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Comparative Biometric Study of Internal Reproductive Structures of White Fulani and Red Bororo Cows

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ABSTRACT

White Fulani and Red Bororo cattle are important breeds of cattle in Nigeria. The biometry of reproductive organs in cows is crucial and may determine the extent to which these organs are able to perform their physiological roles. In this study, 63 White Fulani (WF) and 21 Red Bororo (RB) breeds of cattle were used to study and compare the baseline dimensions of the ovary, oviduct uterine horns (right and left), and uterine body as well as the cervix in these two breeds of cattle. The samples were collected from a local abattoir (Ubakala, Abia State) and taken to the Theriogenology Laboratory of Michael Okpara University of Agriculture, Umudike, where the aforementioned organs were measured with the aid of weighing balance, thread, meter ruler and Vernier callipers. Parameters measured were weight and length of ovaries as well as lengths of oviduct, uterine bodies, uterine horns and cervix. The results showed that the mean weights of the right and left ovaries of 3.09 ± 0.25 and 3.51 ± 0.23 kg in the WF were significantly (P<0.05) higher than that of RB whose values were 2.67 ± 0.15 and 2.89 ± 0.35 cm respectively. On the contrary, there was no significant difference in the length of the ovary between the two breeds. The number of follicles with more than 4 mm in diameter range from 10 to 15 in both WF and RB. The lengths of the right and left oviducts in the WF (16.18 ± 0.76 and 17.86 ± 1.53 cm) were statistically similar (P>0.05) to that that of RB (14.83 ± 1.25 and 15.98 ± 1.62 cm). WF had right uterine horn that was significantly (P<0.05) higher than that of RB whereas other uterine biometrics were similar in the two breeds. The length of the cervix of WF breed (6.74 ± 0.64) was statistically (P>0.05) similar to 6.00 ± 0.81 cm of RB. These data may be useful in further study related to the physiological function of individual structures measured in this study and specifically may find a practical application of determining the length of catheter used in artificial insemination. It is concluded that parameters of some segments of reproductive organs such as ovary and uterine horn differed significantly between WF and RB breeds of cattle, while other segments that included uterine body, oviduct and cervix were similar. Further studies with larger population size are suggested.

Keywords: Cervix, ovary, oviduct, uterus, Red Bororo, White Fulani.

INTRODUCTION

Cattle are the most common type of large domesticated ungulates (Hongo et al. 2009). They are prominent member of the subfamily *Bovinae* and are the most widespread species of the genus *Bos*. Cattle are raised as livestock for meat (beef and veal), as dairy animals for milk and as draft animals for pulling carts and ploughs. Other products from cattle are leather and dung for manure and fuel. By grazing forages in the open range and pasture lands, cattle produce high quality protein for human consumption from by-products and forage sources that humans do not consume. While per caput consumption of meat in some industrialised countries is high based on FAO standard, per caput consumption below 10 g in developing countries is considered insufficient and often leads to under-nourishment and malnutrition (FAO 2005). To effectively combat such malnutrition and undernourishment, more than 20 g of animal protein per person per day is recommended (FAO, 2005). The supply and provision of this amount of animal protein require an increased production of livestock. Besides, the steady growth in world population and in Nigeria especially creates a high demand for meat and requires a commensurate expansion of livestock production.

In Nigeria, other sources of animal protein are beef, pork, mutton, chicken and in some localities dog meat. However, beef is a major source of meat in Nigeria and increased cattle production will contribute to more availability of animal protein in the country. Beef is generally accepted across all ethnic groups for many reasons. One, the meat is sweet and highly nutritious. Secondly, beef is devoid of religious sentiment in comparison to other animal protein sources such as pork abhorred by Muslims for religious reasons. The consumption of beef is not associated with any taboo or cultural belief as is observed for goat and dogs that are regarded as 'food of deities' in some cultures in the country.

