Turkish Journal of Agriculture - Food Science and Technology, 4(5): 374-377, 2016

Turkish Journal of Agriculture - Food Science and Technology

www.agrifoodscience.com,
Turkish Science and Technology

Morphology of the Testis and Epididymis of Large White Boars

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A R T I C L E I N F O

Article history:
Received 19 December 2015
Accepted 31 January 2016
Available online, ISSN: 2148-127X

Keywords:
Anatomy
Testis
Epidydymis
Parameters
Pigs

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A B S T R A C T

The testis and epididymis of twenty five adult Large White boars were used to investigate the biometric and histomorphometric parameters of the testis and epididymis of the boars. The aim of the study was to provide information which could be useful in the comparative regional anatomy of the male reproductive organs of domestic animals and thus an improved assessment of breeding soundness and fertility potential in boars. The average weight of the animals was 71.3 ± 10.7 kg. The average weights of the right and left testes were 170 ± 0.7.60 g and 179±6.48g, respectively with no significant difference. The average weights of the right and left epididymis were 40.9 ± 6.81 g and 43.7 ± 8.55 g, respectively, with no significant difference. The relative testicular and epididymal weights were 0.49% and 0.12%, respectively. This study shows that the testis is about four times the size of the epididymis. The ductal diameter of the head, body and tail of the epididymis were 418 ± 22.6 µm, 432 ± 20.3 µm and 939 ± 50.6 µm, respectively. The mean relative volume of the germinal epithelium, interstitium and lumen of the seminiferous tubules of the boars rats were 68.4 ± 3.46%, 5.5 ± 0.66% and 78.0 ± 4.81%, respectively. It can be concluded that the morphology of the testis and epididymis of the Large White boar are similar to those of most mammals. This work provides information the testis and epididymis of the Large White boar which could be useful in the comparative regional anatomy of the male reproductive organs of domestic animals and thus an improved assessment of breeding soundness and fertility potential in boars.

Introduction

The Large White breed of pig was developed in England in the late 1700s and has been rated as the leading breed of pigs in the world as Yorkshires in the USA and Canada are direct descendants of the Large White (Taylor et al., 2005). They have white skin (usually free from black hair), longer legs than other breeds and moderately long heads with the face slightly dished, and the ears are pricked (Bunter and Bennett, 2004). The knowledge of the basic morphometry of reproductive organs is a vital tool in the assessment of breeding soundness and fertility potential in domestic animals (Togun, 2006). Morphology and morphometry are important tools in anatomical researches being the pivots of clinical practice in mammals (Kolodzieyski and Danko, 1995; Olukole et al., 2009).

A number of morphometric studies on the male reproductive organs of wild and domestic animals had been reported in Nigeria: the accessory reproductive glands of the male African giant rat (Oke et al., 1988); the ultrastucture of the epididymis of the African giant rat (Oke et al., 1989) sperm anatomy of the grasscutter (Olukole et al., 2008); biometrical observations on the testis and epididymis in the domesticated African greater cane rat (Olukole et al., 2009); gross morphometry and histology of the male accessory sex glands in the greater cane rat (Adebayo et al., 2009) and gross anatomy of male reproductive organs of the domesticated grasscutter (Olukole et al., 2010). Recent research reports on the reproductive biology of pigs include: reproductive performance of Polish Large White sows in intensive production (Schwarz et al., 2009); semen characters in reproductive artificial insemination boars (Kmiec et al., 2006); relationships among measures of testicular development and endocrine function in boars (Schinkel et al., 1984) and wild boars (*Sus scrofa scrof*a) seminiferous tubules morphometry (Costa and Silva, 2006).

However, there is a dearth of research information on the gross and histomorphometry of the testis and epididymis of domestic boars. This study was therefore designed to investigate the gross and histomorphometric parameters of the testis and epididymis of the Large White boar with the aim of providing information which could be useful in the comparative regional anatomy of the male reproductive organs of domestic animals and thus an improved assessment of breeding soundness and fertility potential in boars.

Materials and Methods

The reproductive organs of twenty five adult Large White boars retrieved at necropsy from the University of Ibadan Slaughter House were used for the study. The boars were examined and found to be clinically healthy,

weighed using a Microvar® weighing balance before being stunned, and before being slaughtered.

The right and left testes and epididymides were then dissected out quickly and placed in Petri dishes containing normal saline prior to morphometric investigations. The weight of the testes and epididymides were determined using the Digital Microvar® weighing balance, while metric investigations were made using a venier caliper. The epididymides were carefully dissected out and separated into the caput, corpus and cauda regions on the basis of morphology. A total of 20 biometrical parameters of the testis and epididymis, were carried out following the procedure reported by Olukole et al., 2009.

