MACROSTRUCTURE OF THE FEMALE REPRODUCTIVE TRACT OF WILD DIURNAL GREY SQUIRREL (*SCIURUS CAROLINENSIS*)

[1]WANMI, Nathaniel, [2]AKPAN, Dominic Umosen, [3]KWINJO, Columbus Philemon, [2]ALI Magdalen Nkwase and [4]ADI, Deborah Se-ember

[1]Department of Veterinary Anatomy, College of Veterinary Medicine, University of Agriculture, Makurdi, Benue State, Nigeria.

[2]Department of Veterinary Anatomy, Faculty of Veterinary Medicine, Ahmadu Bello University, Zaria, Kaduna State, Nigeria.

[3]Department of Veterinary Theriogenology, Faculty of Veterinary Medicine, University of Abuja, Abuja, Nigeria.

[4]Department of Veterinary Theriogenology, College of Veterinary Medicine, University of Agriculture, Makurdi, Benue State, Nigeria.

Corresponding Author: Wanmi, N. Department of Veterinary Anatomy, University of Agriculture, Makurdi, Benue State, Nigeria. **Email:** nathanielwanmi2014@gmail.com **Phone:** +234 8034696906

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ABSTRACT

This study aim at reporting landmarks and quantitative aspect of the wild diurnal squirrel reproductive tract. Knowledge on the reproductive system of this species may give better understanding on the reproductive physiology and production. Five squirrels were used for this study. The live body weight and length were 391.57 ± 22.561 g and 52.62 ± 4.559 cm respectively. The length of the ovary and the whole reproductive tract were (0.96 ± 0.128 cm right, 0.91 ± 0.173 cm left) and 7.603 ± 0.120 cm respectively. Length of the various segments were significantly different at p<0.05. Gross features indicated long fallopian tubes or oviduct, separated at the external uterine bifurcation. The oviduct is ill-define to differentiate the ampulla from a short isthmus. The ampulla is longer, wider than isthmus and the reproductive system is of the bicornuate type.

Keywords: Grey squirrel, Macrostructure, Reproductive tract

INTRODUCTION

Squirrel is a member of the Order, Rodentia, Family, Sciuridae, Genus, *Sciurus* (Andrén and Delin, 1994). Squirrels are found in the rain forest zone where they are restricted to farmlands, grasslands and orchard. They are frequently seen at day crossing roads, running along farmland and around homes. They are social animals and as such, several individuals live together in a burrow (Waterman, 1997). In other to augment animal protein deficiency, there is a need to enhance food production in developing countries as most people live under deplorable conditions with shortage in protein rich food (FAO, 2002).

This animal has been hunted and sold as bush meat, which serves as delicacy and steady source of income for rural dwellers (Ibrahim and Abdu, 1992). In view of their abundance and size, they are trap and eaten by some rural dwellers and is considered as delicacy. Smoked carcasses are seen in some village markets most especially in northern Nigeria.

Developing countries including Nigeria in recent time have considered diversification of its economy in order to meet up with its low animal protein requirements for her populace. In view of this, attempt has being made to breed and rear the animal in captivity for food in Nigeria (Ajayi, 1975).

There are scanty documentations on the reproductive system of this species of rodent. To achieve breeding of this rodent, it is critical to study the anatomical landmarks of its reproductive system that will in turn help in improving productivity and enhance diagnosis of reproductive system related pathological conditions in this species.

Some aspect of work done on the squirrel include; on the GIT of the squirrel (Nzalak *et al.*, 2015), morphology of the respiratory system of squirrel (Wanmi *et al.*, 2017). To achieve domestication and breeding capability of this wild species of rodent, there is need to investigate the anatomical features of it reproductive system.

MATERIALS AND METHODS

Experimental Animals: Eight apparently healthy squirrels were purchase from farmstead settlers in Kadarko, Nasarawa State, Nigeria. The animals, according to the hunters, were trap using a wire cage. Animals were transported in a ventilated laboratory cage to animal units of the Department of Veterinary Anatomy, College of Veterinary Medicine, University of Agriculture, Makurdi, Nigeria. Animals were left for two months for preconditioning. During this period, feed (groundnut, sweet potato, melon) and water was given *ad libitum*. The feeding troughs and drinkers were sterilized daily using Milton (Laboratoire Rivadis, Louzy, France). Cages were also swept and disinfected daily using Milton, as well as a broad spectrum bactericidal, fungicidal and virucidal agent. The experimental protocol was approved by the Ethical Committee of the University of Agriculture, Makurdi, Benue State, Nigeria. Management of the experimental animals was as stipulated in the Guide for the Care and Use of Laboratory Animals, 8th Edition, National Research Council, USA (2011).