The primary reproductive organ in female animals is the ovary which performs dual roles of oogenesis and steroidogenesis by producing ova and ovarian steroids respectively (Arthur *et al.,* 1989). Other reproductive organs include oviduct, uterus and the cervix with very important roles in female reproductive capacity and functioning. The semen deposited into the vagina or cervix during ejaculation must navigate the cervical folds and travel upward through the uterine body and the horn to get to the ampulla (Hafeez and Hafeez, 2000). The ovum shed during ovulation is collected by the fimbriae part of the infundibulum and conveyed in opposite direction to meet the spermatozoa usually in the isthmic-ampulla region of the oviduct where fertilization occurs and the formed zygote is transported back to the uterus. The main role of the uterus is to support an embryo during gestation (Aplin *et al.,* 2008). The functions of all the aforementioned reproductive parts do overlap and sometimes, require stimulation/inhibition by some products of the other segments. Under normal anatomical and physiological conditions, all these parts work in collaboration and synergistically to achieve maximum reproductive capacity in female animals.

The knowledge of reproductive organs' biometry of WF and RB cows is crucial and may determine the extent to which these organs are able to perform their physiological roles (Memon, 1996). For instance, the number of cervical rings is related to the length of the cervix and determines the 'hurdles' the sperm has to cross before getting to the uterus. Therefore, for efficient assisted reproductive technology like artificial insemination, information on the parameters of the reproductive organs will be useful. Presently, there is lack of information concerning the biometry of the female reproductive organs in WF and RB breeds of cattle in Nigeria. The knowledge of such biometry is also useful for pregnancy diagnosis and investigating cases of infertility in farm animals (Khaton, 2015). The objective of this study is to establish and compare baseline dimensions of the different segments of the female reproductive tracts of ovaries, oviducts and uterus as well as the cervices of WF and RB cows.

MATERIALS AND METHODS

Experimental animals and Study area

The study was conducted on 84 cows (WF = 63 and RB = 21) slaughtered in a local abattoir at Ubakala, Umuahia South Local Government Area of Abia State between June and October, 2014. Abia State is in the South-eastern part of Nigeria. Umuahia, the capital of Abia State is located at longitude 7.5^0 and latitude 5.4^0 and has a total land mass of 5,243.7 km^2. The State has about 2.8 million people according to National Population Commission (2006). The ages of the cows were estimated according to dentition as was earlier described by Lawrence *et al.,* (2001). The age range of the animals used in the study was between 2 and 3 years.

Sample collection

During routine slaughtering operations, the reproductive tracts of female White Fulani and Red Bororo cows were taken in a plastic bag with each sample marked with proper identification and taken to the Theriogenology Laboratory of Michael Okpara University of Agriculture, Umudike where the study was carried out. The samples were usually collected between 7 am and 8 am and transported to the laboratory within one hour after animal slaughter. Samples with abnormalities in any segment of the internal genitalia to be measured were excluded from the study.

Parameters' measurement

In this study, 63 WF and 21 RB breeds of cattle were used to study the baseline dimension of the ovary, oviduct, uterine horns (right and left) and uterine body as well as the cervix. Abattoir specimens were used in this study because of two reasons. One, they are more economical and secondly, they are reportedly to be the best in obtaining biometrical values (Rind *et al.,* 1999). Materials and equipment needed for the study were collated and prepared in the laboratory. These include a metric ruler, an electronic balance, a vernier calliper, a large dissection tray, hand gloves, sewing thread, syringe and needle, sample bottle and beaker. The tray and electronic balance were placed on the laboratory slab in bright light area. All the parameters were measured as was described in earlier study of Jaji *et al.* (2010) with little modification.

The whole reproductive organ was made flat in a tray (Plate 1) before separating out individual organs. The length measurements were recorded in cm and weights in g. The ovary was examined under bright light and then measured. Different segments of the tract, that is, cervix, uterine body, uterine horns, oviducts and ovaries were measured using metric rule and thread individually with proper identification of the right and left parts of each organ. The ovaries were removed at their junction with the ovarian ligament as close to the ovarian tissue as possible after the fimbriae was removed. The length was measured as the distance between the anterior and the posterior poles of the ovary with the aid of vernier calliper. The ovary was weighed with the electronic balance (XY600BJ-1301146 Citizen, Delhi). The numbers of follicles whose diameters were more than 4 mm were also counted on each ovary.

The oviducts were dissected out to be free of their ligamentous attachment and measured on their full length straightened out as shown in Plate 2. The uterine body was measured from the point after the bifurcation of the horn to the point of uterine cervix. The length of the cervix was also measured and recorded as the distance between external and internal orifice.

