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Ultrasonographic Measurements of Reproductive Organs of Male Goat during Non-breeding Season

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Abstract:
The aim of the present study was to visualize the testes and the accessory sex glands in male goat during non-breeding season with ultrasonography. A clinically healthy eight adult Egyptian male Baladi goats were used in a study to compare ultrasonographic measurements of reproductive organs. A scanning technique done in standing position using rectal probe for imaging scrotal contents and imaging pelvic accessory sex glands and the measurements were recorded. The mean scrotum circumference was 25.75 ± 0.55cm and the morphometric measurements of the right and left testis length were (9.50 ± 0.32cm and 9.75 ± 0.25cm respectively. Ultrasonographic imagings of testes were appeared as homogeneous with a coarse medium echo-pattern testicular parenchyma ranging from low to moderate echogenicity. The tail of the epididymis was appeared as globular, heterogeneous, less echogenic than testis with some white streaks in center. Ampulla appeared as hypo-echogenic to non-echogenic texture. Vesicular glands appeared as a heterogeneous hypo-echogenic structure. The pars disseminata of prostate gland was not well developed in bucks. Bulbourethral glands were easily identified in all bucks and appeared with variable echogenicity from hypo-echogenic to moderate echogenicity. It was concluded that ultrasonography provides a benefits in studying the changes in echogenicity and measurements of the testes and accessory sex glands of male goat and obtained data could provide a useful tool for predicting male goat fertility.

Keywords: Bucks, Ultrasound, Testis, accessory sex glands, Non-breeding season.

INTRODUCTION

Ultrasonography has become efficient diagnostic tool in small ruminants veterinary practice especially male reproduction (Gouletsou and Fthenakis, 2010; Gouletsou *et al*., 2004; Lacasta *et al*., 2009). The ultrasonographic appearance of buck testes have been done by (Ahmad and Noakes, 1995; Ahmad *et al*., 1991; Eilts *et al.,* 1989; Jeyakumar *et al.,* 2013), ram (Gouletsou and Fthenakis, 2010; Gouletsou *et al.,* 2003; Andrade *et al.,* 2014). The main functions of ultrasound were to evaluate anatomical structures and determine the echogenicity of testicular parenchyma (TP) and mediastinum (Chandolia *et al.,* 1997; Clark *et al.,* 2003) or monitoring progressive changes that occur in testis at different stages of maturation (Ahmad and Noakes, 1995). There is little information about the evaluation of accessory sex glands and appearance of buck testis using ultrasonography and most of the work has been done in ram and other species (Kumari *et al.,* 2015). Recently, ultrasonography can be used in comparison of actual testicular volume in bucks (Samir *et al.,* 2015). Buck has three accessory sex glands the seminal vesicles, pars disseminata of prostate and bulbourethral glands. Disorders of accessory sex glands are of diagnostic importance but till now few reports have been done in bucks by ultrasonography (Kumari *et al.,* 2016). Accessory sex glands receive very little attention during routine breeding soundness evaluation (BSE) of livestock species (Gouletsou and Fthenakis, 2010). The vitality of male accessory sex glands is essential for effective male reproduction (Emam, 2016). Therefore, the aim of this study was to characterize the size and sonographic features of the ampullae of the ductus deference, seminal vesicles, prostate, bulbourethral glands and evaluation of the scrotum and its contents in bucks during non-breeding season using linear probe and provide a basic data help in diagnosis any affection with ultrasound.

MATERIALS AND METHODS

Animals

The present study was carried out on a total number of eight adult bucks (Baladi goat) belonged to educational farm, faculty of veterinary medicine, Sadat City university. Bucks were aged between 2 - 2.5 years and averaging (40-50) kg body weight during the period from (April to May, 2017). All bucks were apparently normal, housed in free stall barn and fed a balanced ration (14% crude protein, 15% crude fiber, 9% ash and 2% fat), as well as free access of the drinking water and green fodders (Alfalfa).

Testis measurement

Scrotal circumference was measured by measuring steel tape (Ahmed and Noakes, 1995). Testis length was measured from top of the tail to the head of the epididymis for each testis using a pair of metal calipers (Islam and Land, 1977).

