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Biometrical Studies of Reproductive Organs of Dairy Cows of Different Genotypes in Bangladesh

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ABSTRACT

Genotype has a significant effect on biological efficiencies of dairy cows. Environmental changes affect differently between different genotypes of animals. A biometrical study was conducted on reproductive organs of dairy cows (n = 100) of different genotypes (Local, Local×Holstein Friesian, Local×Jersey and Local×Sahiwal) available in Bangladesh. Reproductive tracts of cows were collected immediately after slaughter from different slaughter houses in Rajshahi, Bangladesh. The comparison of morphometric values of most of the parameters of reproductive tract observed in different genotypic cows showed significant differences ($p<0.05$). Local×Holstein Friesian had significantly higher values ($p<0.05$) on the most of parameters of genitalia measured, followed by the Local×Jersey, Local×Sahiwal and Local. Local×Holstein Friesian had the longest uterine horn (29.20±1.65 cm for right and 29.87±1.75 cm for left), uterine body (3.42±0.20 cm length and 2.83±1.40 cm width), cervix (5.64±0.24 cm length and 4.89±0.23 cm width) and vagina (24.66±0.64 cm length and 6.08±0.36 cm width). The right ovary was wider in diameter, larger in length and heavier in weight as compared to left one in all genotypes. This confirms the fact of right ovary being more active than the left one. Moreover, the biometry of ovary and tubular parts of genitalia in Local×Holstein Friesian and Local×Jersey cows are suggestive for selection of crossbred dairy cows to get maximum benefits from crossbreeding in respect of productive and reproductive performance and also for genetic improvement.

Key words: Biometry, dairy cow, genotype, reproductive organs

INTRODUCTION

The cattle is important source of milk and meat in the whole world. Cattle occupy the first position of livestock population. It plays an important role not only in the rural economy but also in the national economy in Bangladesh. The current population of cattle 23.1 million (Ministry of Finance, 2013) and cannot met the demand against 16 crore people of Bangladesh. Regular and successful reproduction is the key to profitable cattle production. The main goal of dairy farmers is one calf/cow per year. High reproductive efficiency is an important facet for achieving maximum return from the animal. But the production is hampered due to various reproductive diseases. Research on reproductive system of cow has got paramount importance from the stand point of national development. Any structural and functional abnormalities in reproductive system may interrupt animal reproduction. The reproductive disorders of cattle can lead to economic losses in term of reduce fertility, longer inter calving interval and increased

expense on medication in farms (Samad *et al*., 1987). Ultimately its effects fall on the economic tract of this species. When sufficient information about reproductive status of cow will be available then these disorders could be minimized.

The characterization of genotypes of livestock is the first approach to a sustainable use of its animal genetic resource (Tolenkhomba *et al*., 2012). The dairy cattle improvement programme in Bangladesh aims to improve local cattle for milk production by incorporation of both tropical breeds (Sahiwal) and temperate breeds (Holstein-Friesian and Jersey).

The productive and reproductive performances of different crossbreds have been studied by several researchers and they showed that the Holstein-Friesian crossbred performed comparatively better than others (Khan *et al*., 2005). Crossbreeding has been in practice for several years as a tool to improve production performance of our native cattle breeds. Holstein Friesian and Jersey are the two breeds of choice for crossbreeding (Lakshmi *et al*., 2009).

The reproductive performance depends upon the normal structure and functions of genital organs of an animal (Siddiqui *et al*., 2005). The knowledge of biometrical status of female genital tract is essential to perform artificial insemination, pregnancy diagnosis and dealing with the infertility problems (Memon, 1996). However, in a bid to increase and improve cattle production in Bangladesh, study on the effect of genotype/breed on reproductive organ of cow is essential for a maximum and rational utilization of the cattle breeding (Ibrahim *et al*., 2012). Furthermore, there is limited study that compared reproductive organ on morphometric characteristic of any genotypes of cows. Little is known on the anatomy and physiology of the female genitalia of tropical breeds of cattle (Kumar *et al*., 2004); compared to the exotic breeds (*Bos taurus*) been described by various authors (Getty, 1975; Napolcan and Quayam, 1996; Amle *et al*., 1992; Newham, 2001).

Reliable information on the reproductive parameters of cattle of different genotypes owned by farmers and nomadic farmers in Bangladesh is scanty in the literature. 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 within the genotypes. The present study was therefore design to determine and compare the reproductive tracts' morphometry of different genotypes of cow as well as to establish baseline data on the normal dimensions of different segments of the reproductive tract of cows in Bangladesh.

