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Species Variation on Gross Morphology and Gross Morphometry of Accessory Sex Glands in One-Humped Camel Bull (*Camelus dromedarius*), Uda Ram and Red Sokoto Buck

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ABSTRACT

Species variation on gross morphology and gross morphometry of accessory sex glands of One-humped Camel Bull (OCB), Uda Ram (UR) and Red Sokoto Buck (RSB) were carried out. Fifteen reproductive systems were collected; the accessory sex glands were grossly examined, and measured for weight or length. All the three studied animals have ampulla, prostate gland and bulbourethral gland. However, there was no presence of vesicular gland (seminal vesicle) in the OCB. Gross morphologically, the ampulla was most pronounced in the UR and least in the OCB. The two ampullae attached to each other through genital fold connective tissues mostly in the UR followed by OCB and then in the RSB. The broadness of the ampulla was also in that order. The seminal vesicles were markedly lobulated, dark-greyed in color and were the largest of the accessory glands. Though curved in both UR and RSB, seminal vesicles were however more pronounced in the UR in which each pair presented a lateral central depression. The prostate gland consisted of only disseminated or scattered parts extending along the pelvic urethra in the UR and the RSB. In OCB, the prostate gland was the largest accessory sex gland. In OCB, prostate glands were found on the dorsolateral aspect of the pelvic urethra above the ischial arch with a thick interglandular septum between them and almond in shape. Also in the RSB, they were found in the same area as in the OCB, but with a relatively less space. Gross morphometrically, results of the mean ampulla lengths and weights of OCB, UR and RSB showed that the means were significantly different. The results of the mean vesicular gland weights of UR and RSB indicated a significant difference. The results of the mean lengths, weights and diameters of bulbourethral gland showed that the means were significantly different in the three studied species. It was concluded that although results show that the studied animals are different ruminant species they exhibit some similarities and interesting morphological differences in gross morphology and gross morphometry of their accessory sex glands compared to the majority of mammals. The basic morphological characterizations done in this study are important for future studies, such as comparison with other species of ruminants (whether true or pseudo).

Key words: Species variation, Gross morphology, Gross morphometry, Accessory sex glands, Red Sokoto buck, Uda ram, One-humped camel bull.

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INTRODUCTION

The accessory sex glands; prostate, vesicular, ampullae of vas deferens and bulbourethral glands play an important role in the reproductive process (Chughtai et al., 2005). In dromedaries, the accessory sex glands are: the ampullae, the prostate and the bulbo–urethral (Cowper's) glands while the most important feature, is the absence of seminal vesicles (Mobarak et al., 1976). In sheep and goats their accessory sex glands are the ampullae, vesicular glands, prostate gland and the bulbourethral glands which open and empty their secretion into the urethral passage (Khalaf and Merhish, 2010). The accessory glands greatly contribute to the fluid volume of semen. Their secretions are solution of buffers, nutrients and other substances needed to assure optimum motility and fertility of semen (Hafez, 1974; MC Donald, 1980; Bone, 1988). The secretions of the accessory genital glands constitute 60-90% of total volume of semen (Dukes, 2005). The morphology of these glands varies widely among different mammalian species (Thomson and Marker, 2006).

Many researchers have worked on the individual morphology of the accessory sex glands in mammals including one-humped camel (Aliet al., 1978), sheep and goat (Kundu, 1980; Nissar and Suri, 2012; Gofur, 2015). The enlarged end of the vas deferens near the urethra is the ampullae (Khalaf and Merhish, 2010). In sheep and goat, the ampullae is 6-8 cm in long and 4-8 mm in diameter (Getty, 1975) while Ali et al. (1978) reported an average of 18 cm in one-

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humped camel. The vesicular glands are paired, large, externally smooth, hollow and knobby (Dyce et al., 2010). The prostate gland is unpaired gland about the size of chestnut visible on the outside of the urethra just posterior to the excretory ducts of the vesicular gland (Dyce et al., 2010). Grossly, two portions of the prostate gland maybe distinguished: the compact of external portion (corpus prostate) and the disseminate or internal portion (el-Wishy et al., 1972 and Dyce et al., 2010). The body of the prostate in one-humped camel is oval or circular in shape while the disseminate part of the prostate surrounds the pelvic urethra, lies caudally to the body and extend to its end (el-Wishy et al., 1972).

