



Comparative anatomy of wild adult tilapia (*Oreochromis niloticus*) testes during rainy and dry periods in Zaria, Nigeria

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Abstract

The study was undertaken to investigate the effects of rainy and dry periods on the gross and histology of the testes of *Oreochromis niloticus* in Zaria, Kaduna State, Nigeria. Twenty-four adult wild tilapia fish with average weight of 234.74±5.20 gm and 177.84±31.07 gm was used during rainy and dry periods, respectively. They measured a standard body length of 23.50±0.29 cm and 22.17±0.73 cm during rainy and dry periods, respectively. The fishes were sourced from Zaria dam and transported live in open plastic troughs containing clean water to the Gross Anatomy Laboratory in the Department of Veterinary Anatomy, Ahmadu Bello University Zaria. Each fish was euthanized using tricaine anaesthetic at 8 drops/litre of water. The testes were extracted, weighed and fixed in bouin's fluid for 24hours. Each testis was then dehydrated through series of ascending concentrations of ethanol, cleared in xylene, embedded in paraffin wax and sectioned at 5µm. Hematoxylin (H) & Eosin (E) were used for histological evaluation. Grossly, the testes of *O. niloticus* were whitish, non-lobulated and well developed during both rainy and dry periods. Each testis had a smooth lateral and medial edge. Seminal vesicles and Bulbourethral glands were absent. The average weight of both testes shows insignificant variation across both periods (0.458). The Gonado-somatic index value was insignificantly higher during rainy period (0.159) compare to dry period. Histologically, the lumen of seminiferous lobules was filled with spermatozoa during both rainy and dry periods. The tunica albuginea and interstitial connective tissues were thin across both periods. In conclusion, Gross and histological results which coincide with the values of Gonado-somatic index revealed that wild adult tilapia fish spawns during both rainy and dry periods in Zaria, Nigeria.

Keywords: Gonado-somatic index, Testes, Seminiferous lobules, Spermatozoa, Wild Tilapia, Zaria dam

Introduction

Nile tilapia *Oreochromis niloticus* (Linnaeus, 1758) is native to Africa, ranging from the upper Nile River south to the equator and west to the Atlantic coast (Trewavas, 1983). The species is favored among aqua culturists due to its ability to tolerate a wide range of environmental conditions, fast growth, successful reproductive

strategies, and ability to feed at different trophic levels. These same traits allow them to be an extremely successful invasive species in subtropical and temperate environments (Peterson et al., 2005). *Oreochromis niloticus* is the second most important cultured freshwater fish worldwide after carp (FAO, 2006).

Tilapia fish share basic testicular structure to other fish (Del Mundo, 1994). In fish unlike in mammals, the seminiferous lobule is of cystic type and cells similar in maturity stages are grouped together in cyst (Van Dyk & Pieterse, 2008). The male reproductive organ of *O. niloticus* is composed of a pair of non-lobulated testes, a common milt duct, and an external conical papilla located ventro-caudal to the anal opening. The conical papilla is an external reproductive organ which enhances reproductive efficiency, the sperm usually get to the exterior via the papilla, the shape of the papilla is used in sex determination (Guimaraes *et al.*, 2005). Although, fish farming activities in Nigeria started over 50 years ago (Olagunju *et al.*, 2007), Nigeria has not been able to meet protein requirement to its populace. Thus, the study of the anatomical variations in the testes of wild adult tilapia during rainy and dry periods will enrich the existing data on the growth and production of Tilapia fish in Nigeria.

Materials and Methods

Study area

The study was carried out in Zaria dam in Zaria city, Kaduna State, Nigeria. Zaria is situated in the northern Guinea Savanna Zone with a tropical continental climate possessing distinct rainy (May-October) and dry (November-April) seasons. The area has an average annual temperature of 24.9 °C/ 76.8 °F and rainfall of 1050 mm/ 41.3 inch. The dam 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 metres and a maximum height of 15 metres from the river bed (Tanko *et al.*, 2012).

Experimental animals

Twenty-four wild adult tilapia were sourced from Zaria dam, Kaduna State, Nigeria during rainy and dry periods. Twelve fishes each were used per period. They were transported live in open troughs containing clean water to the Gross Anatomy Laboratory, Department of Veterinary Anatomy, Ahmadu Bello University, Zaria, Nigeria.

Morphometric parameters

The weight and length of each fish were determined using Mettler balance with sensitivity of 0.01 gm and measuring tape, respectively. The weight and dimensions of the testes 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 & Badia, 2014).

Harvest of testes

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

Histology

The extracted testes were fixed in Bouin's solution 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 (Cek *et al.*, 2001).