MATERIALS AND METHODS

The present study was conducted on 100 non-gravid female reproductive organs of different genotypes (Local, n = 43; Local×Holstein Friesian, n = 24; Local×Jersey, n = 20 and Local×Sahiwal, n = 13) of cows, at different slaughter-houses in Rajshahi, Bangladesh. Reproductive tracts were randomly collected during the routine slaughtering operations and brought to the laboratory for biometrical studies during the period from September 2014 to March 2015. Reproductive organs included ovaries (length, width, thickness and weight), oviducts (length), uterine horns (length), body of uterus (length and width), cervix (length, width and ring), vagina (length and width) and vulva (length and width). Cervical rings and folds were considered as the number of rings/folds from *os externum* to *os internum*.

After collection, reproductive organs were transferred to the laboratory in physiological saline solution within 30 min of slaughter. As documented by Wilson (1978), 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 with the help of electronic digital calliper (Stainless Hardened). The width was taken as the

greatest line perpendicular to the length line. The weight of ovary was taken with the help of electrical weighing balance. The oviducts were dissected out and a measurement taken on their extended length from the top of the fimbria to the tubal-uterine horn junction (Fig. 1). 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 (Fig. 2). 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

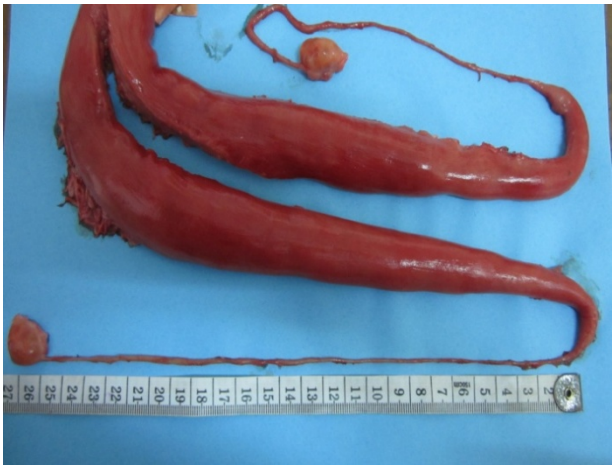

Fig. 1: Measurement of the oviduct length taken from the top end of the fimbria to the uterine-tubal junction

Fig. 2: Measurement of the uterine horn length taken from the bifurcation of the uterine body to the uterine-tubal junction

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 and 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. All measurements were recorded in centimeters with the help of electronic digital calliper, China (Stainless hardened) and measuring tape. All weights were recorded in grams by using electrical weighing balance (Unilab Instruments, USA).

Statistical analysis: Data was presented as Mean±SE. The DMRT was performed to observe significant differences of parameters of reproductive organs between different genotypes of cows. All analysis was performed using SPSS software version 20. $p<0.05$ was considered as significant.

RESULTS

Ovary: The measurements of ovaries in different genotypes of cow were shown in Table 1. The ovaries of cows were ovel in shape, had no ovulation fossa and located at the cranial portion of the oviduct. The mean length, width and thickness were recorded as 2.48±0.98, 1.84±0.59 and 1.48±0.10 cm for right ovary and 2.33±0.56, 1.62±0.26 and 1.27±0.59 cm for left ovary, respectively. The weight of right and left ovary was recorded as 3.75±0.18 and 3.09±0.15 g, respectively. The comparison of the morphometric values of both ovaries in the different genotypes (Local, Local×Holstein Friesian, Local×Jersey and Local×Sahiwal) showed significant differences ($p<0.05$) in length, width, thickness and weight (Table 1). Local×Holstein Friesian had significantly higher values ($p<0.05$) on most of the parameters measured, followed by the Local×Jersey, Local×Sahiwal and the Local.

Oviduct: The oviducts of the cows were paired convoluted tubes that reached the ovaries to the tapped ends of the uterine cornua or horn. The oviduct was torturous, wiry, hard and embedded in fat of mesosalpinx. This tube lay in a peritoneal fold derived from the lateral layer of the broad ligament. It serves to transport ova or unfertilized eggs from the ovary to the uterus. The average length of right and left oviducts were 21.05±0.39 and 21.00±0.38 cm, respectively in different genotypes of cow. The values of right and left oviducts were higher in Local×Holstein Friesian (23.79±0.76 and 23.54±0.79 cm) than other groups (Table 2).