In sheep and goat, only disseminated part of prostate gland surrounds the pelvic urethra which extends caudally along the pelvic urethra (Bearden and Funguay, 2000). The paired bulbourethral gland consists of right and left club-shaped independent lobes, which lies on the dorsal surface of the caudal part of pelvic urethra and closely related to the bulb of penis (Shively, 1982). Since there is paucity of information on the comparative morphology of accessory sex glands in these in One-humped Camel Bull (OCB), Uda Ram (UR) and Red Sokoto Buck (RSB), this research work was carried out with the aim of filling the lacuna.

MATERIALS AND METHODS

Fifteen accessory sex glands of healthy adult OCB, UR and RSB (five samples per species) were collected from Sokoto metropolitan abattoir. Sokoto metropolis is located on latitudes 10° N and 14° 50′ N and longitudes 7° E, east of the equator, in the extreme northwest of Nigeria (NPC, 2006). Following the collection, they were transported to veterinary anatomy laboratory, Usmanu Danfodiyo University, Nigeria, where gross features of the accessory sex glands were examined and recorded. They were then dissected out for measurements. The weights (g) and lengths (cm) were measured using a weighing balance (Shimadzu AW320, Germany), meter rule and thread respectively. Photographs were taken using digital camera (Samsung ES95, 16.2 megapixels).

RESULTS

Gross Morphology

Ampulla: The ampullae of the three species are shown on Figures 1, 2 and 3. The terminal wall of the vas deferens on reaching the bladder became thickened and folded to form a structure known as the ampulla**.** It was paired and elongated spindle-shaped in all the three studied species. Structurally, it was the most pronounced in the UR and the least in the OCB. The two ampullae attached to each other through genital fold connective tissues mostly in the UR, followed by OCB and then in the RSB. The broadness of the ampulla was also in that order. The ampullae narrowed and passed under the body of the prostate ventrally to empty into the colliculus seminalis after passing the dorsal wall of the pelvic urethra.

Seminal vesicles (vesicular glands): The seminal vesicles (vesicular glands) of the two species are shown on Figures 1, 2 and 3. The seminal vesicles (vesicular glands) were paired accessory sex glands located on the floor of the pelvis, lateral to the ampulla of vas deferens and the neck of the bladder. Each of the vesicles was connected with the pelvic urethra in the region of the bladder by means of a main excretory duct opening into the colliculus seminalis. They were well developed in both the UR and RSB but larger in the former and absent in the OCB. In these two species, seminal vesicles were markedly lobulated, dark-greyed in color and were the largest of the accessory glands. Though curved in both, they were however more pronounced in the UR in which each pair presented a lateral central depression. In the UR, the dorsal portions were oval in shape and extended laterally up to a reasonable distance of the distal portion of the ampullae while in the RSB, it was knobby in appearance and extended laterally just a short distance of the distal portion of the ampullae.

Prostate gland: The prostate glands of the three species are shown on Figures 1, 2 and 3. The prostate was a single, compound tuboalveolar gland. The gland consisted of only disseminate or scattered parts extending along the pelvic urethra in the UR and RSB. In the OCB, the prostate gland was the largest accessory sex gland. The gland consisted of a dorsal body and a ventral pars disseminate overlying the prostatic urethra. The body of prostate was entirely intra-pelvic, being situated on the dorsal aspect of the urethra and overhanging the neck of the urinary bladder. It was massive and discoid in shape, soft and greyish in color. The cranial two thirds were almost free, while the caudal third was fused with the prostatic urethra. The prostatic urethra was short (3-5 cm). The parenchyma of the body of prostate was observed to be gradually delineated by a thin band originating from the internal aspect of the urethral muscle, thus forming a disseminate portion confined mainly to the prostatic urethra. Caudally, it was continuous with the glandular pelvic urethra.