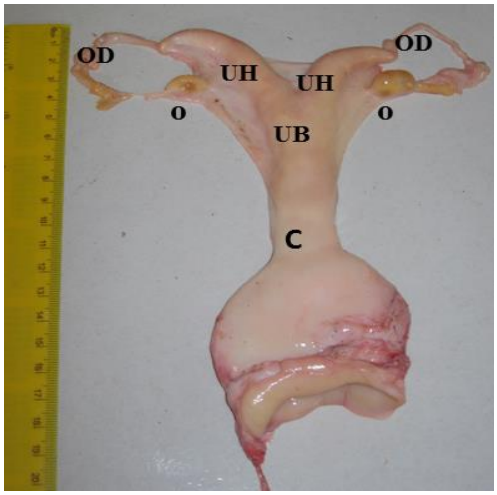

Plate 1: The reproductive system of White Fulani cow, (C) cervix; (O) ovary; (OD) oviduct; (UB) uterine body; and (UH) uterine horn

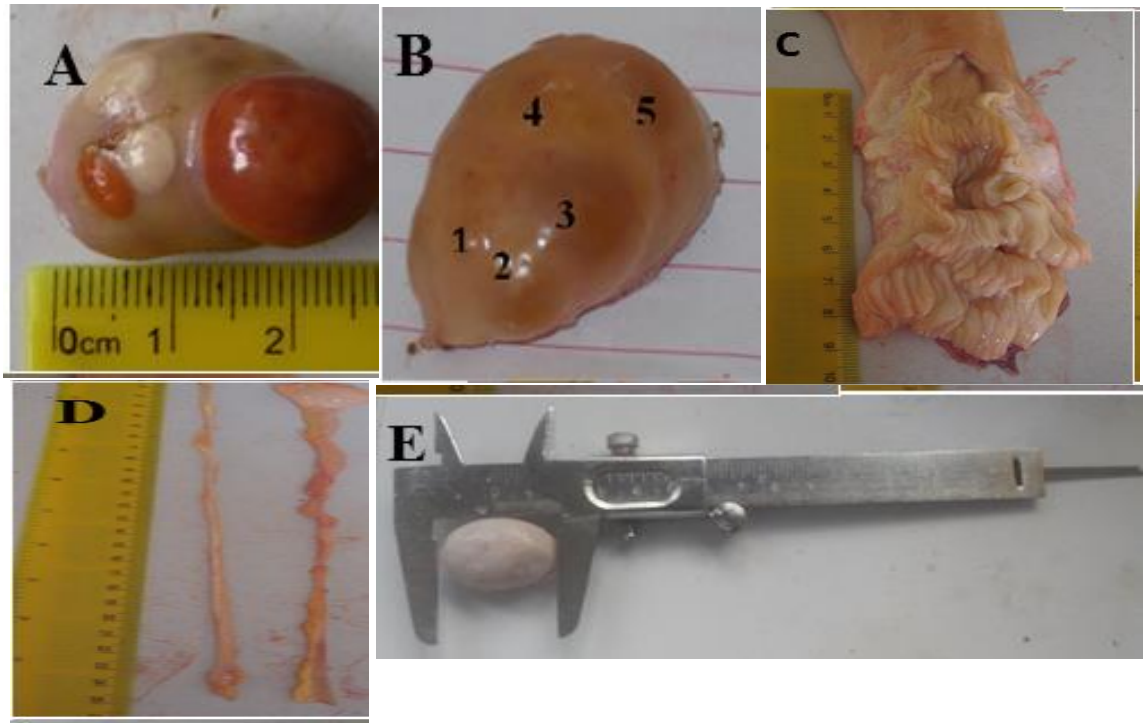

Plate 2. Measurement of different reproductive organs: (A) Ovary with corpus haemorrhagicum (CH), (B) Ovary having 5 follicles with more than 4 mm in diameter, (C) Cervix, (D) Oviduct and (E) Ovary in the Vernier calliper

Data analysis

In a parametric model, the data were presented as mean ± Standard error of mean. The parameters were analysed using Statistical Package for Social Sciences (SPSS 18.0 for Windows, Chicago, IL, USA). The Parameters from the two breeds of cattle were compared using Student's t-test. Significance was established at $P < 0.05$.

