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Morphometric analysis of the reproductive system of African zebu cattle

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ABSTRACT

A study was carried out on the morphometry of reproductive genitalia of 45 African Zebu cattle (AZC) using standard laboratory procedure, with special reference to heifers and cows. The overall mean weight of the genitalia of heifers and cows were 0.43 ±0.03 kg and 0.79 ± 0.02 kg respectively. The mean ovarian weights of the heifer from left and right were 3.80 ±0.12g and 4.88 ±0.04g; that of the cows were 3.53 ±0.10g and 5.48 ±0.04g respectively. The mean length of the cow oviduct from left and right was 30.04 ±0.08 cm and 30.21 ± 0.07 cm; that of the heifer was 21.68 ± 0.18 cm and 22.14 ± 0.16 cm respectively. There was no significant difference in the diameter of the oviduct and between the right and left length of the oviduct ($P > 0.05$). The length and diameter of the cervix of heifer were 7.38 ± 0.10 cm and 3.18 ± 0.07 cm; and that of the cows were 8.08 ± 0.04 cm and 3.48 ± 0.02 cm respectively. It was observed that the ovaries of cows were significantly greater in weight than those of the heifers ($P<0.05$). This study provides a baseline for our indigenous breed of African Zebu Cattles in the North-east zone of Nigeria.

1. Introduction

Domestic cattle breeds can be separated into two major groups, humpless taurine (*Bos taurus*) and humped Zebu (*Bos indicus*). Zebus (*Bos indicus*), sometimes known as 'humped cattle', are better-adapted to tropical environments than other domestic cattle (Meirelles *et al.,* 1999). There are about 75 known breeds as at 2010, split about evenly between African breeds and South Asian ones. According to Anonymous 2011, the major Zebu cattle breeds of the world include Gyr, Guzerat, Indu-Brazilian, Nellore, Ongole and Brahman. Zebu has humps, large dewlaps and ears. They have more sweat glands than European cattle (*Bos taurus*).

Little attention has been paid to the livestock industry in Nigeria. Over the past fifty years much remains to be done (Gofur *et al.,* 2007). Many researchers have studied the biometry of female reproductive tract in exotic cows and heifers, but there is little published information on indigenous breeds of Zebu cattle. A fair amount of information on its breeding (Napolean and Quayam, 1997) nutrition (Amle *et al.,* 1992) and anatomical aspects (Mittal and Madan, 1992) is available. Selection and breeding of Zebu cattle breed that will compete favorably with the exotic breeds in production will require an in-depth study of the anatomy of the reproductive organs. Little is known on the anatomy and physiology of the female genitalia of tropical indigenous breeds of African Zebu cattle (Kumar *et al.,* 2004); compared to the exotic breeds (*Boss taurus*) been described by various authors (Sisson and Grossman, 1975; Napolean and Quayam, 1997; Amle *et al.*, 1992; Newham, 2001).

Reliable information on the reproductive parameters of African zebu cattle (AZC) owned by farmers and nomadic farmers in Nigeria is lacking. Hence, the need for this study to provide a baseline data for teaching and further research on the anatomy and physiology of the reproductive system and for enhancing the reproductive capacity of the breed.

2. Materials and methods

2.1. Experimental procedure

A total of 45 complete reproductive genitalia of non pregnant animals were used for the study. Eleven heifer and 34 non-pregnant cow genital organs were collected from animals slaughtered for human consumption at the main abattoir in Maiduguri, Borno State, over a period of 2 months (May –June 2008). The sampled animals were of different ages and live weights but the same breed. The samples were examined and measured with the help of Varnier caliper, measuring tape, surgical blade and scissors and electrical weighing balance (P1210, Metler instrument AG, Switzerland). The samples were trimmed of all excess fat, and associated ligaments. The length, weight, thickness and diameter of the various parts (ovary, uterine tube/horn, body of the uterus, and the cervix) were measured.

As documented by Wilson, 1995; the ovaries were removed at their junction with the ovarian ligament -as close to the ovarian tissue as possible after the fimbria was removed. The length of ovary was taken along the excision from the ovarian ligament. The width was taken as the greatest line perpendicular to the length line. The oviducts were dissected out, and a measurement taken on their extended length from the top of the fimbria to the tubaluterine horn junction. The uterine horns were dissected free of their ligamentous attachments, and extended their full length for measurement. Each uterine horn was incised along its dorsal surface to expose its lumen from the oviduct tubal junction to the bifurcation of the body of the uterus. The body of the uterus was also incised, and this dorsal incision continued in a straight line to the dorsal commissure of the vulva in order to fully expose the cervical canal and the vagina. This method of exposure gave the relative thickness of the walls of the uterine horns, body of the uterus, cervix and vagina. The length of the uterine body was taken from its bifurcation to the internal os of the cervix.

