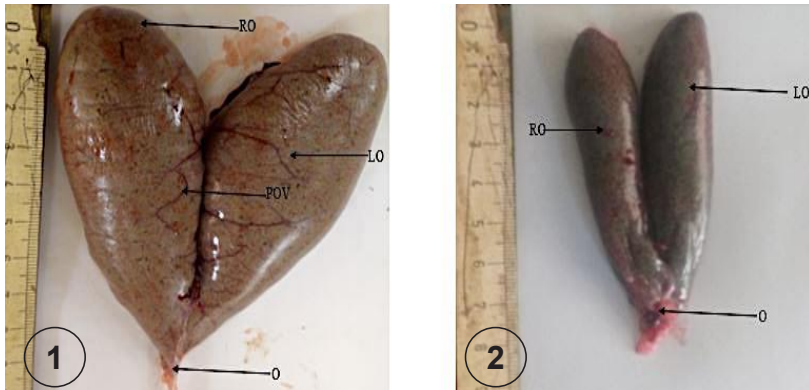


Fig (1): Extracted ovary of a 1kg wild *Clarias gariepinus* during rainy period showing a pair of well-developed and highly vascularized oval shape ovaries with prominent ovarian veins. LO Left ovary, O Oviduct, POV Prominent ovarian veins, RO Right ovary.

Fig (2): Extracted ovary of a 1kg wild *Clarias gariepinus* during dry period showing a pair of Regressed and poorly vascularized ovaries with an oviduct. LO Left ovary, O Oviduct, Ro Right ovary

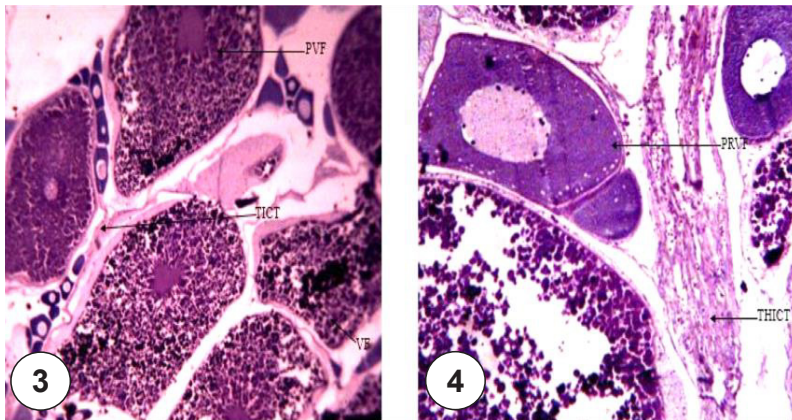


Fig (3): Histological section of the ovary of *Clarias gariepinus* during rainy period showing vitellogenic and post-vitellogenic follicles with interstitial connective tissue at 5 μm. H&E X100. TICT Thin interstitial connective tissue, PVF Post vitellogenic follicle, VF Vitellogenic follicle.

Fig (4): Histological section of the ovary of *Clarias gariepinus* during dry period showing predominant pre-vitellogenic follicles with thick interstitial connective tissue at 5 μm. H&E X100. PRVF pre-vitellogenic follicles, THICT Thick interstitial connective tissue.

Animal species in this Issue

Catfish (*Clarias gariepinus*)



Kingdom: Animalia & Phylum: Chordata & Class: Actinopterygii & Order: Siluriformes & Family: Clariidae & Genus: *Clarias* & Species: *C. gariepinus*

Most catfish are bottom feeders. In general, they are negatively buoyant, which means that they will usually sink rather than float due to a reduced gas bladder and a heavy, bony head. Catfish have a variety of body shapes, though most have a cylindrical body with a flattened ventrum to allow for benthic feeding.

A flattened head allows for digging through the substrate as well as perhaps serving as a hydrofoil. Some have a mouth that can expand to a large size and contains no incisor-like teeth; catfish generally feed through suction or gulping rather than biting and cutting prey. However, some families, notably Loricariidae and Astroblepidae, have a suckermouth that allows them to fasten themselves to objects in fast-moving water. Catfish also have a maxilla reduced to a support for barbels; this means that they are unable to protrude their mouths as other fish such as carp.

Catfish may have up to four pairs of barbels: nasal, maxillary (on each side of mouth), and two pairs of chin barbels, though pairs of barbels may be absent depending on the species. Catfish barbels always come as pairs. Many larger catfish also have chemoreceptors across their entire bodies, which means they "taste" anything they touch and "smell" any chemicals in the water. "In catfish, gustation plays a primary role in the orientation and location of food". Because their barbels and chemoreception are more important in detecting food, the eyes on catfish are generally small.

Source: Wikipedia, the free encyclopaedia