RESULTS

Animal age

All the animals use for the study were adult with their ages ranging between 2 to 3 years. Precisely, 38 animals that represented 45.2% of the total number were 2 years while (34) 40.5% and (12) 14.3% were 21/2 and 3 years respectively.

Table 1: Reproductive organs' biometrics of White Fulani and Red Bororo breeds of cattle

Organ	segment	White Fulani	Red Bororo
Ovary	Right weight (g)	3.09 ± 0.25*	2.67 ± 0.15*
	Left weight (g)	3.51 ± 0.23*	2.89 ± 0.25*
	Right length (cm)	3.34 ± 0.15	2.87 ± 0.22
	Left length (cm)	3.11 ± 0.15	3.03 ± 0.22
No of follicles	Right ovary	11.27 ± 0.90	12.77 ± 2.18
	Left ovary	11.52 ± 0.97	11.82 ± 1.58
Oviduct	Right length (cm)	16.18 ± 0.76	14.83 ± 1.25
	Left length (cm)	17.86 ± 1.53	15.98 ± 1.62
Uterine body	Length (cm)	8.65 ± 0.15	8.52 ± 0.92
Uterine horn	Right length (cm)	16.18 ± 0.76*	14.84 ± 1.25*
	Left length (cm)	17.86 ± 1.53	17.86 ± 1.62
Cervix	Length (cm)	6.74 ± 0.64	6.00 ± 0.81

Significance is established at P<0.05. The weight of the right and left ovaries and length of the right uterine horn in the WF were significantly higher than those of RB at P<0.05 (*).

Ovary

The mean weight of the right and left ovaries in the WF were 3.09 ± 0.25 cm and 3.51 ± 0.23 cm while those of RB were 2.67 ± 0.15 cm and 2.89 ± 0.25 cm respectively (Table 1). Both the weight and length of the right and left ovaries were similar in each of the breed but the weight of the ovary of WF was significantly higher than those of RB. In addition, the total number of follicles found in both right and left ovaries range from 10 to 15 in the two breeds with no statistical difference between the number in WF and RB. Also, the number of follicles in right ovary was not significantly higher than those on the left in the individual breed.

Oviduct

The length of the right and left of the oviducts of WF were 16.18 ± 0.76 and 17.86 ± 1.53 cm while that of the RB were 14.83 ± 1.25 and 15.98 ± 1.62 cm respectively (Table 1). These parameters in the two breeds were statistically (P>0.05) similar.

Uterine body and horn

The length of the uterine body, the right and their left uterine horns and uterine bodies in WF were 8.65 ± 0.15, 16.18 ± 0.76 and 17.86 ± 1.53 cm respectively (table 1). The same parameters for the RB were 8.52 ± 0.92, 14.84 ± 1.25 and 17.86 ± 1.62 cm respectively (table 1). The right uterine horn in the WF were significantly (P>0.05) higher than that of RB, whereas there was no significant difference in the left and uterine bodies.

Cervix

The length of the cervix in the WF breed was 6.74 ± 0.64, while that of RB was 6.00 ± 0.81 cm. The difference between the lengths of this organ in the two breeds was not statistically different.

DISCUSSION

The ovary, oviduct, uterus and cervix play synergistic roles in female reproductive functioning (Siddiqui *et al.,* 2005). The biometric parameters of these organs may determine the extent to which they are able to fulfil their physiological roles towards attainment of optimal reproductive capacity in female mammals. The age range of 2-3 years observed across all the animals might be due to cost consciousness on the part of the cattle owners who deemed it fit to slaughter the animal at the earliest time of reaching slaughter weight.

The results of the length of ovary in WF and RD cows were in accordance with Roberts (1992) and Memon (1996). The weight of the ovary in WF cow was in accordance with reports of Arthur *et al.,* (1989). However, a higher weight of 5-10g of the ovary reported by Roberts did not agree with our research findings. Also, Ali *et al.,* (2006) reported mean weight of 4.0 ± 0.2 and 4.3 ± 0.3 g for left and right ovaries respectively in Zebu cow. The weights of the ovary in WF were significantly higher than those of RB. The disparity is obviously due to different breed (Sloss and Dufty, 1980). There was no significance difference in the weight of the right and left ovaries in both WF and RB in contrary to the report of Rind *et al.,* (1999) and Khaton *et al.,* (2015) where the right ovary was said to be more active than the left

ovary. The activities of the ovary involve formation of follicle which ovulates and then becomes luteinised to form the CL that eventually forms the corpus albican after luteolysisis (Scaramuzzi *et al.,* 2011). The presence of these different ovarian structures determines weight and length of the ovary. The physiology to explain the higher weight of right ovary over the left was based on speculation that the position of the rumen to the left impedes adequate flow of blood to that region and hence the right produces more dominant follicle that ovulates than the left ovary (Khaton *et al.,* 2015).