Extraction of the Reproductive Organ: Each animal was sedated by intraperitoneal injection of 20 mg/kg thiopental sodium (Rotexmedica, Trittau, Germany) and immediately weighed in grams using a digital electronic balance (Citizen Scales PVT Limited, India). The nose-rump and tail lengths (body – tail length) were obtained in centimeter with a measuring tape. Thereafter, each animal was placed on a dorsal recumbency on a dissection table, and perfused with 4 % paraformaldehyde fixative, through the left ventricle, using a modification of the method of Gage *et al.* (2012). Immediately after the perfusion fixation, animal was placed on dorsal recumbency and an incision was made from the xiphoid cartilage to pelvic cavity there by exposing the abdominal organs. The reproductive tract was seen attached to the body wall via a broad ligament. Incisions of the broad ligament free the ovary, fallopian tube and uterus. Another incision was made between the anorectal sphincters thereby freeing the reproductive organ from the abdominal cavity. Photographs were captured using 3D digital handheld camera connected to HP laptop.

Anatomical Study: The reproductive organ was immersed in normal saline to wash off blood/hairs that might have stain/attach to the specimen. Morphological measurement of parts of the reproductive system was obtained using a tape and a vernier caliper (MG6001DC, General Tools and Instruments Company, New York) and converted to centimeter. The body length was obtain by placing the tape at point zero, from the rostral most tip of the nostril, the occipital region, running it through the rump on the dorsal of the vertebrae to the tip of the tail. The ovary, cervix/vagina was measure using a vernier caliper and recorded in centimeter. The ampulla was measure from the base of the ovary to the point where it starts narrowing as the beginning of isthmus. The landmark for isthmus was considered as short, narrow tube, which terminate into the uterus was taken as it length.

Statistical Analysis: Data obtained were subjected to student t-test to determine significant differences among means. Values of $p<0.05$ were considered significant and expressed as mean ± SEM (standard error of mean) in tables.

RESULTS

The mean body-tail length and weight of the wild squirrel were 52.62 ± 5.559 cm and 391.57 ± 22.561 g respectively. The mean length of the right and left ovary was 0.96 ± 0.128 cm and 0.91 ± 0.173 cm respectively (Table 1).

Table 1: Body weight and length of the female reproductive tract of wild diurnal grey squirrel

Nose, rump-tail length (cm)	Body weight (g)	Length of ovary (cm)		Length of ampulla (cm)	
		Right	Left	Right	Left
52.62 ± 4.559	391.57 ± 22.561	0.96 ± 0.128	0.91 ± 0.173	1.35 ± 0.113	1.48 ± 0.087

The mean length of ampulla and isthmus for right and left side were 1.35 ± 0.113 cm, 1.48 ± 0.087 cm and 0.47 ± 0.072 cm, 0.38 ± 0.061 cm respectively (Tables 1 and 2). The uterus and cervix/vagina measured 1.25 ± 0.058 cm and 0.91 ± 0.076 cm respectively (Table 2). Using student t-test to compare paired organ, there was no significant at $p<0.05$.

Table 2: Body weight and length of the female reproductive tract of wild diurnal grey squirrel

Length of isthmus (cm)		Length of uterus (cm)	Length of cervix/ vagina (cm)	Length of the organ (cm)
Right	Left			
0.47 ± 0.072	0.38 ± 0.0061	1.25 ± 0.058	0.91 ± 0.076	7. 603 ± 0.120

Gross Features: The reproductive system *in-situ* is contact with the transversus abdominis ventrad with uterus being caudal to the colon. Ovaries are attached to the lateral walls of the abdominal cavity via broad ligaments with left ovary lying caudolateral to the stomach. A long non-delineated fallopian tube exit from the ovaries and meets to form a wide 'Y' shaped structure ventral to the colon. The uterus lies ventral to the colon and dorsal to the urinary bladder in the pelvic inlet. In and intact specimen, care is taken as the ovaries are embedded in a thick abdominal fat (Figure 1). The ampulla is a large, long tube from the base of the ovary, which continue down as short, narrow tube, which join the horn of the uterus as the isthmus. The uterus and cervix form bulges and the vestibule is longer along the tube. The cervix is hard and pliable but uterus is void of this feature (Figure 2).

