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### Original article

## Morphometric studies on the female genitalia of the local domestic cat (*Felis catus catus*) in North West Nigeria

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#### ABSTRACT

Measurement of various parts of reproductive system of sixteen non-pregnant female cats (Queen) were used, the cats were of Mongrel non-specified breeds but different age and live weight. The average weight of entire genitalia of adult queen cats and small queen cat's genitalia ranged from 2.84 – 3.11g and 2.14 – 2.48g respectively. The mean length and diameter of ovaries ranged from 0.67cm to 0.3cm to 0.3cm, 0.3cm to 0.43cm in adult queen cat and small queen cats respectively. Dimension of ovaries of adult queen cat was greater than that of small cats. The mean length and diameter of uterine horns ranged from 7.4cm to 7.6cm and 6.3cm to 7.3cm in adult and small queen cats respectively. There was a great variation in length and diameter of uterine horns of adult and small queen cats. The mean length and diameter of the body of uterus ranged from 1.06cm to 1.1cm, 0.76cm to 1.06cm in adult and small queen cats respectively. The cervix of small cats was smaller compared to adult queen cat. The average mean length and diameter of vagina in adult and small queen cats was observed to be 0.76cm to 0.8cm and 0.33cm to 0.67cm respectively. It was concluded that female genitalia of small queen cat had smaller dimension compared to adult cats respect to specific age.

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## 1. Introduction

Cat is a carnivorous mammal belonging to the family felidae, Domestic cats are abundant and many genetic varieties ("breeds") exist, with color, hair and other differences. There are numerous breeding colonies as well as cat fancier clubs and Societies. The ultimate origin of cats has been studied extensively and is summarized by Nowak & Paradiso (1983). The domestic cat is believed to have derived from *Felis (silvestris) lybica* (Starck, 1995). The domestic cat has a 63-65 day gestation and produces litters of variable size, usually 4, but ranging from 1-8. Its placenta has often been investigated and a large literature exists on cat pregnancies, diseases, and genetics. The newborn weight is from 60-110 g, maternal weight (not pregnant and at term) is around 6,000 g, depending on the breed. Sexual maturity of females is reached between 7 and 12 months of age. Fox et al. (1984) have discussed the reproductive physiology. Domestic cats may live to be over 30 years. The knowledge of the biometry of the female (queen) cat genitalia relation to age is very important, because this specie is useful for biomedical research and may become a valuable animal model for examining the anatomy and physiology of the reproductive system (Encarta, 2005). Research work on the morphology, physiology, pathology, gross and developmental anatomy of various organs and system of female cat (Bustinza, 1979, Asari et al., 1985, Wilson, et al., 1990, Recce, 1997, Franco, et al., 2004, Sonfada, 2006) has been reported in different countries by many researchers. Research has shown that little information is available regarding the morphometry and biometry of female genitalia of the domestic tom cat in Nigeria. However, objective information does become available on the genitalia of queen cat. Evidences of not only the present reproduction state of the queen cat, but also valuable information on the size of the genitalia in relation to their ages. This study will describe the relationship between age and size of the reproductive tract of queen cat. The research will serve as a base line data in the study and teaching of the anatomy and reproduction performance of tomcat.

## 2. Materials and methods

Sixteen female non- pregnant Cats (queen) were used, the cats were of mongrel non specified breeds but different ages and live weight; the cats were caught at the males and females student's hostel in the city campus and sahara males hostel. The sixteen female genitalia were examined and measured with the help of vernier caliper, measuring tape, surgical blade and scissors and electric weighing balance.

They were kept at the feline kennel in the Faculty of Veterinary Medicine, Usmanu Danfodiyo University, Sokoto, and were fed with fish, milk, rice and beans and fresh tap water. The cats were conditioned for a period of 21 days before commencement of the experiments. Prophylaxis antibiotic was given along with ivermectin® as a dewormer. The animal were first restrained and sedated using xylazine to calm the cat and the animal was euthanized by pumping air into the heart using needle and syringe at the left side of the thoracic cavity between the 4th – 5th intercostals space. The cats were weighted alive using compression spring balance (AT-1422), size C-1, sensitivity of 20kg X 50g in Kilogram (Ohaus scale crop) and were grouped and sacrifice according to through interval daily, the cat were grouped into groups from A to E as A(3- 6 months), B(6 months - 1 year), C(1- 11/2 year), D(11/2 - 2 years) and E(2-4 years) respectively using their dentition as documented by Getty, (1986). All the cats were humanely euthanised.