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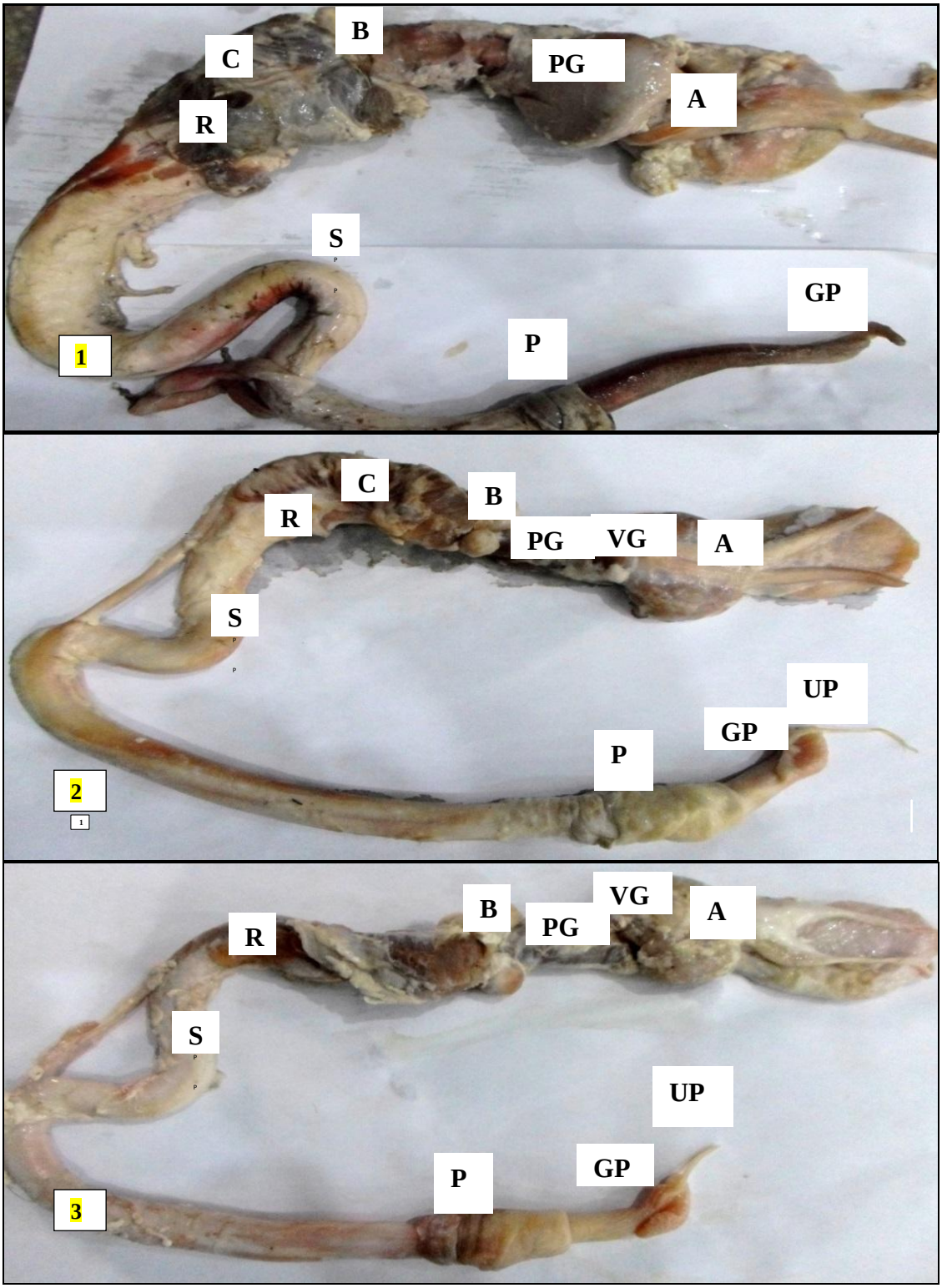
Bulbourethral (Cowper's) glands: The bulbourethral glands (Cowper's glands) of the three species are shown in Figures 1, 2 and 3. The bulbourethral (Cowper's) glands were paired glands located around the pelvic urethra near the ischial arch. In the OCB, they were found on the dorsolateral aspect of the pelvic urethra above the ischial arch with a thick interglandular septum between them and almond in shape. In the RSB, they were found in the same area as in the OCB, though with a relatively less space. In the RSB, they were oval in shape and pea in size. In the UR, the glands were found entirely on dorsal roof of the ischial arch with a very limited space between the pair. Although in all the three studied species, they were partially covered by the urethral and the bulbocavernosum muscles, they were more superficial in UR than in the remaining two species. The glands of all the studied species were covered externally by muscles and internally by a thick layer of dense tissue.



