

RELATIONSHIPS BETWEEN SEXUAL DESIRE AND TESTICULAR, SCROTAL AND PENILE MORPHO-HISTOMETRICS IN EGYPTIAN BUFFALO BULLS

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ABSTRACT

Ten buffalo bulls, five with low sexual desire (G1) having a mean reaction time (RT) of 155.0 s and five contemporary bulls with a normal sexual desire (G2) having a mean RT of 56.8 s, were used. Semen was collected and reaction time was measured weekly through an experimental period of 12 wk. At the end of the experiment, each of scrotal circumference and wall thickness was measured. Peripheral blood plasma testosterone concentration was determined. Thereafter, all bulls were slaughtered and morpho-histometrics of testis and scrotum and morphology of penis were investigated.

Results indicated that bulls in G1 had ($P<0.01$) a longer RT by about 173% and lower semen quality than those in G2. Significant ($P<0.001$) negative correlation coefficients were found between RT and semen characteristics. Testicular weight (TW) and volume (TV) were higher ($P<0.01$) in G2 than G1 (163.6 g and 180.3 cm³ vs. 109.9 g and 110.7 cm³). Scrotal weight did not differ significantly between the two groups, however, scrotal circumference (SC) and wall thickness (SWT) were significantly ($P<0.01$) lower in G1 than G2 by about 17.0 and 20.3%, respectively. Reaction time correlated ($P<0.001$) negatively with TW (-0.40), TV (-0.53), SC (-0.88) and SWT (-0.78). Weight, length and diameter of the penis were significantly lower in the bulls with low sexual desire (G1) than in G2 (345.0 g, 83.8 and 4.0 cm vs. 243.2 g, 72.6 and 3.4 cm). However, weight of retractor muscle and weight, length, width and thickness of ischiocavernous muscle did not differ significantly between the two groups.

Level of peripheral plasma testosterone in bulls of G1 was significantly ($P<0.05$) lower by about 46.3% than G2, which was associated with a decreased ($P<0.05$) proportion of the testicular parenchyma in G1 than in G2 (11.0 vs. 20.2%). Thickness of scrotal epidermis and smooth muscle layer (Tunica dartos) was significantly ($P<0.05$) thinner in G1 than in G2, however, thickness of scrotal dermis did not significantly differed. The study indicated the presence of relationship between the sexual desire of buffalo bulls and the morpho-histometrics of the testes and the scrotum.

Keywords: Buffalo bulls, sexual desire, testis, scrotum, morphology, histology

INTRODUCTION

In the past few decades, while researchers focused their attention on factors affecting reproductive performance of Egyptian buffalo-cows, relatively fewer studies were carried out on factors affecting reproductive capacity of buffalo bulls. Sexual desire of buffalo bulls correlates with plasma testosterone concentration (Darwish, 1996). It has been also reported that sexual desire of bulls had significantly positive correlation coefficient with the scrotal wall thickness (Mansour *et al.*, 1989). Scrotal circumference positively correlated with sexual desire and fertility (Anderson and Alanko, 1992). Yet,

little information are available on the relationships between sexual desire and testicular and penile measures, and semen quality of buffalo bulls.

In large buffalo herds, incidence of a considerably larger number of bulls with low sexual desire is apparent. Therefore, the aim of this study was to identify some morpho-histometrics changes of the genital organs incorporated with atypical cases of buffalo bulls with low sexual desire.

MATERIALS AND METHODS

Animals used in this study belonged to the buffalo herd of Mehallet Mousa Experimental Station, Animal Production Research Institute. Five bulls were taken from the herd, as culled bulls for their low sexual desire. All culled bulls (G1) were free of infectious diseases having healthy appearance and live body weight (LBW) (502.5 ± 44 kg) and age (38.8 ± 3.3 mo) appropriate for semen production. Their performance was compared to a group of five bulls with normal sexual desire (G 2) having a LBW of 496.3 ± 46 kg and 39.4 ± 4.1 mo of age.