A mid ventral abdomen incision was made on each animal, the peritoneum reflected, and the intestine displaced to gain access to the root of the reproductive system. A through morphometric observation of the external and internal genitalia were made insitu, before the consideration of the biometry. The length, weight, thickness and width or diameter of the various segments of the genitalia were measured using a meter ruler, measuring tape, dividers Vernier calliper and electrical weighing balance (Metler® 01210 instrument AG, Switzerland) with a sensitivity of 0.01g. The data obtained were subjected to statistical analysis using spss statistical software.

The measurements of various parts of the reproductive tract were made as follows:-

### 2.1. The ovaries

Three measurements were taken, length was taken as the greatest distance between the two ovarian poles along the attached border (hilus), the breath as the greatest distance between the hilus and the free border that is from attached border to the free border and the width (thickness) as the thickest portion between the two ovarian surfaces (Edwards, 1965). The ovaries were then examined grossly for the shape and position.

## 2.2. Oviduct

The measurement was taken from the infundibulum up to the junction joining the uterine horn taken the length, with the help of a thread and measuring tape.

## 2.3. The uterus

Uterine Horn: In non-pregnant specimens, the diameters of the uterine horns were measured at the greater curvature near the external bifurcation. Both the horns were separated from the mesometrium and the length of each was measured from the internal os of the cervix to the utero-tubal junction. In pregnant specimens the diameters of the gravid and non-gravid cornua were measured at the external bifurcation. Then the uterine wall was incised between the rows of the cotyledon, the numbers and diameters of the biggest cotyledons were recorded.

Body of Uterus: The measurement on the body of the uterus was taken from internal bifurcation of the uterine horn to the anterior end of the cervix as the length; the external diameter was taken before cutting through the body of uterus.

## 2.4. Cervix

The external diameter was measured in the middle third of the length of the cervix. The length was measured from the junction of the cervical and the uterine mucosa to the ventral lip of the cervical and the uterine mucosa to the ventral lip of the external os. The number of annular rings was recorded for each specimen. The shape of the os-uteri was observed but in some cases it could not be recorded as it was left out with the vagina.

The data obtained were statistically analysed using standard statistical methods.

## 3. Results

### 3.1. Shape and location of general organs

It was observed that ovaries were located in the dorsal abdomen caudal to the kidneys; ovaries were oval in shape in most cases studies. Shape and position of the oviduct, uterus and cervix of queen were quite similar in respect to specific age.

### 3.2. Weight of the genital organs

The mean weights of genital organs of queen cats are presented in Table 1. Weight of entire genitalia of queen cat ranged from 2.14-3.11g in small and adult cat respectively. It was further observed that Adult Queen cats had significantly higher weight compared to small queen. There was gradual increase in the weight of genital organs as the age advanced.

### 3.3. The ovaries

The ovarian dimensions are presented in Table II. In general, adult queen cats have greater dimension than small queen cats, the mean length, diameter and weight of ovaries ranged from 0.3-0.8cm, 0.3-0.38, 0.85-1.23g respectively. Comparison of length diameter, diameter and weight of the ovaries of small cats and adult cats showed that small queen cat's ovaries were smaller compared to adult cats. However, there was no significant difference between the ovaries of small cats and adult cats except some differences in length diameter and weight.

### 3.4. The oviducts

The oviducts were thin, and the lining is thrown up into the longitudinal fold or ridges, they were embedded in fats of mesosalpinx. The mean length of oviducts of small cats and adult cats is presented in Table III, the mean length ranges from 9.71-10.98cm, there is no significant difference between the left and right oviducts was noticed (Table III).