Figures 1, 2 and 3. Photographs of male reproductive tracts of One-Humped Camel Bull (1), Uda Ram (2) and Red sokoto Buck (3), showing ampullary gland (A), vesicular gland (VG), prostate gland (PG), bulbourethral gland (B), cavernosus muscle (C), root of the penis (R), sigmoid flexure (S), prepuce (P), glans penis (GP) and urethral process (UP)

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Gross morphometry

The results on gross morphometry are represented on Tables 1 and 2.

Ampulla: The results of the mean ampulla lengths of OCB, UR and RSB showed that the means were significantly different (P≤0.05). The mean ampulla length value of 19.40±0.74 cm in OCB was significantly (P≤0.05), the highest value in the three species, followed by that of UR (7.38±0.63 cm) and least in RSB (4.17±0.33 cm).

The results of the mean ampulla weights of OCB, UR and RSB showed that the means were significantly different (P≤0.05) from one another. The mean ampulla weights value of 10.92±0.12 g in OCB was significantly (P≤0.05), the highest value in the three species, followed by that of UR (4.35±0.33 g) and least in RSB (1.30±0.15 g).

Seminal vesicles (vesicular glands): The results indicated that there was a significant difference (P≤0.05) between the mean vesicular gland weights of these two species. The mean vesicular gland weight of UR (7.78 ± 0.97 g) was significantly (P≤0.05) higher than that of RSB (5.47 ± 0.58 g). There was no significant difference (P>0.05) between mean vesicular gland lengths of the two species.

Bulbourethral glands: The results of the mean lengths of bulbourethral gland showed that the means were significantly different (P≤0.05) in the three studied species. The mean length of bulbourethral gland in OCB (3.74±0.11 cm) was significantly (.05) higher than those of UR (2.00±0.18 cm) and RSB (1.50±0.29 cm). However, there was no significant (P>0.05) difference between the mean values of UR and that of RSB.

The results of the mean bulbourethral gland weights of OCB, UR and RSB showed that the means were significantly different (P≤0.05). The mean weight of bulbourethral gland of 7.58±0.41 g in OCB was significantly (P≤0.05) higher than those of UR (2.60±0.25 g) and RSB (2.40±0.21 g). However, there was no significant (P> 0.05) difference between the mean values of UR and that of RSB.

The results of the mean bulbourethral gland diameters of OCB, UR and RSB showed that the means were significantly different (P≤0.05). The mean bulbourethral gland diameter of 0.83±0.17 cm RSB was significantly lower compared to those of OCB (2.46±0.18 cm) and UR (2.58±0.22 cm). However, there was no significant (P> 0.05) difference between the mean values of OCB and that of UR.

Table 1. Mean weights and lengths of accessory sex glands of the One-humped Camel Bull, the Uda Ram and Red Sokoto Buck

Parameters	OCB	UR	RSB
Ampulla length (cm)	19.40±0.74[a]	7.38±0.63[b]	4.17±0.33[c]
Ampulla weight (g)	10.92±0.12[a]	4.35±0.33[b]	1.30±0.15[c]
Bulbourethral gland length (cm)	3.74±0.11[a]	2.00±0.18[b]	1.50±0.29[b]
Bulbourethral gland weight (g)	7.58±0.41[a]	2.60±0.25[b]	2.40±0.21[b]
Bulbourethral gland diameter (cm)	2.46±0.18[a]	2.58±0.22[a]	0.83±0.17[b]

[a, b, c] Mean ± SEM within the same row without the same superscript letters are significantly different (P≤0.05) from each other; OCB: One-humped Camel Bull, UR: Uda Ram and RSB: Red Sokoto Buck.

Table 2. Mean ± SEM weights and lengths of vesicular glands of the Uda Ram and the Red Sokoto Buck

Parameters	UR	RSB	P-value
Vesicular gland weight (g)	7.78 ± 0.97	5.47 ± 0.58	0.004[*]
Vesicular gland length (cm)	4.22 ± 0.49	3.33 ± 0.60	0.993[NS]

[NS] Not significant (P> 0.05), *Significant (P≤0.05).