Data analysis

All data obtained were expressed as mean ± standard deviation. 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 and Discussion

The average body weight was 234.74±5.20 gm and 177.84±31.07 gm during rainy and dry periods, respectively. They measured a standard body length of 23.50±0.29 cm and 22.17±0.73 cm during rainy and dry periods, respectively. Grossly, Tilapia fish had a pair of whitish and well developed non-lobulated testes across rainy and dry periods (Plates 1A and 1B), which suggest that tilapia fish spawns all year round, this agrees with the findings of Mark *et al.* (2004) who reported that coastal Mississippi watershed tilapia reproduces all year round. This equally agrees with the findings of Diyaware *et al.* (2010) who reported a whitish and well-developed testis of *Clarias anguillaris* during the spawning season. The lateral and medial edges of both testes were smooth during rainy and dry periods (Plates 2A and 2B), this is in contrary with the findings of Zakariah *et al.* (2016) who reported the

Table 1: Mean ± SD values of body weight, length and testicular parameters of adult wild tilapia fish (*O. niloticus*) during rainy and dry periods

Parameters	Mean± SD (n=24)		p-value
	Dry Period	Rainy Period	
BW (gm)	177.84±31.07	234.74±5.20	0.206
BL (cm)	22.17±0.73	23.50±0.29	0.200
LT (cm)	16.50±1.26	12.70±3.84	0.431
DT (cm)	0.87±0.09	1.12±0.08	0.109
WT (gm)	0.70±0.07	0.76±0.04	0.458
GSI	0.40±0.04	0.32±0.02	0.159

Key: BW= Body weight, BL= Body length, LT= Length of testes, DT= Diameter of testes, WT= Weight of testes and GSI= Gonado somatic index

P<0.05 are statistically significant

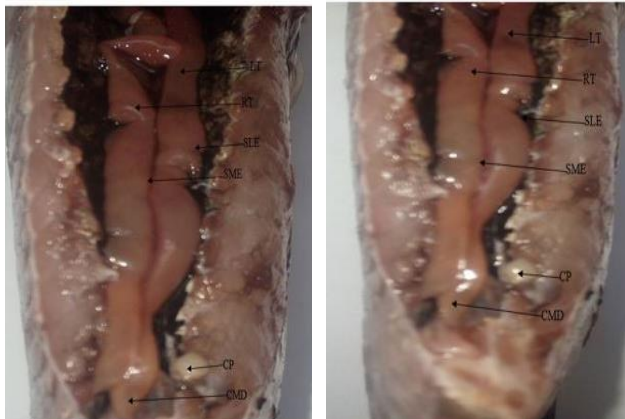


Plate 1: Wild adult *Oreochromis niloticus* showing a pair of well-developed, non-lobulated testes with smooth lateral and medial edges and a common milt duct in situ during (A) dry period and (B) rainy period

Key: CMD= Common milt duct, CP= Conical papilla, LT= Left testis, RT= Right testis, SLE= Smooth lateral edge, SME= Smooth medial edge

presence of lateral fringes at the lateral edges of the paired testes of *Clarias gariepinus* during both spawning and non-spawning season. Histologically, the tunica albuginea and interstitial connective tissue were very thin during both rainy and dry periods possibly due to the pressure exerted by the distended testicular lobules filled with spermatozoa (Plates 3A and 3B), this further suggest that tilapia fish spawns actively during rainy and dry period, similar to the findings of Mahmoud & Badia, (2014) who reported a thin tunica albuginea and thin interstitial connective tissues in the testes of *Clarias lazera* during spawning season. The GSI values of *O. niloticus* showed insignificant variation across rainy and dry periods (Table 1). Although, the GSI value was insignificantly higher during the rainy period (0.159), which may suggest that, even though *O. niloticus* spawns actively during both rainy and dry periods, the spawning rate may be higher during rainy period than dry period, this is in disagreement with the findings of Demeke (1996) who reported that the GSI value of Ethiopian Nile



Plate 2: Extracted testes of *Oreochromis niloticus* during (A) dry period and (B) rainy period showing a pair of non-lobulated testes with a common milt duct. The medial and lateral edges are smooth.

Key: CMD= Common milt duct, LT= Left testis, RT= Right testis, SLE= Smooth lateral edge, SME= Smooth medial edge

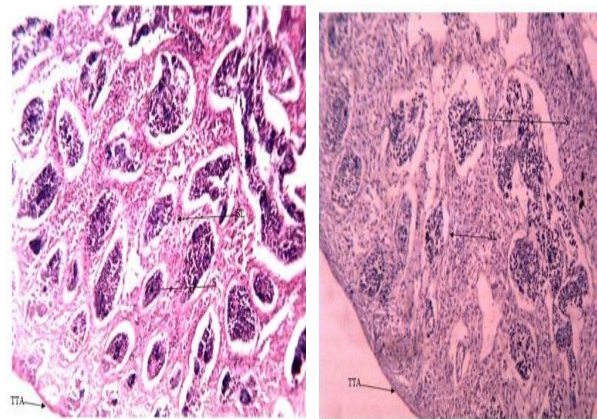


Plate 3: Histological section of the testis of *Oreochromis niloticus* during (A) rainy period (B) dry period showing seminiferous lobules filled with spermatozoa with thin tunica albuginea at 5µm. H&E X100.

Key: S= Spermatozoa, SL= Seminiferous lobules, TTA= Thin tunica albuginea

Tilapia is usually highest during dry season.

In conclusion, the results of this study, revealed that adult wild Tilapia fish spawns during both rainy and dry periods in Zaria Nigeria. Although, tilapia fish was observed to breed more during rainy period, possibly due to the availability of more phytoplankton during rainy period, as nutrition plays crucial role in reproduction.

Conflicts of Interest

The authors declare no conflict of interest.

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