Ultrasonographic examination of the scrotal and its content

An ultrasound examination of bucks was done by means of 5 -7.5 MHz linear probe of Scanner (Sonoscape- A5V, China) per cutaneous to investigate the testis and epididymis following previously described method (Gouletsou *et al.,* 2003). The animal was restrained and the testes should be pulled downwards within the scrotum. The examiner's left hand was placed on the surface opposite to the one where the transducer with coupling gel was applied upon, in order to stabilize the organs. The transducer was placed on the caudal surface of the testis along its longitudinal axis (sagittal plane) and moved from right to left. The transducer was moved upwards to image the head of the epididymis and the pampiniform plexus and then the transducer moved downwards to image the tail of epididymis. The procedure was repeated for the other testis.

Ultrasonographic examination of the accessory genital glands

The ultrasonography of accessory sex glands was done in standing position using rectal probe. The transducer was fitted in a self-manufactured connector to favor its manipulation per rectum .The ultrasound transducer was lubricated with coupling gel then placed in the rectum and was moved over the dorsal surface of the pelvic urethra and accessory sex glands (ampulla, vesicular glands, pars disseminate of prostate gland, bulbo-urethral glands). The accessory genital gland echogenicity were evaluated and the dimensions were measured.

Statistical analysis

Data are presented as means±standard errors of means (SEM). Statistical analysis was performed using (GraphPad prism 5 software Inc., La Jolla, CA).

RESULTS

The external genitalia and scrotum were normal and no abnormalities were recorded. The testes were firm on palpation with homogeneous consistency and freely movable in the scrotum. The epididymal tail and spermatic cord were normally palpated. The mean scrotum circumference was 25.75 ± 0.55cm and the morphometric measurements of the right and left testis length were 9.50 ± 0.32cm and 9.75 ± 0.25cm respectively. Ultrasonographic measurement of scrotum and its contents and accessory sex glands as presented in the (Table 1).

Table 1. Ultrasonographic measurements (mm) of the (testes, epididymal tail, spermatic cord), accessory genital glands (Ampulla, vesicular, Pars disseminata of prostate, bulbourethral glands) and scrotum circumference (cm) in bucks (mean ±SEM).

Ultrasonographic Measurements of scrotal contents (mm)		Mean ± Std. Error	Ultrasonographic Measurements of accessory sex glands (mm)		Mean ± Std. Error
Testes	Length right	35.52 ± 1.17	Ampulla	Diameter right	5.1 ± 0.32
	Breadth right	41.17 ± 1.13		Diameter left	5.05 ± 0.33
	Length left	39.50 ± 1.2			
	Breadth left	38.90 ± 1.0			
Tail of epididymis	Length right	22.10 ± 1.29	Vesicular gland	Length right	25.07 ± 1.15
	Breadth right	17.20 ± 0.64		Diameter right	10.40 ± 0.30
	Length left	22.96 ± 1.64		Length left	22.62 ± 1.28
	Breadth left	16.40 ± 0.39		Diameter left	10.10 ± 0.64
Spermatic cord	Breadth right	18.35 ± 0.95	P.disseminata	Diameter	14.10 ± 0.39
	Breadth left	18.55 ± 0.78			
Scrotum circumference (cm)		25.75 ± 0.55	Bulbourethral gland	Length right	13.30 ± 0.25
				Diameter right	12.07 ± 0.56
				Length left	14.02 ± 0.61
				Diameter left	11.92 ± 0.47

Echogenicity of the scrotum and its content

Ultrasonographic imaging of the scrotum revealed that testes appeared as homogeneous with a coarse medium echo-pattern testicular parenchyma ranging from low to moderate echogenicity (Figure1). The mediastinum testis appeared as a centrally located white hyperechoic line of variable thickness in longitudinal section and it was visualized in all bucks (Figure 2).The testes surrounded by a distinct white hyperechoic tunic line encircling the testicular parenchyma. Scrotal septum appeared between testes as a hyperechoic linear thick band. Testicular tunics were identified close to the scrotum. During whole study, some unilateral white testicular spots or foci were found on the testis parenchyma in two bucks (2/8) (Figure 3).