Bulls in both groups were subjected to the same routine feeding and management system applied for bulls in the station. Through an experimental period of 12 weeks (from Dec. 1999 to Mar. 2000), semen was collected from all bulls twice weekly using an artificial vagina. Bulls were sexually stimulated by allowance of two false mounts prior to ejaculation.

Reaction time was recorded as the time elapsed from the approach of a bull to a teaser until complete ejaculation. Scrotal circumference was measured using a tape. Physical semen characteristics including semen volume, sperm cell concentration, and percentages of sperm motility and abnormality were determined for the fresh semen of the 2nd ejaculation on each collection day.

At the end of the collection period, blood samples were taken from the jugular vein of all bulls before their slaughter, for determination of testosterone concentration using active testosterone RIA (Diagnostic System Lab., Inc. USA).

Immediately after slaughter, the genital system including accessory glands was dissected out of the carcass and trimmed from the attached fat. Each testis was stripped off its tune, separated from the epididymis and weighed. Testicular length (dorsal-ventral distance), width (mido-lateral diameter) and volume (by immersing the testes in water) were measured. Also, scrotal and penile tissues were weighed, and length and diameter at root of penis were measured.

Fresh specimens of each testis and scrotum (middle portion) were immediately fixed in formol saline solution and taken to the Physiology Laboratory, Department of Animal Production, Faculty of Agriculture, Mansoura University. Then the specimens were embedded in paraffin, sectioned at 6-8 μ m in thickness and stained with haematoxylin and eosin (H&E) and periodic acid schiff reaction (PAS) (Drury and Wallington, 1980).

A total of 24 cross sections (4 x 3 animals) was examined in each testis and two microscopic fields in each section of scrotum were randomly chosen and examined using research microscope.

Statistical analysis was carried out for testing the differences between the two groups using "T-test" according to Snedecor and Cochran (1980).

RESULTS AND DISCUSSION

Reaction time

Sexual interest expressed as reaction time (RT) was consistently and significantly ($P < 0.01$) longer for bulls in G1 than their contemporaries of G2 at all collection weeks (Fig. 1). The overall mean of RT was 173% longer for G1 (155.0 ± 15.6 s) than G2 (56.8 ± 11.7 s). Reaction time of 42.2 s was reported in normal Egyptian buffalo bulls by El-Siefy (1999), which indicates the low sexual desire of bulls in G1 compared to the reported values for normal sexual-desired bulls taken in the present study.

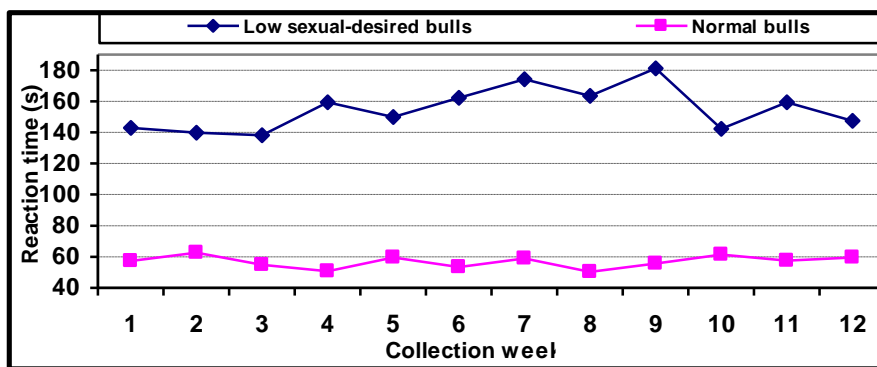


Fig. (1): Reaction time (s) of low and normal sexual-desired buffalo bulls.

Semen quality

Physical semen characteristics presented in Table (1) indicate that the low sexual-desired bulls produced poor quality semen, while semen of normal sexual-desired bulls was characterized by good quality appropriate for AI process.

Table 1: Different physical characteristics of semen collected from buffalo bulls.