The length and diameter of the cervix was recorded. The length of the vagina was taken as the distance from the external os of the cervix to the ventral commissure of the vulva. A measurement of the vaginal width was regularly taken at a point from the external os of the cervix, prior to extending the dorsal incision through the vagina. All measurements were taken with a thin, flexible, graduated steel tape. Measurement errors due to variation in operator technique were kept to a minimum by following a standard procedure of dissection as adopted by Chibuzor (2006), with each tract in an identical position.

2.2. Statistical analysis

The data obtained were subjected to statistical analysis using student's t – test. Values of $P<0.05$ were considered significant.

3. Results

3.1. Macroscopic observation

The female genitalia of the African zebu cattle were generally divided into the ovary and the oviduct. The ovaries are cylindrically oval in shape and located at the cranial portion of the oviduct. The oviduct was torturous, wiry and hard and embedded in fat of mesosalpinx. The oviduct comprises of the uterine tube/horn, the uterine, cervix and the vagina. The entire genitalia are bounded dorsally by the rectal portion of the large intestine ventrally by the urinary bladder and laterally by the pelvic structures i.e. muscle and bones of the pelvic region. It was observed that their intimacy with the neighbouring structures is similar in all ruminants. The uterine horns are paired and relatively long, the body of the uterus is a relatively short hollow organ and the cervix is a narrow canal, which is a short thick muscular wall. The entire genitalia are held in position by many ligaments.

The suspensory ligament which extend from the roan to the dorsal abdominal wall.

The proper ligament of the ovary extends between the ovary and the cranial end of the uterine horn.

The round ligament of the uterus which extend from the cranial and of the uterine horn through inguinal canal.

The entire genitalia of Zebu cattle are anchored laterally by the broad ligament which is divided in to mesometrium, mesovarian and mesosalpinx.

In AZC, the broad ligament is more extensive and the most dominant ligament that hold the genitalia into position.

3.2. Morphometric observations

The mean genital weight of heifer and cow in African Zebu cattle were 0.43 ± 0.03 kg/gm and 0.79 ± 0.02 kg/gm respectively (Table 1). The mean length, breath, thickness and weight of the ovaries ranged from 2.50 – 2.84 cm, 1.44 – 1.63 cm, 0.84 – 1.05 cm and 3.53 – 5.48 gm respectively (Tables 2). The length and diameter of all the other segments are summarized in Tables 2 and 3 below.

Table 1
Weight of Genitalia in Zebu Cattle

	Sample size (n)	Mean Weight (Kg ± SEM)
Heifer	11	0.43 ± 0.03
Cow	34	0.79 ± 0.02

Table 2
Dimensions of Ovary of AZC in the North-Eastern zone of Nigeria

	Heifer (mean ± SEM)	Cow(mean± SEM)
Left Ovary		
Length (cm)	2.50 ± 0.06	2.81 ± 0.02
Breath (cm)	1.44 ± 0.05	1.56 ± 0.01
Thickness(cm)	0.84 ± 0.15	1.04 ± 0.01
Weight (g)	3.80 ± 0.12	4.88 ± 0.04
Right Ovary		
Length (cm)	2.53 ± 0.05	2.84 ± 0.02
Breath (cm)	1.44 ± 0.04	1.63 ± 0.02
Thickness (cm)	0.85 ± 0.14	1.05 ± 0.01
Weight (g)	3.53 ± 0.10	5.48 ± 0.04

4. Discussion

Gross examination of the female genitalia of Zebu cattle reveals considerable similarities in shape and interaction of various anatomical parts with those of local and exotic breads of cattle in comparison with many

literatures (Sisson and Grossman, 1975; Darnell, 1987; Newham, 2001). The purpose in dissecting the specimen components from their ligamentous attachments before measurement was to present a more accurate picture of the comparative length of oviduct - to uterine horn – to body of the uterus. In the normal position (*in vivo*), the uterine horn is difficult to measure because the posterior areas of the uterine horns are united by connective and muscular tissues, and have a common peritoneal covering, common to ruminant animals (Sisson and Grossman, 1975).