DISCUSSION

The morphology of accessory sex glands as obtained in this study is in agreement with that of Ali et al. (1978) in one-humped camel and that of Khalaf and Merhish (2010) in small ruminants. The presence of the ampullae in OCB as found in this study agrees with the findings of Ali et al. (1978) who reported that the terminal end of vas deferens is markedly thickened to form an ampulla. The result is however contrary to the report of Mukasa-Mugerwa (1981) who said that there is no confirmation as to whether the dilation at the end of the vas deferens is in fact the ampulla or not.

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The result on the ampullae of UR and RSB that were found to be narrow and located ventrally under the body of the prostate, was in agreement with the report of Cunningham (2002) in small ruminants.

Absence of vesicular gland in OCB as found in this study was previously reported by Ali et al. (1978) in one-humped camel. The presence of paired vesicular glands in UR and RSB and their location on the floor of the pelvis, lateral to the ampulla of ductus deferens and the neck of the bladder agree with previous report of Bone (1988) in small ruminants. The anatomical description of the vesicular gland in this study is similar to what was described by Khalaf and Merhish (2010) in small ruminants. The prostate gland of OCB consisted of a dorsal body and a ventral pars disseminate overlying the prostatic urethra. The finding agrees with those reported by el-Wishy et al. (1972) in one-humped camel, who described a corpus prostate and pars disseminate. The finding of small pars disseminate in OCB in this study, agrees with the report of Ali et al. (1978) in one-humped camel. However, it differs from its homologue in the bull (Kainer et al., 1969), ram (Aitken, 1959) and boar (Aitken, 1960), where it extends along the entire length of the pelvic urethra and contains abundant mucous units. The prostate gland in bull, as described by Nickel et al. (1973) to be S-shaped, irregular and elongated in form, often bent on itself, differs from the results of this study in UR and RSB. The results obtained here also disagree with the report of McDonald (1980), who reported that the two lateral lobes of prostate in sheep are well developed and closely distributed along the pelvic urethra. However, the results obtained here, agree with the finding of Dyce et al. (2010) in small ruminants. This difference could be due to difference in species as well as breeds.

The bulbourethral glands were paired and located around the pelvic urethra near the ischial arch. Similar findings were reported in one-humped camel (Ali et al. 1978) and in sheep and goat (Nickel et al.1973; Getty, 1975). Contrary to the present findings of an almond-shaped bulbourethral gland in ram, Roberts (1971) reported that the bulbourethral gland is much larger and consists of two lobes that are cylindrical in sheep. In addition, Cunningham (2002) stated that the bulbourethral gland in bull and horse are enclosed in bulbospongiosum and it is spherical or ovoid in shape. This difference might be due species or breed variations.

The mean length of ampulla obtained in this study was 19.40±0.74 cm in OCB. This is higher than 18 cm previously reported by Ali et al. (1976) in one-humped camel. The mean length of ampulla in UR found in this study was 7.38±0.63 cm. This value is within the range of 6-8 cm previously reported in sheep and goat by Bone (1979). However, the mean length of ampulla in RSB reported in the present study was outside the range. It is however, close to the range of 4.87-4.98 cm earlier reported by Khalaf and Merhish (2010) in ram and buck. This difference might be due species or breed variations

The mean weight (2.40±0.21 g) of bulbourethral gland in RSB as obtained in this study is similar to the reports of Hemeida (1985) who reported a range weight of 2-2.5 g in Balady bucks. However, bulbourethral gland mean diameter of 0.83±0.17 cm obtained in the study differs from his report. This difference may be attributed to genotype.

CONCLUSION

The results showed that the studied animals exhibit some similarities and interesting morphological differences in gross morphology and gross morphometry of their accessory sex glands. The basic gross morphological and gross morphometrical studies done here, have established a comparative baseline data for the accessory sex glands in these animals. It is expected that the results will guide further researchers on the accessory sex glands of these domestic animals.

Competing interests

The authors declare that there are not significant personnel, professional or financial competing interest that might have influenced the presentation of the results of the study described in this manuscript.

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