Characteristic	Low sexual-desired bulls	Normal sexual-desired bulls	Significance
Ejaculate volume (ml)	1.87 ± 0.11	3.20 ± 0.14	**
Sperm cell concentration ($\times 10^6/\text{ml}$)	533 ± 48.0	1146 ± 29.0	**
Sperm motility (%)	45.4 ± 1.00	78.2 ± 1.10	**
Live sperm (%)	49.3 ± 2.90	81.9 ± 2.10	**
Sperm abnormality (%)	21.1 ± 0.70	8.30 ± 0.80	**

** significant differences at $P < 0.01$.

The present results indicate a negative relationship between bull reaction time and most of physical characteristics of semen. Significant ($P < 0.001$) negative correlation coefficients were found between RT and ejaculate volume ($r = -0.89$), live sperm percentage ($r = -0.91$), motility percentage ($r = -0.84$) and sperm cell concentration ($r = -0.75$). However,

reaction time correlated positively ($P<0.001$) with sperm abnormality percentage ($r=0.82$). Similar correlation coefficients were reported by El-Siefy (1999) for normal Egyptian buffalo-bulls.

Testosterone profile

Concentration of peripheral plasma testosterone was lower ($P<0.01$) in G1 than in G2 by 46.3% (0.364 vs. 0.678 ng/ml). These results indicate that the sexual desire of bulls was associated with plasma testosterone concentration, which supports the findings of Massoud *et al.* (1991). Abdel-Khalek *et al.* (1999) found that RT was strongly related to level of testosterone concentration in Friesian bulls. Also, Ahmed *et al.* (1991) pointed out that the sexual behavior was concomitant with an increase in the peripheral testosterone concentration in Nili-Ravi buffalo-bulls.

Morphological and histometric study

Testicular measures

The morphological examination revealed that testicular shape did not differ between bulls of the two groups or even between the right and left testes in all slaughtered bulls. The testicles were oval in shape with a long diagonal axis in the scrotum. Similar findings were reported by Osman (1965) and Abdel-Rahman *et al.* (1982) on Egyptian buffalo bulls.

Regarding the testicular measures (Table 2), testes without epididymis of bulls in G1 were lighter ($P<0.001$) than those of their contemporaries in G2 by about 33%. In spite of this difference, the testicular weight of G1 was still within the normal weight of Egyptian buffalo bulls' testis (70-178 g) as reported by Amer (1993) and Osman (1996) at 24-42 mo of age.

The testicular weight was reported to be closely correlated with LBW (Noseir *et al.*, 1984 and Darwish, 1996). The decreased ($P<0.05$) testicular weight relative to LBW of bulls in G1 (Table 2) indicated a strong relationship between testis weight and the sexual desire of these bulls.

Table 2: Testicular measures of buffalo bulls.

Item	Low sexual-desired bulls	Normal sexual-desired bulls	Significance
Testicular measure:			
Weight (g)	109.9±3.6	163.6±9.9	***
Weight (g)/kg LBW	0.23±0.02	0.33±0.02	*
Length (cm)	7.7±0.11	9.0±0.41	*
Width (cm)	4.2±0.07	4.9±0.14	**
Volume (ml)	110.7±6.7	180.3±10.4	***

* significant at $P<0.05$ ** significant differences at $P<0.01$. *** significant at $P<0.001$.

Values of testicular length, width and volume (Table 2) were significantly lower in bulls of G1 than their contemporaries of G2. The present testicular length and width of the low sexual-desired bulls are less than those obtained by Mokhless and Ibrahim (1990); Amer (1993) and Osman (1996), who reported a range of 8.2-12.4 cm in length and 4.5-4.6 cm in width for normal buffalo's testis. Mean testicular volume of the low sexual-desired bulls was significantly ($P<0.001$) lower by 38.6% than their

contemporaries of G2 (Table 2). Results of correlation coefficients revealed that RT correlated negatively ($P<0.001$) with testicular volume ($r=-0.53$) more than with testicular weight ($P<0.01$) ($r=-0.40$).