The anatomical representations of the genitalia of African zebu cattle by many ligaments, makes it a good animal for breeding with less chances of dystocia ie. difficulty in giving birth. This is in line with the finding of Kaikini (1974) on Berari cattle (exotic breed of cattle). The total weight of the genital organs of the heifers observed in the study (Table 1) was nearly half that of adult non-pregnant cow. This is contrary to the findings of Newham, (2001), who observed difference only due to pregnancy. This variation in weight of genital organs may be due to age, breed difference, individual disparity and plan of nutrition (Hafez, 1974; Darnell, 1987). It was further observed biometrically that adult cow had significantly higher ($P<0.05$) weight of genital organs compared to heifer. The mean ovarian dimension (Table 2) showed that cows have higher dimension than the heifer. It was also observed that in both the heifer and cow, the dimension of the right ovary is significantly greater than that of the left ($P<0.05$).

Table 3

Dimensions of Oviduct of AZC in the North-Eastern zone of Nigeria

	Heifer (mean ± SEM)	Cow (mean ± SEM)
Oviduct		
Left uterine Horn		
Length (cm)	21.68 ± 0.18	30.04 ± 0.08
Diameter(cm)	2.44 ± 0.06	2.89 ± 0.03
Right uterine Horn		
Length (cm)	22.14 ± 0.16	30.21 ± 0.07
Diameter(cm)	2.62 ± 0.06	2.92 ± 0.02
Body of Uterus		
Length (cm)	2.10±0.07	2.27 ±0.03
Diameter(cm)	3.23± 0.08	3.24± 0.03
Cervix		
Length (cm)	7.38 ± 0.10	8.08 ± 0.04
Diameter(cm)	3.18 ± 0.07	3.48 ± 0.02

The average dimension of the ovaries of heifer were comparatively smaller compared to adult non-pregnant cows, and larger ovaries in adult cow were reported to be due to greater quantity of interstitial tissue and pressures of corpora lutea of albicans (Darnell, 1987; Chauhan and Adamu, 1990). The average size (2.81 x 1.56 x 1.04 cm) of the ovaries of the adult non-pregnant zebu cattle observed in this study was closely related (2.53 x 1.60 x 1.25 cm) with the report by Parkale and Hukeri (1989) on Nigerian cattles and Jainudeen *et al*., (1983) on Niger zebu cattle. However, Kumar *et. al*., (2004) in another study in zebu reported that the mean width and length of ovaries was 2.7 ± 0.7 and 1.8 + 0.06 cm respectively. The oviducts of the heifer were comparatively smaller than that of adult non-pregnant cow (18 cm vs. 21 cm). The mean length of the oviduct observed in this study was less than that reported by Chauhan and Adamu (1990) but higher than that reported by Darnell (1987) and Ali *et al*. (2003) on exotic breed of cattle. The uterine horns and body of uterus of the heifer were comparatively smaller than those of the adult non-pregnant cows. The Disparity in length and diameter might be related to general body growth and genetic make-up of the animal. Comparison of length, breadth, thickness and weight of the ovaries of heifer and non-pregnant cow showed that heifer ovaries were smaller compared to cow but there was no significant difference statistically.

The length and diameter of the cervix was greater in adult non-pregnant cow compared to heifer. Most of the non-pregnant exotic cattle have cervix length measuring 7 – 10 cm (Napolean and Quayam, 1997; Ali *et al.,* 2003). However, in this study average length of cervix was 8.0 cm.

Disparity between the right and left uterine horn exists. The study showed that the right uterine horn is longer than the left. This is at variance with the report of Kaikini (1974) and Parkale and Hukeri, (1989) on Nigerian dairy cattle with the left horn longer than the right horn. However, Pierson and Ginther, (1987) studied 1,000 bovine genitalia and found out that the right ovary and uterine horn were slightly larger than the left, which is in line with the finding of this study. It is evident that the dimension of adult cow is greater than that of heifer. Comparison of length and diameter of the ovaries of heifer and adult cow in this study showed that their difference is highly significant at ($P<0.05$). The differences in the cervix of heifer and adult cow were highly significant in length but no significant difference in diameter of the cervix was noticed.

5. Conclusion

In summary, it was observed that, not only that the genitalia of heifer are smaller compared to non pregnant adult African Zebu cattle, but also has smaller dimension in the length of oviduct compared to Nigerian dairy cattle. Examination of the female genitalia of the Zebu cattle reveals considerable similarities in shape and interaction of various anatomical parts with those of local (indigenous) breeds of cattle. Presence of many supportive ligaments makes it a good animal for breeding with less chances of dystocia. The study showed that the right uterine horn is longer than the left, at variance with earlier reports on Nigerian dairy cattle, with the left horn longer than the right.

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