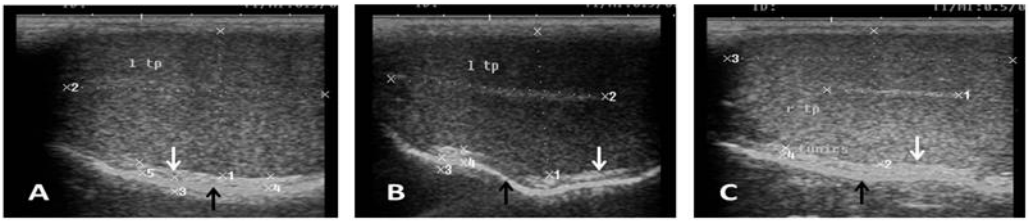

Fig.1. Ultrasound image of testes: Note the difference in echogenicity of testicular parenchyma from echogenic (A), (C) to hypo-echogenic texture (B). Scrotal tunics have echogenic white color in ventral part of image (black arrow).Tunica albuginea of testicular parenchyma (white arrow).

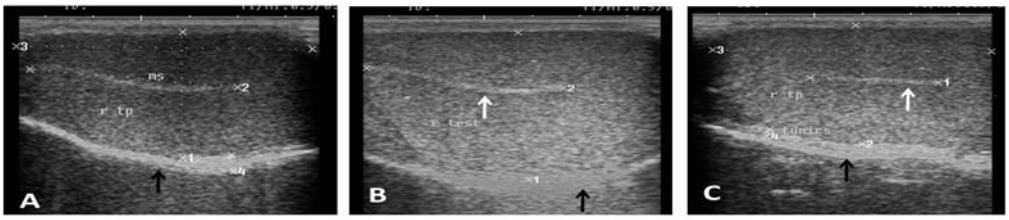

Fig.2. Ultrasound image of testes: Note the difference in length and thickness of mediastinum testes (white arrow). Scrotal tunics appear more echogenic white color (black arrow).

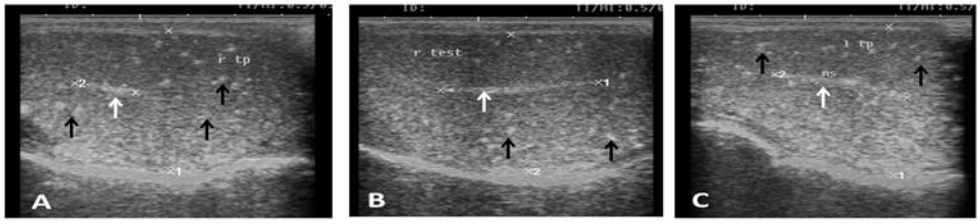

Fig.3. Ultrasound image of testes: Note the white spot present in the testicular parenchyma (black arrow) and mediastinum testes (white arrow).

The tail of the epididymis was easily identified at the distal end of the testis and appeared as globular, heterogeneous, less echogenic than testis with some white streaks in

the center (Figure 4). The epididymal body was difficult to identify in live bucks on medio-lateral aspect but can be identify in the distal part near the tail with increase its lumen (Figure 5). The epididymal head was partially or hardly imaged and appeared to be similar or slightly increased echogenicity as compared to the normal testis (Figure 6).

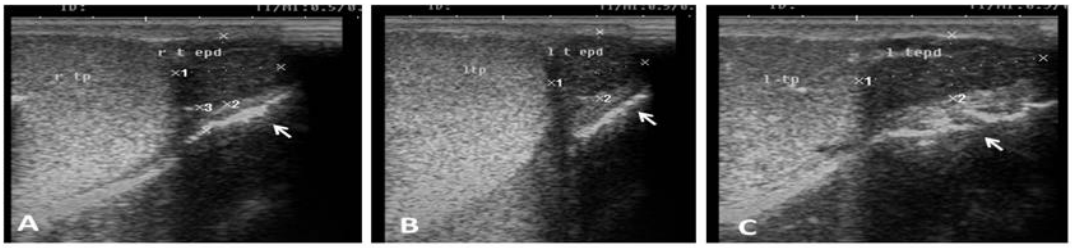

Fig. 4. Ultrasound image of epididymal tail: Note the hypo-echogenic texture of epididymal tail than the testicular parenchyma (white arrow).