Uterine horns: The uterus of cow was "Y" shaped hollow muscular organ consisting of a body and divided anteriorly into two horns. The average length of right and left uterine horns was

Table 1: Length, width, thickness and weight of ovaries in different genotypes of cows (Mean±SE)

	Genotypes				
Organ and measurements	Local (n = 43)	L×F (n = 24)	L×J (n = 20)	L×SL (n = 13)	Average
Right ovary					
Length (cm)	2.25±0.33^{b}	2.79±0.89^{a}	2.53±0.10^{b}	2.56±0.13^{a}	2.48±0.98
Width (cm)	1.70±0.56^{b}	2.02±0.10^{a}	1.85±0.07^{ab}	1.96±0.16^{ab}	1.84±0.59
Thickness (cm)	1.50±0.24	1.42±0.85	1.51±0.10	1.44±0.30	1.48±0.10
Weight (g)	2.96±0.16^{c}	5.31±0.50^{a}	3.76±0.33^{ab}	3.46±0.31^{b}	3.75±0.18
Left ovary					
Length (cm)	2.15± 0.42^{b}	2.65±0.72^{a}	2.34± 0.10^{b}	2.35±0.11^{b}	2.33±0.56
Width (cm)	1.54±0.69	1.75±0.96	1.61±0.10	1.65±0.21	1.62±0.26
Thickness (cm)	1.18±0.48^{b}	1.36±0.73^{a}	1.29±0.61^{ab}	1.32±0.08^{ab}	1.27±0.59
Weight (g)	2.63±0.17^{b}	3.85±0.35^{a}	3.15±0.40^{ab}	3.12±0.49^{ab}	3.09±0.15

N: Total, L: Local, F: Holstein friesian, J: Jersey, SL: Sahiwal, SE: Standard error, ^{a,b,c}Statistically significant ($p<0.05$) in between the column

Table 2: Measurements of tubular parts of reproductive tract of different genotypes of cows (Mean±SE)

		Genotypes				
Part of reproductive tract	Measurements	Local (n = 43)	L×F (n = 24)	L×J (n = 20)	L×SL (n = 13)	Average
Right oviduct	Length (cm)	19.48±0.57^{b}	23.79±0.76^{a}	21.55±0.84^{b}	20.38±0.68^{b}	21.05±0.39
Left oviduct	Length (cm)	19.62±0.53^{b}	23.54±0.79^{a}	21.20±0.86^{b}	20.53±0.77^{b}	21.00±0.38
Right uterine horn	Length (cm)	22.72±1.05^{c}	29.20±1.65^{a}	26.60±1.42^{ab}	24.92±1.23^{b}	25.34±0.72
Left uterine horn	Length (cm)	22.83±1.00^{c}	29.87±1.75^{a}	27.50±1.46^{ab}	25.38±1.16^{b}	25.79±0.73
Body of uterus	Length (cm)	2.90±0.12	3.42±0.20	3.10±1.17	3.34±0.24	3.12±0.72
	Width (cm)	2.30±0.46^{b}	2.83±1.40^{a}	2.46±0.13^{ab}	2.69±0.24^{ab}	2.51±0.59
Caruncle	Number	94.95±2.39	99.54±2.90	97.55±4.82	98.15±3.08	96.99±1.61
Cervix	Length (cm)	4.65±0.16^{b}	5.64±0.24^{a}	5.27±0.26^{ab}	4.69±0.26^{b}	5.02±0.11
	Width (cm)	4.36±0.20	4.89±0.23	4.57±0.27	4.61±0.28	4.56±0.12
Cervical ring	Number	3.65±0.12	4.04±0.14	3.95±0.18	3.92±0.23	3.84±0.13
Vagina	Length (cm)	21.81±0.47^{b}	24.66±0.64^{a}	22.50±0.85^{b}	21.46±0.88^{b}	22.59±0.34
	Width (cm)	4.83±0.17^{b}	6.08±0.36^{a}	5.70±0.45^{ab}	5.84±0.54^{ab}	5.44±0.16
Vulva	Length (cm)	8.50±0.26	9.37±0.24	9.10±0.28	8.69±0.28	8.85±0.14
	Width (cm)	4.55±0.21^{b}	5.00±0.26^{ab}	5.45±0.28^{a}	4.50±0.32^{b}	4.83±0.13

N: Total, L: Local, F: Holstein friesian, J: Jersey, SL: Sahiwal, SE: Standard error, ^{a,b,c}Statistically significant ($p<0.05$) in between the column

25.34±0.72 and 25.79±0.73 cm, respectively in different genotypes of cow (Table 2). The highest length of right and left uterine horns was observed in Local×Holstein Friesian and it was 29.20±1.65 and 29.87±1.75 cm, respectively.