The histometric study of the testes showed some quantitative differences between bulls of the two groups (Table 3). Mean diameter of seminiferous tubules (ST) was lower ($P<0.05$) by 18.4% and number of ST per mm^2 of the testicular tissue was greater ($P<0.01$) by about 67.6% in bulls of G1 than their contemporaries of G2 (Table 3). This was reflected ($P<0.05$) in proportionally greater testicular area occupied by ST and less area of testicular parenchyma in testes of the low sexual-desired bulls as compared to those of G2. (Table 3). These differences are shown also in plates 1 & 2.

Table 3: Histometric characteristics of testis of buffalo bulls.

Item	Low sexual-desired bulls	Normal sexual-desired bulls	Significance
Smallest diameter of ST (μm)	120 \pm 8.4	160 \pm 11.7	**
Largest diameter of ST (μm)	234 \pm 9.6	274 \pm 10.1	*
Mean diameter of ST (μm)	177 \pm 7.8	217 \pm 8.9	*
Number of ST per mm^2	36.2 \pm 1.2	21.6 \pm 1.8	**
Proportion of area occupied by ST (%)	89.0 \pm 2.7	79.8 \pm 2.9	*
Proportion of testicular parenchyma (%)	11.0 \pm 2.6	20.2 \pm 2.8	*

* significant at $P<0.05$ ** significant differences at $P<0.01$. ST = seminiferous tubules

Several authors indicated that mean diameter of ST of buffalo calves was about 188 μm at 24 mo of age (Mansoor *et al.*, 1988 and Osman, 1996). However, higher value (222 μm) was reported by Amer (1993) in mature buffalo bulls, which indicated the lower diameter of ST obtained from the low sexual-desired bulls in the present study.

The relatively lower ($P<0.05$) proportion of the testicular parenchyma and lower density of interstitial cells within it in low sexual-desired bulls might explained the lower concentration of testosterone in blood plasma of bulls in G1 than G2. Similar findings were pointed out by Aboul-Ela *et al.* (1982) in rabbits.

Beside the quantitative differences, qualitative variations were evident between bull groups. The histological examination revealed that testes of bulls in G1 contained densely packed ST as compared to those of G2 (Plates 1 & 2). A decreased number of interstitial cells and an extensive inter-tubular fibrosis were also detected in the testicular parenchyma of low sexual-desired bulls as compared to their contemporaries (plates 3 and 4). The testicular parenchyma of bulls in G1 showed lower reaction to PAS than that of their contemporaries. This may be related to glycoprotein deficiency in testicular tissue of low sexual-desired bulls (Miyake *et al.*, 1983).

Scrotal measures

Scrotal measures (Table 4) showed that scrotal weight (SW) and its values relative to LBW did not differ between bull groups. However, scrotal circumference (SC) and wall thickness (SWT) were lower ($P<0.01$) in bulls of G1 than their contemporaries of G2.

Cross-section in testis of buffalo bulls showing:

Plate (1): Testicular parenchyma (TP) and seminiferous tubules (ST) of low sexual-desired bulls.
(H&E, X150)

Plate (2): Testicular parenchyma (TP) and seminiferous tubules (ST) of normal sexual-desired bulls.
(H&E, X150)

Testicular parenchyma in buffalo bulls showing:

Plate (3): More fibers and less density of interstitial cells in low sexual desired bulls.
(H&E, X600)

Plate (4): Less fibers and more density of interstitial cells in normal sexual-desired bulls.
(H&E X600)

F= Fibers. ST= Semineferous tubules. I= Interstitial cells

The present values of SC and SWT in the low sexual-desired bulls were less than normal values reported by Mansour (1976) (33.0 and 0.69 cm) and Mansour *et al.* (1989) (32.0 and 0.72 cm) in mature Egyptian buffalo bulls. Moreover, Madrid *et al.* (1988) reported that sexual desire and semen characteristics were found to be poor in Angus bulls with small scrotal circumference.

Table 4: Scrotal measures of buffalo bulls.