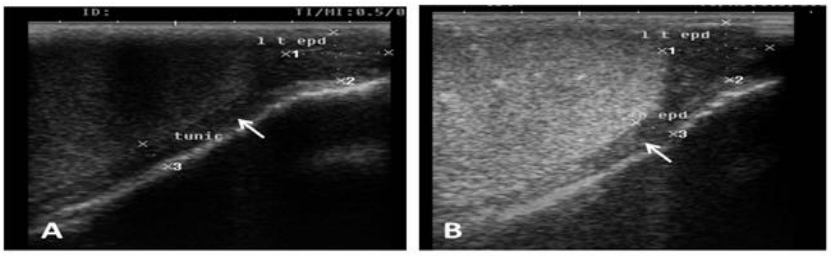

Fig. 5. Ultrasound image of epididymal body: (A) epididymal body characterized with hypo-echogenic texture than testicular parenchyma (B) epididymal body near the tail characterized with increase in lumen and its echogenicity similar to texture of epididymal tail.

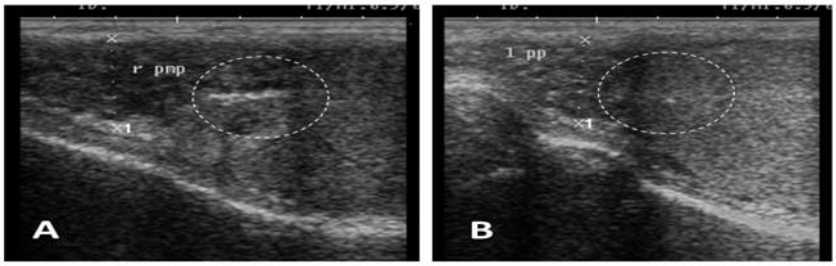

Fig. 6. Ultrasound image of epididymal head: Note the head of the epididymis have echogenic texture (A) and can be hardly to visualized (B).

The vascular pampiniform plexus was easily identified on the proximal end of the testis as a hypoechoic linear structure. It contained numerous convoluted sonolucent tubular structures representing small spermatic vessels and surrounded by a distinct white hyperechoic tunic line of the scrotum (Figure 7).

Echogenicity of the accessory sex glands

Ampulla appeared as two dorsal lines on the neck of the bladder with hypo-echogenic to

non-echogenic texture surrounded by a uniformly echogenic line (Figure 8). Vesicular glands appeared as a heterogeneous hypo-echogenic structure with irregular outline and circumscribed with echogenic line near the non-echogenic black urinary bladder (Figure 9).

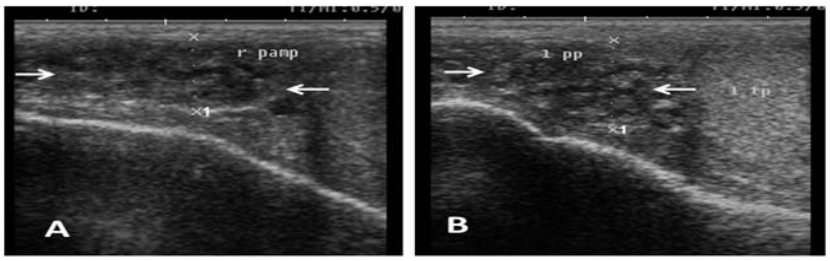

Fig. 7. Ultrasound image of pampiniform plexus: (A) right pampiniform plexus (B) left pampiniform plexus show small non -echogenic network.