Body of uterus: The uterus of cows was cornuate in shape, two horns joined together to form a body of uterus that was situated in between os-internum and true bifurcation of cornua. This is the point where semen is deposited during artificial insemination. The mean length and width of body of uterus were 3.12±0.72 and 2.51±0.59 cm, respectively in cows of different genotypes. The highest length and width of body of uterus was observed in Local×Holstein Friesian and were 3.42±0.20 and 2.83±1.40 cm, respectively (Table 2).

Cervix: Cervix was a sphincter muscle like structure, which formed a physiological barrier between the vagina and uterus. Its wall was harder, thicker and more rigid than the walls of either the uterus or the vagina. The mean length and width of cervix was recorded as 5.02±0.11 and 4.56± 0.12 cm, respectively in different genotypes of cow (Table 2). The highest length (5.64±0.24 cm) and width (4.89±0.23 cm) of cervix were observed in Local×Holstein Friesian.

Vagina: Vagina was a tubular sheath like structure, which extends from cervix to the urethral opening. The mean length and width of vagina were 22.59±0.34 and 5.44±0.16 cm, respectively in different genotypes of cow (Table 2). The highest length (24.66±0.64 cm) and width (6.08±0.36 cm) of vagina was observed in Local×Holstein Friesian cows.

Vulva: Vulva was the external portion of the tract that extended from vagina to the exterior opening. The mean length and width of vulva were 8.85±0.14 and 4.83±0.13 cm, respectively in different genotypes of cow (Table 2). The highest width of vulva was observed in Local×Jersey (5.45±0.28 cm) cows.

DISCUSSION

Genotypes of parents influence the genetic composition of offspring. Genotype and environmental factors play a crucial role in productive and reproductive performance of dairy cows.

In the present study, genotype of cows had a significant effect on most of the parameters of reproductive tract of dairy cows of different genotypes in Bangladesh.

The average mean length of the ovary recorded in the present study fall within the range (1.30-3.5 cm) of the results of Dobson and Kamonpatana (1986), Kunbhar *et al.* (2003), Carvalho *et al*. (2005), Ali *et al.* (2006) and Bello *et al.* (2012). However the measurement for length recorded in the present study was shorter than the figures (2.8-5.0 cm) reported by Settergren (1983) and Memon (1996) in cattle. The width of ovary as recorded in the present study was in agreement with the results (1.1-1.9 cm) of Kunbhar *et al.* (2003), Ali *et al.* (2006) and Bello *et al.* (2012) in cattle. However, it was slightly smaller to those (2.2-2.5 cm) reported by Getty (1975) and Carvalho *et al*. (2005) in cattle. The thickness of the ovary found in the present study was in the range of those (0.6-2.0 cm) recorded by Kunbhar *et al.* (2003), Carvalho *et al*. (2005), Ali *et al.* (2006) and Bello *et al.* (2012) in cattle. However, the results obtained by Arthur *et al.* (1989) and Memon (1996) were greater than the present findings. The present findings for the weight of ovary were in agreement to those (3.8 g) reported by Arthur *et al.* (1989) and Kunbhar *et al.* (2003) in cattle. On the other hand higher weight (4-19 g) of right and left ovary was reported by Carvalho *et al*. (2005), Ali *et al.* (2006) and Bello *et al.* (2012). The discrepancy in the parameters could be due to age, breed, parity, body weight, body condition score and managemental factors variation as it is established fact that the ovaries of *Bos-indicus* breeds are generally smaller and lighter than those of the *Bos-taurus* breeds. It was concluded that the left ovary is shorter in length, narrower in width and lighter in weight to that of the right ovary in different genotype of cows. This confirms the fact that the right ovary is more active than the left ovary. Moreover, Local×Holstein Friesian had significantly higher values ($p<0.05$) on most of the parameters of ovary measured, followed by the Local×Jersey, Local×Sahiwal and the Local.