### 3.4. The uterus

Has a very short body and extremely long narrow horns. The horns are of uniform diameter, are nearly straight and lie within the abdomen. They diverge from the body in the form of V towards each kidney. The dimension of uterus and cervix is presented in Table (IV). It is evident that the dimensions in Adult cats are

greater than that of small cats. The mean length and diameter of uterus ranged from 1.1-0.77cm and 0.47-0.40cm, respectively. Comparison of length and diameter of uterine horns of small cats and adults showed that there are no significant difference, the mean length and diameter of the body of the uterus ranged from 1.1-0.77cm and 0.47-0.4cm respectively. The body of the uterus of adult was larger and wider compared to small cats. However, no difference in diameter was noticed between adult and small cats.

### 3.5. Cervix

The mean length and diameter of cervix ranged from 0.3-0.2cm and 0.47-0.4cm respectively. However, no significant difference in diameter of cervix was noticed between adult and small cats.

**Table 1**

Relationship between body weight and weight of genitalia at specific age.

Age	No. of animals	Mean body weight (Kg) ±SEM	Weight of the entire genitalia (g) ±SEM
3-6 months	3	0.51±0.02a	2.15±0.1a
6 months-1 year	3	1.05± 0.03b	2.27±0.2b
1 year-1½ years	3	1.86 ±0.02c	2.48± 0.1c
1½ years – 2 years	3	2.25 ±0.02d	2.84± 0.2d
Above 2½ years	4	2.87 ±0.03e	3.12 ±0.3e

<sup>ab</sup> means on the same row with different superscripts are significantly different (P < 0.05).

**Table 2**

Relationship between ovary and oviduct at specific age.

Age	No. of Animals	Mean weight of ovary (kg) ±SEM	Mean weight of the oviduct (g) ±SEM
3-6 months	3	0.85 ±0.02a	1.29 ±0.2 A
6 months-year	3	0.95 ±0.03b	1.32 ±0.1b
1year-1½ years	3	1.09 ±0.01c	1.39 ±0.1c
1½ years – 2 years	3	1.14 ±0.01d	1.70 ±0.2d
Above 2½ years	4	1.23 ±0.02e	1.88 ±0.3e

<sup>abcde</sup> means on the same row with different superscripts are significantly different (P < 0.05).

**Table 3**

Dimension of the uterus in relation to age specific.

Age	No.	Mean uterine ( infundibulum) horn			
		Left		Right	
		Length (cm) ±SEM	Diameter (cm) ±SEM	Length (cm) ±SEM	Diameter (cm) ±SEM
3-6 months	3	1.0±0.03a	0.3±0.01a	1.1±0.02a	0.3 ±0.01a
6 months-1 year	3	1.1 ±0.02b	0.4± 0.01b	1.1±0.02b	0.3±0.01b
1 - 1½ years	3	1.2 ±0.03c	0.4 ±0.01c	1.2± 0.01c	0.3± 0.01c
1½ – 2 years	3	1.3±0.03d	0.4 ±0.01d	1.2 ±0.01d	0.4 ±0.01d
Above 2½ years	4	1.3± 0.03e	0.4 ±0.02e	1.3 ±0.02e	0.4 ±0.02e

<sup>abcde</sup> means on the same row with different superscripts are significantly different (P < 0.05).

## 4. Discussion

Spector et al (1956), further describes the uterus of the adult queen as a Y – shaped organ consisting of a 2cm long body lying between the descending colon dorsally and the urinary bladder ventrally and to 10cm uterine horns that extends cranially to meet the uterine tube (oviducts).