Item	Low sexual-desired bulls	Normal sexual-desired bulls	Significance
Scrotal measures:			
Weight (g)	325±9.5	375±23	NS
Weight (g)/kg LBW	0.71±0.04	0.75±0.02	NS
Circumference (cm)	27.9±0.36	33.6±0.56	**
Wall thickness (cm)	0.63±0.02	0.79±0.02	**

NS Not significant ** significant at P<0.01

In indicating the positive impact of scrotal measures on the reproductive performance of bulls, significant positive correlation was found between SWT and the sexual desire (Mansour, 1976), and between SC and fertility (Anderson and Alanko, 1992). In the present study, significant (P< 0.001) negative correlation coefficients were found between RT and each of SC (r=-0.88) and SWT (r=-0.78).

Generally, testicular measurements (Table 2) were parallel to those of scrotum in both groups, particularly between both testicular weight and volume, and SC. This is in agreement with Madrid *et al.* (1988), who found that SC was correlated (P<0.001) positively with testicular weight (r=0.91).

Histometrically, marked differences (P<0.05) were found between both bull groups in thickness of scrotal layers (Table 5). The low sexual-desired bulls had (P<0.05) thinner scrotal epidermis (plate 5 and 6) and smooth muscle layer of tunica dartos (plates 7 and 8), while the scrotal dermis layer did not differ significantly between the two groups (Table 5).

Table 5. Histometrics of scrotum of buffalo bulls.

Item	Low sexual-desired bulls	Normal sexual-desired bulls	Significance
Thickness (mm) of :			
Skin epidermis	0.41±0.07	0.78±0.05	*
Skin dermis	5.13±0.18	5.34±0.19	NS
Tunica dartos	1.42±0.09	1.91±0.09	*

NS Not significant * significant at P<0.05

Histologically, epidermis was less keratinized and dermis was less vascular and fibrous in low sexual-desired bulls than their contemporaries in G2 (Plates 5 & 6). No marked differences were found between scrotum of bulls in their reaction to PAS.

**Plate (5): Scrotal epidermis (SE) of
low sexual-desired bulls.**
(H&E, X100)

**Plate (6): Scrotal epidermis (SE) of
normal sexual-desired bulls.**
(H&E, X100)

**Plate (7): Tunica dartos (TD) in
scrotal wall of low sexual-
desired bulls.**
(H&E, x 400)

**Plate (8): Tunica dartos (TD) in
scrotal wall of normal
sexual-desired bulls.**
(H&E. x 400)

Penile and muscular measures

Data in Table (6) reveal that all penile measures were significantly lower in bulls of G1 than their contemporaries of G2. Penile measures play an important role in semen collection by artificial vagina and site of ejaculation within the female reproductive tract during natural service.

Table 6: Penile and muscular measurements of buffalo bulls.

Item	Low sexual-desired bulls	Normal sexual-desired bulls	Significance
Penis:			
Weight (g)	243±5.80	345±12.4	***
Weight (g)/kg LBW	0.51±0.04	0.70±0.03	**
Length (cm)	72.6±0.57	83.8±3.10	*
Diameter at root (cm)	3.40±0.08	4.00±0.08	***
Ischiocavernous muscle:			
Weight (g)	129±7.30	141±8.80	NS
Length (cm)	11.6±0.21	11.1±0.58	NS
Thickness (cm)	3.60±0.16	3.90±0.29	NS
Retractor muscle:			
Weight (g)	63.7±2.80	63.9±2.60	NS

NS Not significant

* significant at P<0.05

** significant differences at P<0.01.

*** Significant at P<0.001.

On the other hand, measures of ischiocavernous muscle and retractor muscle did not differ significantly between G1 and G2. A wide variation in penile measures were reported by Abdel-Rahman *et al.* (1982); Mokhless and Ibrahim (1990); Darwish (1996) and Osman (1996) in Egyptian buffalo bulls at 24 mo of age might be explained an age effect and difference in body weight.