Local×Holstein Friesian had significantly ($p<0.05$) higher length of both right and left oviducts than other groups (Table 2). The findings about the length of oviducts were in agreement with the results (20-30 cm) of Petter (1993), Kunbhar *et al.* (2003) and Bello *et al.* (2012) in cattle. On the other hand lower length (17.8-19.8) of right and left oviducts were reported by Carvalho *et al.* (2005).

Genotype significantly ($p<0.05$) affects the length uterine horns and width of uterine body. The significantly longer uterine horn was observed in Local×Holstein Friesian (29.20±1.65 cm for right horn and 29.87±1.75 cm for left horn) but there was no significant difference between cows of other genotypes. The length of uterine horns of present study fall within the range (15-30 cm) reported by Kunbhar *et al.* (2003), Ali *et al.* (2006) and Bello *et al.* (2012); however higher values (35-40 cm) were recorded by Getty (1975) and Petter (1993). The highest width of body of uterus was observed in Local×Holstein Friesian and it was 2.83±1.40 cm but there was no marked difference between cows of other genotypes (Table 2). The result for length of uterine body was higher than that reported by Petter (1993), Kunbhar *et al.* (2003) and Bello *et al.* (2012) in cows but was in agreement with the values (3-5 cm) were reported by Getty (1975) and Carvalho *et al*. (2005) in cattle. The findings for the width of the present study were in agreement to the results (2.5 cm) reported by Kunbhar *et al.* (2003) in cows. Whereas, Bello *et al.* (2012) reported higher values (3.75-4.40 cm) as compared with the present investigation. The difference in values could have been due to age, fertility status and shrinkage of the endometrium.

The highest length (5.64±0.24 cm) and width (4.89±0.23 cm) of cervix were observed in Local× Holstein Friesian (Table 2). The length recorded in this study was lower with the results obtained by Memon (1996) and Kunbhar *et al.* (2003), Carvalho *et al.* (2005) and Bello *et al.* (2012), respectively in cows. The findings of present study were in agreement with the values

(4.35-6.12 cm), reported by Ali *et al.* (2006). Whereas, the width recorded during present study were higher to the results (2.3-2.8 cm) of Petter (1993) and Kunbhar *et al.* (2003) and were in agreement with the results (3.35-6.25 cm) reported by Ali *et al.* (2006) and Bello *et al.* (2012) in cows.

The highest length of vagina was observed in Local×Holstein Friesian (24.66±0.64 cm) but there was no marked difference between genotypes of Local (21.81±0.47 cm), Local×Jersey (22.50±0.85 cm) and Local×Sahiwal (21.46±0.88 cm). Genotype had significant effect ($p<0.05$) on the length and width of vagina of cows (Table 2). The highest width of vagina was observed in Local×Holstein Friesian (6.08±0.36 cm) and the lowest in Local (4.83±0.17 cm) but there is no difference between genotypes of Local×Jersey (5.17±0.45 cm) and Local×Sahiwal (5.84±0.54 cm) (Table 2). These results regarding length were in agreement with the results (17.5-25 cm) reported by Petter (1993) and Kunbhar *et al.* (2003) in cattle. However the results (25-36 cm) reported by Carvalho *et al*. (2005) was higher than the present findings. The measurement regarding the width of vagina was in agreement with the results (4.50 and 6.50 cm) recorded by Sorensen (1988) and Kunbhar *et al.* (2003) in cattle.

Genotype also significantly ($p<0.05$) affects the width of vulva of cows. The highest width of vulva was observed in Local×Jersey (5.45±0.28 cm) (Table 2). The findings regarding vulva of the present study were lower with the values reported by Kunbhar *et al.* (2003) in cattle.

CONCLUSION

From the present study it is concluded that the biometrical study based on available genotype is essential for getting better performance. Moreover, the biometry of reproductive organs in Local×Holstein Friesian and Local×Jersey cows is imperative for selection of dairy cows to get the better productive and reproductive performance from crossbreeding and also for genetic improvement in respect of Bangladesh. The data of present study also provide a baseline information about biometry of various parts of the reproductive organs of cows of available genotypes in Bangladesh that will certainly help in teaching and further research on the anatomy and physiology of the reproductive system of dairy cows. As, selection of dairy animals for economic traits like reproductive performance, productive life, health and survival greatly depends on genotypic traits, the present study certainly help in selecting better quality crossbred dairy cows for livestock and genetic improvement.

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