Latimer et al (1939), stated that the ovaries of the adult queen cat are oval structures approximately 1.0 x 0.3 x 0.5cm in size and 220mg in weight located in the dorsal abdomen caudal to the kidneys, the ovary, the uterine

tube and uterus is suspended in the peritoneal cavity by a reflection of peritoneum, the broad ligament which is subdivided into the: suspensory ligament of the ovary, the mesovarium, mesosalpinx and mesometrium. Normal size of the ovaries varies considerably from species to species and even within the species there is some variation, for example the normal size of the ovary of the queen is less than an inch long and 0.5 (1.5cm) inch thick, while that of bitch is slightly larger than that of queen, though Arthur (1975) has reported that the size of an ovary will depend chiefly on the period in the estrus cycle at which it is examined and whether or not it contains an active corpus luteum and the presence of follicles does not alter the size of the ovary. Del Campo et al (1974), reported the ovarian artery originated from aorta supplies the ovary and cranial portion of the uterine tube, the ovarian vein drains the ovary, the uterine tube and the cranial portion of the uterine horn terminating in the caudal venal cava. Wildt et al (1980), states that the gross and histologic appearance of the ovary varies with a stage of the estrus cycle, during anestrus the surface of the ovary is smooth, 0.5mm diameter follicles are visible. Histologically as the follicular phase (estrus) approaches 3 – 7 days follicle enlarged and rest undergoes atresia, most follicular development occurs in the 48 hours interval just prior to onset of estrus behaviours and mature follicles measures 2.5 to 3.5mm in diameter.

**Table 4**  
Dimension of Uterine Body and vagina at specific ages.

Age	No.	Mean Uterine Body		Mean Vagina	
		Length (cm)±SEM	Diameter (cm) ±SEM	Length (cm) ±SEM	Diameter (cm)±SEM
3-6 months	3	5.3±0.2a	0.3±0.01a	0.8±0.2a	0.4±0.01a
6 months-1 year	3	6.4±0.3b	0.4±0.02b	0.9±0.2b	0.5±0.01b
1 year-1½ years	3	7.3±0.2c	0.4±0.02c	1.1±0.2c	0.5±0.01c
1½ years – 2 years	3	7.4±0.3d	0.4±0.02d	1.1±0.2d	0.5±0.01d
Above 2½ years	4	7.6±0.1e	0.4±0.01e	1.1±0.3e	0.5±0.02e

abcde: means on the same row with different superscripts are significantly different (P < 0.05).

**Table 5**  
Dimension of Cervix and Vagina at specific ages

Age	No. of Animals	Cervix		Vagina	
		Length (cm)±SEM	Diameter (cm)±SEM	Length (cm)±SEM	Diameter (cm)±SEM
3-6 months	3	0.2± 0.01a	0.4±0.01a	0.8±0.2a	0.4±0.01a
6 months-1 year	3	0.2 ±0.01b	0.5±0.01b	0.9±0.2b	0.5±0.01b
1 year-1½ years	3	0.2 ±0.01c	0.5±0.01c	1.1±0.2c	0.5±0.01c
1½ year – 2 years	3	0.2 ±0.01d	0.5±0.01d	1.1±0.2d	0.5±0.01d
Above 2½ years	4	0.3 ± 0.02e	0.4±0.02e	1.1±0.3e	0.5±0.02e

abcde: means on the same row with different superscripts are significantly different (P < 0.05).

Wildt et al (1978), also describe the queen as induced ovulator, copulation, vaginal stimulation or gonadotrophin. Administration induces ovulation within approximately 24 – 32 hours; occasional estrus queen may ovulate spontaneously, perhaps stimulated by tactile or visual cues, corpora lutea which form after ovulation appears orange to yellow grossly and may reach 0.5mm in diameter peaking in size about 16 days after ovulation. Wildt et al (1980), they may persist histological for 6 to 8 months after ovulation. Dawson (1941), in older cats may be shrunken and nodular but follicles and corpora lutea still are present as true senile atrophy does not occur Bloom (1954) states that's polynuclear follicles occurs in the cats. Fletcher (1974) describes the uterine tube (oviduct) of the adult queen is 5 -6cm in length; the infundibulum which is the cranial end of the uterine tube is a cornical enlargement lined by mucosal villi called fimbriae. Anderson (1982) it lies craniomedial to ovary from there the uterine tube passes cranially, laterally and then caudally in the mesosalpinx before joining the top of the