Histological and Histomorphometrical Procedures

The samples from the testis and epididymis were fixed in Bouin's fluid and embedded in paraffin blocks. Sections of 10 µm thick were stained with Haematoxylin and Eosin (Olukole et al., 2014). The slides of testes and epididymis were studied under the light microscope. The slides were examined under the microscope and the following measurements were taken: the relative volume of the germinal epithelium, interstitium and lumen of the seminiferous tubules, the seminiferous tubular diameter, epididymal tubular diameter, epididymal luminal diameter and epididymal epithelial height. For each parameter, ten measurements were made per section using a calibrated eye-piece micrometer (Graticules Ltd. Toubridge Kent).

Statistical Analysis

All data obtained were expressed as means with the standard errors. Analysis of variance was performed using the One-way ANOVA. Means were reported to be statistically significant at $P<0.05$ while correlation between the weight of the animals with testicular and epididymal parameters were determined using the GraphPad Prism version 4.00 for Windows, GraphPad Software.

Results

In all the boars studied, the scrotum was not pendulous but remained rather close to the body wall. Also, the testes were connected to the internal components of the male reproductive system by the spermatic cord which passed through a small opening of the abdominal wall of the animal, the inguinal canal. The average weight of the animals used in the study was 71.3 ± 10.7 kg (Table 1). The average weights of the right and left testes were 170 ± 0.7.60 g and 179±6.48g, respectively with no significant difference ($P>0.05$). The average weights of the right and left epididymis were 40.9 ± 6.81 g and 43.7 ± 8.55 g, respectively, with no significant difference ($P>0.05$). The average percentage body weights for the testes and epididymis were 0.49% and 0.12%, respectively. There was a strong positive correlation ($r = 0.721$) between the body weights of the boars and the weights of the testis and epididymis. There was also a strong positive correlation ($r = 0.812$) between testicular and epididymal weights. There was no significant difference ($P>0.05$) between the right and left testicular and epididymal parameters (Tables 1 and 2).

The mean values of ductal diameter, lumen diameter and epithelial height of the different segments of the epididymis of the boars used in this study are given in table 3. Ductal diameter, luminal diameter and epithelial height all differed significantly ($P<0.05$) between the head and tail of the epididymis (Table 3).The ductal diameter of the head, body and tail of the epididymis were 418 ± 22.6 µm, 432 ± 20.3 µm and 939 ± 50.6 µm, respectively. The luminal diameter across the three segments of the epididymis followed a similar pattern with that of the ductal diameter being 275 ± 13.8 µm, 299 ± 19.5 µm and 657 ± 29.3 µm, respectively for the head, body and tail of epididymis (Table 3).

Table 1 Mean and SEM values of the left and right epididymal parameters of the Large White boar (n = 25).

Parameters	Right	Left
WOA (Kg)	71.3 ± 10.70	71.3 ± 10.70
WOE (g)	40.9 ± 6.81	43.7 ± 8.55
WHE (g)	11.1 ± 2.96	12.4 ± 1.97
WBE (g)	10.9 ± 2.08	13.3 ± 2.89
WTE (g)	17.7 ± 3.95	17.5 ± 3.74
LOE (g)	18.0 ± 1.98	17.6 ± 1.76
LHE (cm)	4.27 ± 0.12	3.8 ± 0.68
LBE (cm)	10.2 ± 1.50	9.8 ± 0.58
LTE (cm)	4.8 ± 0.20	3.9 ± 0.79
BHE (cm)	3.2 ± 0.73	2.5 ± 0.47
BBE (cm)	1.9 ± 0.23	1.80 ± 0.20
BTE (cm)	3.5 ± 0.21	3.57 ± 0.13

WOA: Weight of Animal; WOE: Weight of Epididymis; LOE: Length of Epididymis; WHE: Weight of Head of Epididymis; WBE: Weight of Body of Epididymis; WTE: Weight of Tail of Epididymis; LHE: Length of Head of Epididymis; LBE: Length of Body of Epididymis; LTE: Length of Tail of Epididymis; BHE: Breadth of Head of Epididymis; BBE: Breadth of Body of Epididymis; BTE: Breadth of Tail of Epididymis.

Table 2 Mean and SEM values of the left and right testicular parameters of the Large White boar (n = 25).

Parameters	Mean ± SME
WOA (Kg)	71.3 ± 10.70
WRT (g)	170 ± 7.60
WLT (g)	179 ± 6.48
LRT (cm)	9.7 ± 0.52
LLT (cm)	10.8 ± 0.73
BRT (cm)	7.0 ± 0.76
BLT (cm)	7.13 ± 0.64
CRT (cm)	16.5 ± 0.09
CLT (cm)	17.4 ± 0.35

WOA: Weight of animal; WRT: Weight of right testis; WLT: Weight of left testis; LRT: Length of right testis; LLT: Length of left testis; BRT: Breadth of right testis; BLT: Breadth of left testis; CRT: Circumference of right testis; CLT: Circumference of left testis.