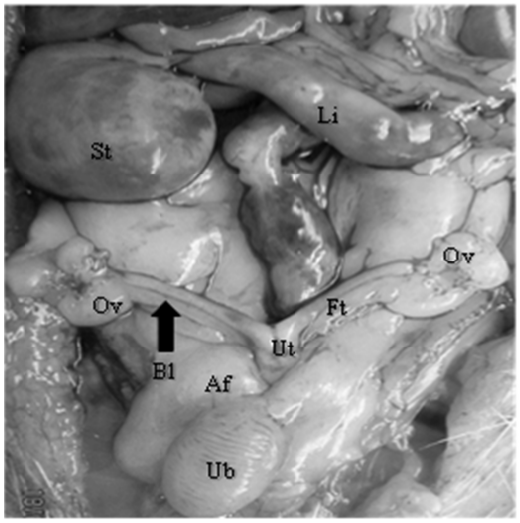

Figure 1: *In-situ* of the female reproductive tract of wild diurnal grey squirrel. St - Stomach, Li - Large intestine, Ov - Ovary, Ft - Fallopian tube, Ut - Uterus, Af - Abdominal fat, Ub - Urinary bladder and Bl - Broad ligament. Mag. x1000

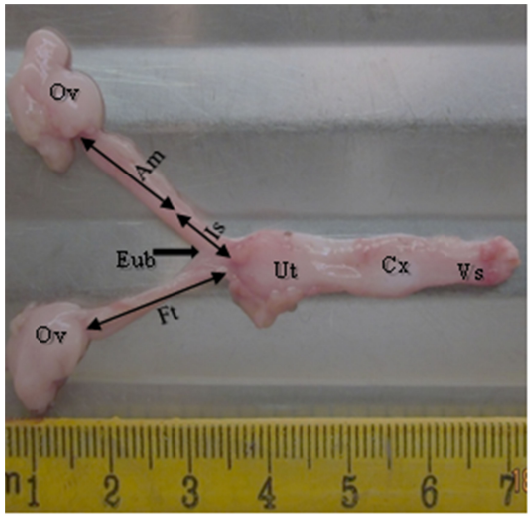

Figure 2: Female reproductive tract of wild diurnal grey squirrel. Ov - Ovary, Am - Ampulla, Is - Isthmus, Eub - external uterine bifurcation, Ut - Uterus, Cx – Cervix and Vs - Vestibule, Mag. x1000

DISCUSSION

In the present study, the live mean weight of the wild diurnal grey squirrel was lower than that of the African giant rat and the cane rat (Byanet *et al.,* 2008; Byanet *et al*., 2010). In rodentia, cane rat is the largest species, then the porcupine and African giant rat. In this hierarchy, the wild diurnal squirrel can be rank fourth in term of its weight.

The nose, rump-tail length of the wild diurnal squirrel is longer than other species of rodents (Ali *et al.,* 2010). The lengthening nature of the nose, rump-tail in the squirrel might have been because of the long coccygeal bones that make up the tail. In the squirrel, literature has shown that the tail helps the animal in maneuver of its predator in the wild and lightens the body during navigation from one tree branch to another (Loeb *et al.,* 2000). The length of the right and left ampulla were not significant different ($p<0.05$). The ampullae are consistently longer than isthmi with both sides showing no significant increase in their length. This report varies with that of the African giant rat, which was longer than that of the squirrel (Ali *et al.,* 2011). The whole length of the reproductive tract is lower than that of the African giant rat (Ali *et al.,* 2010). This indicated that the African giant rat has a longer reproductive tract than the squirrel.

Insitu, the reproductive tract is consistently pinkish throughout and held to the body walls by broad ligament of the abdomen and peritoneum. It is located in the ventral most surface of the abdomen with urinary bladder lying ventral to the uterus.

The ampulla and isthmus form the fallopian tube. The ampullary-isthmus junction is ill defined, the ampulla is larger and the tube narrows into smaller hollow isthmus. In the mare, the ampullary-isthmus junction serve as a control point that allows only fertilized oocyte to pass into the isthmus (Marshall, 1981). The squirrel has a long uterine horn from the short uterus and this type of uteri of the squirrel is probably a bicornuate type. The cervix appears as swelling having a firm, consistent and non-collapsing wall resulting from the cartilagenous nature of the cervix (Danto *et al*., 2012).

Conclusion: The reproductive index of this wild species of squirrel has not been established despite the increase demand for it meat in most rural communities in the central part of Nigeria. The quantitative and structural study on its reproductive indices is essential to obtain baseline information. The ampulla was longer and lengthening nature of the nose rump-tail was as a result of major contribution from the bones of tail. The uterus of the wild diurnal squirrel is of the bicornuate type.

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