uterine horn through a low papillae with a collar of circular smooth muscles that protrude into the lumen of the uterine horn. Rieghard et al (1935), describes the cervix as the thick-walled neck of the uterus connecting it to the vagina Latimer et al (1939) states that the uterine body and horns are attach to the body wall by the mesometrium which is continues. Cranially with the mesovarium and which with the mesosalpinx comprises the broad ligament, the round ligament of the uterus a lateral extension of the broad ligament passes from the horn caudolaterally to attach near the inguinal ring, size of the uterus depends on the size, age and parity of the cat and the phase of the estrus cycle or stage of pregnancy, in non-pregnant adult cats the uterus weights about 1.5g. Pavaux (1983) described the method of estimation of fetal age which was based upon appraisal of the weight, size and development of pilosity. An approximate value of the size, from the top of the neck to the base of the tail (direct length) relative to age, from the third to the seventh months can be obtained by application of Keller's formula:  $x(x + 2) = n(\text{cm})$  where  $x =$  age in lunar months (of 28 days)  $n =$  corresponding size in cm. Hafez (1985) described the vagina of the queen as that portion of the birth canal that is located within the pelvis between the uterus cranially and the vulva caudally. The vagina also serves as a sheath for acceptance of the penis of the male during copulation, the act of breeding or service, the mucus membrane of the vagina is glandless, stratified squamous epithelium, except in the cow, in which there are some mucus cells in the cranial part of the vagina next to cervix. Vulva (pudendum femininum) is the external portion of the genitalia of the female that extend from the vagina to the exterior. The function of the vagina and vulva is marked by the external urethral orifice and frequently also by a ridge just cranial to the external urethral orifice the vestigial hymen. Occasionally the hymen may be complete enough to interface with copulation. McDonald (1980), states that the vestibule of the vagina is the tubular portion of the reproductive tract between the vagina and labia of the vulva. Commonly the vestibule has been considered a part of the vulva, but the *Nomica Anatomica Veterinaria* (N.A.V) lists it separately from both the vagina and vulva. McDonald et al., (1989) reported that in domestic animals the labia or lips of the vulva are simple, rather than consisting of major and minor labia as in the human. The ventral commissure (lowest part) of the vulva conceals the clitoris (which has the same embryonic origin as the penis in the male; the clitoris consist of two crura, or roots, a body and a glans. It is made up of erectile tissue covered by stratified squamous epithelium and is well supplied with sensory nerve endings. Periodic inspection and testing of drinking water supplied to the community is a permanent imperative and should be an obligatory supervisory agency in the country. It should assess the risks from microbial and chemical contamination potential. Physico-Chemical indicators and microbiological quality of drinking water provide a good basis for commitment towards the community supply of drinking water and public health protection. Our research findings indicate good quality of drinking water as a natural resource that exists in the region of Dragash. In the quantitative, appears to be sufficiently available to residents, their hygiene and other activities of daily living. In terms of the quality and safety of health aspect also satisfactory and meets local standards of the WHO (WHO, 2004) and the EU (EU DWD 1998). Physical parameters of water in the region of Dragash explored such as temperature, smell, taste, color and turbidity brought within acceptable local standards but also compared with those of the WHO (WHO, 2004) and the EU (EU DWD 1998). Chemical parameters indicators of human and animal pollution (Ammonia, Nitrates, Nitrites) also brought within standards tendency towards the upper limits, respectively, in the upper limits of the permissible dose, and levels comparable with WHO and EU standards. In total, 80% of the samples analyzed in chemical terms are delivering results within the standards, providing safety and quality of drinking water for community use. 20% of the samples are recorded values exceeded the maximum allowed as follows: Iron, Manganese and Kaliumpermanganati. Since Mn in 13 samples brought to the high limit of DFM (12:05), while in 8 samples is above this limit, consider that it comes from the composition of the soil, while overcoming kaliumpermanganatit values associated with bacterial contamination of water. Other parameters such as pH, Conductivity, Oxygen and Aluminium are within acceptable standards. Microbiological research has given negative results in 78.5% of samples, which means that this measure, using community drinking water in rural areas of Dragash quality is acceptable and safe. 21.5% of the samples resulted in substandard or bacterial presence drinking water making it useless and dangerous to the health of residents.

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