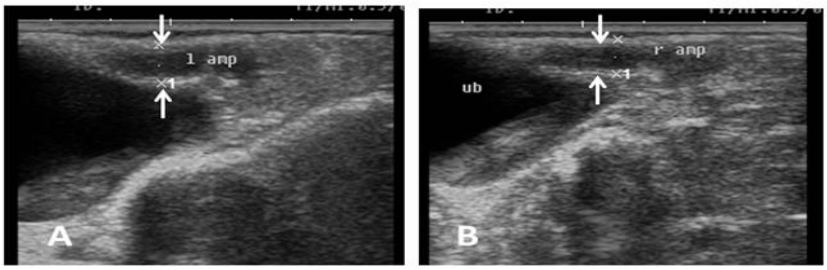

Fig. 8. Ultrasound image of ampulla: (A) right ampulla (B) left ampulla. Note the echogenicity of ampulla varies from hypo-echogenic to non-echoic texture also urinary bladder appear black clear non-echogenic texture.

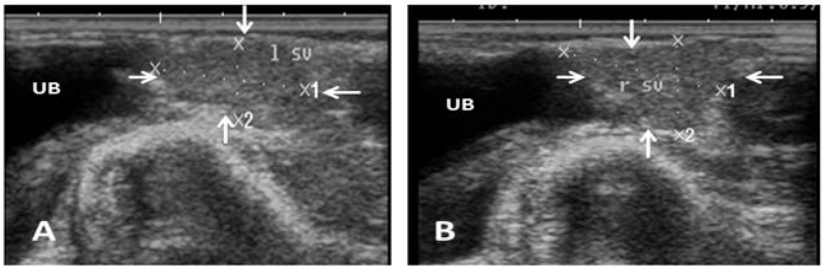

Fig. 9. Ultrasound image of vesicular gland: (A, B) note the low hypo-echogenic circumscribed seminal gland and differ from black non-echoic urinary bladder.

The pars disseminata of prostate gland was not well developed in bucks and appeared as a hyper-echogenic area between the non-echogenic urethral lumen and less echogenic urethral muscle of the pelvic urethra and it can be appear in longitudinal and cross section (Figure 10). The bulbourethral glands were easily identified in all bucks just lateral to the caudal part of pelvic urethra and can be palpated as nut after introducing finger in the rectum. The parenchyma appeared with variable echogenicity from hypo-echogenic to moderate echogenicity (Figure 11).The lumen of pelvic urethra appeared easily in all bucks as non-

echogenic tube in the middle surrounding by moderately hypo-echogenic urethral muscle. It appeared circular in cross section and straight long tube in longitudinal section (Figure 12).

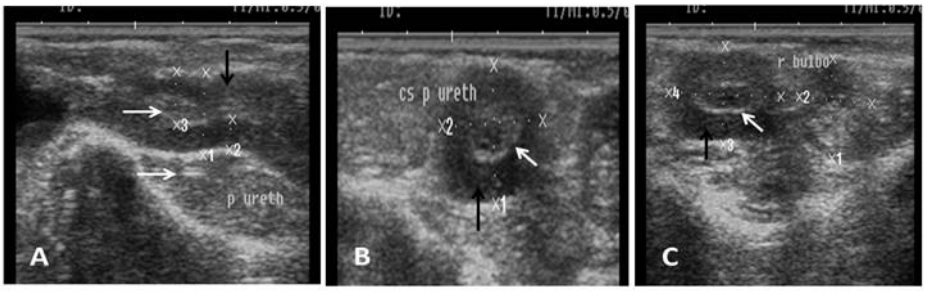

Fig. 10. Ultrasound image prostate gland (P.disseminata): (A) longitudinal section pelvic urethra show the hypo-echogenic pars disseminata of prostate gland (white arrow) (B), (C) cross section P.urethra show white pars disseminata (white arrow) circumscribed by urethral muscle (black arrow).