For successful *in vitro* production of embryos, the evaluation of ovaries, the efficient collection and grading of oocyte is very important. Extensive body of research have been done on *in vitro* maturation (IVM) of oocytes, *in vitro* fertilization (IVF) and embryo transfer (Bousquet, *et al.,* 1999). These technologies have really enhanced reproduction in many food animal species especially in bovine. However, it is noteworthy that these technologies have not been adequately developed and utilised in Nigeria system of animal reproduction. The consequence is lack of information on the potential of using abattoir ovaries for IVF. The results of this study showed that the minimum number of follicles with more than 4 mm in diameter was 10 in the two breeds. Therefore, in the future when studies on IVF is patronised, abattoir specimen present a pool of oocytes that may be useful for IVM.

The mean length of the oviduct in WF and RB cows are lower than 21.8 cm and 21.3cm reported by Kunbhar *et al.,* (2003) for right and left oviduct respectively. The value was also lower than 23.79±0.76 and 23.54±0.79 cm reported by Khaton *et al.,* (2015) for local Holstein cows. The oviduct can be divided into three different regions viz, the infundibulum, the ampulla and the isthmus (Senger, 2003). Interaction between the spermatozoa and the ova and subsequent fertilization of the ovum by the spermatozoon takes place in the isthmic-ampulla region of the oviduct. The stay of the zygote in the oviduct is always very short before it is transferred to the uterine horn. The three regions of the oviduct were not differentiated in this study because it was difficult as there was no strict landmark (s) that might have guided such demarcation.

The length of the uterine body in WF and RB were higher than that reported by Sorenson (1988). This is also higher than 1.7 ± 0.16 cm reported by Kunbhar *et al.* (2003). The mean length of the uterine horn in WF cow is at par with the report of Roberts (1992). The value is, however, lower than those reported by Sorenson (1988) as well as that of Petter (1993) whose range was 35-40 cm. Also, 21.63cm and 20.90cm reported by Kunbhar *et al.,* (2003) for right and left horns respectively are slightly higher than the results obtained in this study. The difference in value could have been due to age, breed and fertility status of the cow (Khaton *et al.,* 2015). The uterus harbours the embryo/foetus during gestation. The length of cervix in WF cow is in accordance with reports by Garcia (1988) which was 6.7cm but lower than 7.8 cm, 8.0 and 7-10 cm reported by Kunbhar *et al.,* (2003), Roberts (1992) and Memon, (1996) respectively. The cervix is the entrance into the uterus. In most species, it forms a rigid and tightly closed distensible structure which is necessary to prevent easy access of microorganism in to the uterus (Senger. 2003). However, the dilation of the cervix is essential under two conditions. One is during coitus or artificial insemination for passage of inseminating catheter; and secondly at partition for expulsion of foetus and foetal membrane (Senger, 2003). Therefore, the length of the cervix is a major factor that determines the length of inseminating catheter for artificial insemination.

In conclusion, we have used abattoir specimens from 84 cows to derive baseline dimensions of the ovary, uterus, oviduct and cervix for WF and RB breeds of cattle. The results have shown that parameters of some segments of reproductive organs such as ovary and uterine horn differed significantly between the two breeds, while other segments that included uterine body, oviduct and cervix were similar. To the best of our knowledge, this is the first study to document and compare the biometric parameters of reproductive organs in WF and RB breeds of cattle in Nigeria. Further studies using larger sample size are suggested to confirm the results in this study. These data may be useful in further study related to the physiological function of individual structures measured in this study and possibly find practical application in determining the length of catheter to be used for artificial insemination as well as diagnosing abnormalities of these organs in these breeds of cattle.

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