The results obtained in this study indicated that the sexual desire was strongly related to blood plasma testosterone concentration, while was indirectly related to testicular (weight and volume) and scrotal (circumferences and wall thickness) morphology. Histometrically, proportion of testicular parenchyma and thickness of scrotal epidermis and tunica darots seem to be greatly associated with sexual desire of bulls.

It may be concluded from the present study that testicular volume and scrotal circumference might be good indicators for sexual desire of buffalo bulls.

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علاقات الرغبة الجنسية مع بعض القياسات المورفولوجية والهستولوجية للخصية وكيس الصفن وقضيب فحول الجاموس المصري

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استخدم في هذه الدراسة عشرة من فحول الجاموس الناضجة في مجموعتين متقاربتين في متوسط الوزن والعمر تضم الأولى منها 5 حيوانات منخفضة الرغبة الجنسية (وقت رد الفعل 155 ثانية) ، وتضم المجموعة الثانية 5 حيوانات طبيعية (وقت رد الفعل 56.8 ثانية).

تم جمع السائل المنوي من حيوانات المجموعتين مرتين أسبوعياً لفترة تجريبية 12 أسبوع من ديسمبر 1999 إلى مارس 2000 ، وتم تقدير الخصائص الطبيعية للسائل المنوي. وفى نهاية الفترة التجريبية وقبل الذبح مباشرة تم أخذ عينات دم لتقدير هرمون التستوستيرون فى بلازما الدم ، وقياس محيط وسمك كيس الصفن ثم تم ذبح جميع الحيوانات وتم فصل الجهاز التناسلي وكيس الصفن والقضيب.

وقد أوضحت النتائج ما يلي:

- 1- انخفاض الرغبة الجنسية للمجموعة الأولى عن الثانية بحوالي 273%.
- 2- كانت جودة السائل المنوي أقل معنوياً في المجموعة الأولى مقارنة بالثانية وذلك بالنسبة لكل الصفات الطبيعية للسائل المنوي وكان معامل الارتباط سالب معنوياً بين زمن رد الفعل وكلاً من حجم القذف وتركيز الحيوانات المنوية والنسبة المؤية للحركة والحيوانات المنوية الحية وموجب معنوياً بين زمن رد الفعل ونسبة الحيوانات المنوية الشاذة.
- 3- انخفض تركيز هرمون التستوستيرون معنوياً في المجموعة الأولى عنه في المجموعة الثانية بمعدل 86.3%.
- 4- كان وزن وحجم الخصية أقل معنوياً في المجموعة الأولى عن الثانية (136,6 و 180.3 مقابل 109.9 جم، 110.7 مل) ، وكان معامل الارتباط سالب معنوياً بين زمن رد الفعل وحجم الخصية أكثر منه مع وزن الخصية.
- 5- كان محيط وسمك جدار الصفن أقل معنوياً في المجموعة الأولى عن الثانية بحوالي 11.7 ، 20.2% على الترتيب ، بينما لم يختلف وزن كيس الصفن بين المجموعتين ، وكان معامل الارتباط بين زمن رد الفعل وكلاً من محيط كيس الصفن وسمك جدار الصفن سالب معنوياً.
- 6- انخفض وزن وطول وقطر القضيب معنوياً في المجموعة الأولى عن المجموعة الثانية (345.2 و 81.8 و 4.0 مقابل 243.2 جم و 72.6 و 3.4 سم).
- 7- انخفضت نسبة النسيج البارانشيمي للخصية (النسيج الضام بين القنيتان المنوية) معنوياً في المجموعة الأولى (11%) عنها في المجموعة الثانية (20.2%).
- 8- انخفض سمك طبقة الإبيدرمس والطبقة العضلية فى جدار كيس الصفن معنوياً فى حيوانات المجموعة الأولى عن الثانية.

وتخلص الدراسة بوجود علاقة وثيقة بين القياسات المورفولوجية والهستولوجية للخصية وكيس الصفن مع الرغبة الجنسية لفحول الجاموس المصري ، وتوصى باستخدام القياسات المورفولوجية للخصية للدلالة عملياً على الرغبة الجنسية.