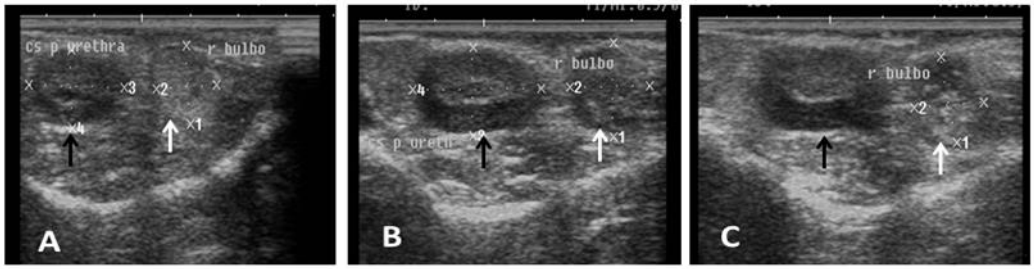

Fig. 11. Ultrasound image of bulbourethral gland: (A) echogenic texture (white arrow) (B, C) hypo-echogenic texture (white arrow) and cross section pelvic urethra (black arrow).

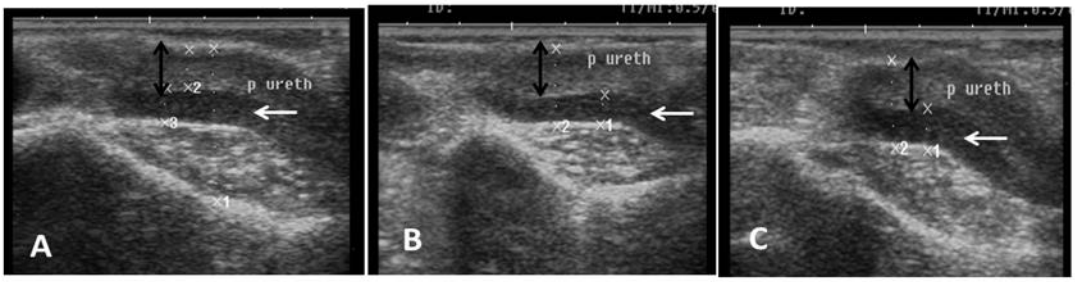

Fig.12. Ultrasound image of pelvic urethra: longitudinal section characterized by non-echoic black lumen (white arrow) surrounded by hypo-echogenic urethral muscle (black arrow) and distal to it present highly echogenic white floor of pelvic bone.

DISCUSSION

Clinical examination of the buck genitalia was very important for reproductive health and breeding soundness as in rams (Gouletsou and Fthenakis, 2010). These data provides guidelines for ultrasonography and size measures of testes and accessory genital glands in the non-breeding season in bucks and can predict the future reproductive performance of

bucks. In addition, a linear probe was found to be very effective methodology to evaluate the normal ultrasonographic features of buck testis.

In the present study the mean scrotum circumference was (25.75 ± 0.55 cm) and the morphometric measurements of the right and left testis length were 9.50 ± 0.32cm and 9.75 ± 0.25cm respectively. The sonographic characteristic of the goat testis was similar to that described by (Ahmad *et al.,* 1991) for sheep and goats (Cartee *et al.,* 1986). The testis appeared as homogeneous with a coarse medium echo-pattern testicular parenchyma ranging from low to moderate echogenicity. The mediastinum testis appeared as a centrally located white hyperechoic line of variable thickness in longitudinal section and it was visualized in all bucks (8/8). Similar results obtained by (Ahmad *et al.,* 1991; Gouletsou *et al.,* 2003; Andrade Moura *et al*., 2008; Jeyakumar *et al.,* 2013; Raji *et al.,* 2016). The testicular parenchyma (TP) appeared anechoic at first month of age and then moderately echogenic as development occurred with advancement of age (Andrade *et al.,* 2014; Kumari *et al.,* 2015). Ultrasound examination may also be useful in monitoring the progressive changes that occur in the testes (Ahmad and Noakes, 1995).