Table 3 Mean and SEM values of epididymal histomorphometric parameters of the Large White boar (n=25)

Parameter (µm)	Head	Body	Tail
Ductal Diameter	418 ± 22.6^{a}	432 ± 20.3^{a}	939 ± 50.6^{b}
Luminal Diameter	275 ± 13.8^{a}	299 ± 19.5^{a}	657 ± 29.3^{b}
Epithelial Height	104 ± 5.5^{a}	77.7 ± 5.4^{b}	71.9 ± 2.3^{b}

Means with different superscripts within rows are significantly different ($P<0.05$).

For testicular hismorphometric parameters, the mean relative volume of the germinal epithelium, interstitium and lumen of the seminiferous tubules of the cane rats were 68.4 ± 3.46%, 5.5 ± 0.66% and 78.0 ± 4.81%, respectively (Table 4).The mean diameter of the seminiferous tubules was 227.4 ± 9.06 µm (Table 4). The testicular germinal epithelium was negatively correlated with the testicular interstitium (r = -0.36) while it was positively correlated with the lumen and diameter of seminiferous tubules (r = 0.38 and 0.54), respectively. There was a high negative correlation (r = -0.72) between the ductal diameter of the head and tail of epididymis. Also, the epithelial height and luminal diameter of the tail of the epididymis were negatively correlated (r = -0.30).

Table 4 Mean and SEM values of testicular histomorphometric parameters of the Large White boar (n=25)

Germinal Epithelium (%)	68.40 ± 3.46
Interstitium (%)	5.50 ± 0.66
Lumen (%)	78.0 ± 4.81
Diameter of Seminiferous Tubules (µm)	227.4 ± 9.06

Discussion

The anatomical relations of the reproductive organs of the boars used for the study correspond to previous report on porcine anatomy (Cartee et al., 1985; Dzuik, 1991; Dyce et al., 2002). Mature spermatozoa were found more in the cauda epididymis than in the corpus epididymis but rarely in the caput epididymis. These are in conformity with earlier reports on the histology of the epididymis of mammals (Oke, 1982). The 0.49% relative testicular weight obtained for the boars in this study is higher than those of the wild boar (*Sus scrofa scrofa*), with a mean relative testicular weight of 0.08% and the 0.04% reported in the White Fulani bull (Costa and Silva, 2006; Oyeyemi and Babalola, 2006). Nevertheless, the relative testicular weight obtained in the study is lower than those of the dog, rat, the Nigerian cock and Leghorn Cock to be 0.05-0.75%, 0.83%, 0.8% and 0.6% respectively (Cavaszos et al., 1954; Frandson, 1974; Aire, 2000).

The absence of significant differences in the right and left epididymal parameters of the boars used in this study is consistent with the findings of Rind et al. (2006) on bovine epididymis and those of Olukole et al. (2009) on the epididymis of the domesticated grasscutter. The relative epididymal weight observed for the animals in this study shows that the testis is about four times the size of the epididymis. The significant differences observed for the ductal diameter, luminal diameter and epithelial height between the heads and tails of epididymis are in conformity with the findings of Olukole and Obayemi (2010). The negative correlation (r = -0.30) between the diameter of the tubule of the epididymis and its epithelial height means that with an increase in epithelial height, the tubular diameter decreases. Spermatozoa are transported through the head and body of the epididymis by continuous peristaltic contractions originated in the smooth muscles present in the wall of the duct, whereas the tail of the epididymis is maintained quiescent unless it can be stimulated to contract. The tail of the epididymis is the main region responsible for sperm storage and survival (Jones and Murdoch, 1996). Mature spermatozoa had been reported to be more in the cauda epididymis than in the corpus epididymis but rarely in the caput epididymis in mammals (Dyce et al., 2002; Olukole and Obayemi, 2010).

The percentage volume of the testicular germinal epithelium, interstitium, lumen and diameter of the seminiferous tubules are similar to those reported in other mammals. The percentage volume of the testicular germinal epithelium, insterstitium and lumen had been reported to constitute 77.6%, 12.3% and 10.0%, respectively of rabbit testes (Toman and Massanyi, 1997). Relative volume of these structures in the testes of the fallow–deer had been reported as 76.2%, 12.4% and 11.5%, respectively for the germinal epithelium, interstitium and lumen (Massanyi et al., 1999). In the testes of the fox, germinal epithelium forms 52.7%, interstitium 11.3% and lumen 36.0% (Massanyi et al., 1997).

It can be deduced from the findings of this work that the diameter of the seminiferous tubules, relative of the lumen and germinal epithelium of the testes, epididymal ductal diameter, lumen diameter and epithelial height are similar in most mammals. The outcome of this work, therefore, provides information on the gross and histomorphometric parameters of the testis and epididymis of the Large White boar which could be useful in the comparative regional anatomy of the male reproductive organs of domestic animals and thus an improved assessment of breeding soundness and fertility potential in boars.

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