Ultrasonographic observations of fibrotic foci representing testicular degeneration has been described in goats (Eilts *et al.,* 1989). In the present study some unilateral testicular white spots or foci were found on testis parenchyma in two bucks and this may be slight degeneration with fibrosis. Similar results obtained by (Ahmad and Noakes, 1995; Gouletsou *et al.,* 2006) the testicular parenchyma appears echogenic due to seminiferous tubule degeneration and mineralization. Also, some focal areas with white spots indicating chronic inflammation with calcification (Blaivas, 2003; Blaivas *et al.,* 2001; Blaivas and Sierzenski, 2001; Blaivas, 2000). Elits and Pechman (1988) reported that focal lesions observed in the testicular parenchyma of bulls during ultrasonography were not always associated with decreased sperm quality. The epididymal tail was appeared as globular, heterogeneous, less echogenic than testis with some white streaks in center. Similar results obtained by (Ahmad *et al.,* 1991; Gouletsou *et al.,* 2003; Jeyakumar *et al.,* 2013).

The epididymal head was partially or hardly imaged and appeared to be similar or slightly increased echogenicity. The epididymal body was difficult to identify in live bucks. Normally the epididymis is closely applied to the caudo- medial aspect of the testis slightly lateral to its mid- sagittal plane (Pechman and Eilts, 1987). While (Pugh *et al.,* 1990) reported that the inability to image the epididymal body was probably due to the intra-scrotal mobility of the testis and epididymis. The vascular pampiniform plexus was appeared as a hypoechoic linear structure that contained numerous convoluted sonolucent tubular structures representing small spermatic vessels. Similar results obtained by (Ahmad *et al.,* 1991; Gouletsou *et al.,* 2003; Jeyakumar *et al.,* 2013).

The available basic data on the ultrasonographic developmental characteristics of accessory sex glands in male goats was very scanty (Kumari *et al.,* 2016). In the present study ampulla appeared as hypo-echogenic to non-echogenic texture surrounded by a uniformly echogenic line. Vesicular glands appeared as a heterogeneous hypo-echogenic structure with irregular outline and circumscribed with echogenic line. While, Kumari et al. (2016) visualized as an anechoic lobulated and irregular gland at 2 weeks of age and as age advanced the echogenicity increased. Left and right seminal vesicles were almost of equal circumference as reported by (Khalaf and Merhish, 2010). Jucá *et al.* (2009) reported that echogenicity of the bulbourethral glands and the vesicular glands in pre-ejaculate as low-intensity hypoechoic. Chandolia et al. (1997) active phase of glands were anechoic due to fluid accumulation and echogenicity increased with advancement of age. In the present study pars disseminata of prostate gland was not well

developed in bucks and appeared as a hyper-echogenic area on each sides of non-echogenic urethral lumen. Similar results obtained by (Kumari *et al.,* 2016) the width of both lobes increased gradually with age. The change in gland was affected by testosterone concentration (Chandolia *et al.,* 1997).

The bulbourethral gland appeared with variable echogenicity from hypo-echogenic to moderate echogenicity. Similar results obtained by (Kumari *et al.,* 2016) the gland is closely related to the root of penis and was oval in shape and pea-sized. The left and right bulbourethral gland circumference dimensions were 10.93±0.38 and 10.85±0.37 mm. However few developing studies involving ultrasound biometry of the bulbourethral glands in Santa Ines sheep (Ribeiro *et al.,* 2017).Also, the high correlations between echogenicity of accessory glands and weight, testicular biometry and the ultrasonographic biometry suggested that heavier animals tend to have larger testes, larger glands, and consequently, greater echogenicity (Ribeiro *et al.,* 2017).The Pelvic urethra appeared easily in all bucks as non-echogenic lumen in the middle surrounding by moderately echogenic urethral muscle. Similar results obtained by (Abdel-Razek and Ali, 2005) after ultrasound rectal examination of six Frisian bulls.

CONCLUSION

Taken together, our results clearly demonstrated that the reproductive ultrasound examination of testes and accessory sex glands is important tool for evaluating physio-pathologic condition during non-breeding season which can be aid in selection of male goat in breeding soundness program. Moreover provide a basic data for measurements of reproductive organs of male Baladi Egyptian goat by ultrasound.

ACKNOWLEDGEMENTS

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CONFLICT OF INTEREST

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