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https://dx.doi.org/10.4314/nvj.v39i2.3 **ORIGINAL ARTICLE**

# Relationship between Testicular and Epididymal Biometry Compared to Semen Quality in Yankasa Rams

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## SUMMARY

This study examined the relationship between the testicular and epididymal biometry compare to semen characteristics in Yankasa rams. Fifteen apparently healthy rams aged between 1-2 years with average weight of 20 kg were used for the study. They were acclimated for four weeks, screened and treated against endo and ecto parasite. They were kept in small ruminant pens under zero grazing, fed with hay, ground nut leaves/straw '*harawa'* and wheat offal with water supplied *ad-libitum*. The scrotal circumference was measured in centimeters using a measuring tape. The testicular length (L), width (W), depth and epididymal head axis, length and tail axis were measured by caliper and testicular volume and weight were calculated by formula methods. Semen samples were collected using an electro-ejaculator and immediately evaluated for colour, volume, motility, pH, sperm concentration, sperm morphology and live/dead ratio. The right testicular and epidydimal biometry were non-significantly greater than that of the left. Semen parameters correlate positively (right testicules, r=0.225) and (left testicles, r=0.346) with testicular volume except for bent tail, coil tail and motility. The left epididymal head's long axis and right epididymal tail axis showed significant positive correlation (r= 0.55) with semen parameters and right epididymal head's long axis and left epididymal tail axis showed negative correlation with semen characteristics. It was concluded that testicular and epididymal biometry increase with increase testicular function and output..

**Key words:** Yankasa ram, testicular biometry, epididymal biometry, and semen characteristics.

## INTRODUCTION

In developing countries like Nigeria, goats and sheep are important in pastoral and agro-pastoral production systems ensuring constant food and fibre supply, providing income and employment to poor families in rural and peri-urban areas (Sahlu and Goetsch, 2005). For the better propagation of the species of sheep, superior ram selection seems to be very important and alternative approach to boast up the production potential. This has led to the development of methods for predicting potential sperm production and

particularly for identifying bucks with high sperm output potential at an early age. (Islam, 2001; Rahman, 2009). Reproductive performance is a function of both ram and ewe fertility. Therefore, all aspects related to semen evaluation are important in management practices, especially for Artificial Insemination in a breeding program. Scrotal circumference, testicular and epididymal biometry and semen characteristics are different within an animal species and among individuals of the same breed (Kridli *et al*., 2005). The potential fertility of breeding males can be evaluated in the field by assessing the mating ability; physical examination and genital tract examination of both external and internal genitalia and semen quality evaluation (Hoflack *et al.,* 2006). fully developed at puberty (Ogbuewu, 2008). Reproductive organs are not unconditionally necessary for the individual`s life, although, but they have essential roles in the reproduction and genetics of the species (Tohman and Masanyi, 1997; Masanyi *et al.,* 2000; Ogbuewu, 2008). Reproductive efficiency and increased production can only be achieved by understanding the histology and morphometric characteristics of these very important and sensitive organs of reproduction (Masanyi *et al.,* 2000). The reproductive organs are the dynamic organs in an animal as it reflects very sensitively various changes in the environment. Many times, they are the only organs which at low toxicity show structural and functional changes (Lukes *et al.,* 2000). Lack of assessment of the basic morphometric characteristics of the reproductive organs in an animal deprives farmers of valuable information for the evaluation of the breeding ability or breeding soundness and potential fertility (Ogbuewu, 2008). Therefore, the objective of this study is to determine the relationship between testicular and epididymal biometry on semaen characteristics of Yankasa rams.

## MATERIALS AND METHODS

This experiment was carried out in the Department of Surgery and Radiology, Faculty of Veterinary Medicine, Ahmadu Bello University, Zaria,

### Experimental animals

A total of fifteen apparently healthy Yankasa rams were sourced from local markets around Zaria. Their age ranged between 1 and 2years with average weight of 20 kg. They were kept in pens under intensive management system and fed with hay, ground nut leaves/straw '*harawa*' and wheat offal with water supplied *ad libitum.* The animals were rested and allowed to adjust to their new environment and feeding regimen for a period of four weeks. A thorough physical and clinical examination was carried out on each ram and treated given prophylactic treatment against internal and external parasite.

### Semen collection and evaluation

Semen samples were collected in the morning from each animal twice weekly using an electro-ejaculator and were labeled accordingly. The sampled semen samples were evaluated immediately for colour, volume, motility and pH as describe by Zemjanis (1970).Smear of each semen sample was prepared; air dried, labeled and kept for further examination vis determination of sperm concentration using formaldehyde; determination of sperm morphology using oil immersion; and determination of live/dead ratio using eosin nigrosin (Rekwot *et al*., 1997) and live-dead ratio using the method developed by Hancock, (1951).

### Testicular-Epididymal measurements

Immediately after slaughtering, both the left and right testes were collected from the rams.

Testicular and epididymal measurements were taken within 4 hours post mortem. The epididymis was carefully excised from the testis along the physiological joints and it was further separated into caput, corpus and caudal. The following parameters were taking; Testicular length (TL), Testicular diameter (TD), Testicular volume (TV), Testicular weight (TW), Epididymal lengtht (EL). The measurements were as follows:

*Testicular length (TL)*
This was measured in centimeter with a flexible measuring tape as the distance along the caudal surface of the scrotum, from its point of attachment to the tip of the scrotum as described by Akpa *et al*. (2012).

*Testicular circumference (TC)*
This is the maximum dimension around the pendulous scrotum after pushing the testes firmly into the scrotum (Akpa *et al*., 2006). It was measured in centimeters (cm)

*Testicular width (TW)*
This was taken as half of Testicular Circumference by dividing by two.

*Testicular weight (TWT)*
This was determined using Bailey *et al.* (1996) formulae as given below;
TWT = 0.5533 x TL x TW
Where; TWT = Testicular weight , TL = Testicular length, TW = Testicular width
Testicular volume ($cm^3$) of each testis of a pair was calculated by the formulae as given below;
$TV=0.5236(L)(W)^2$
Where; TWT = Testicular weight
TL = Testicular length
TV= testicular volume

**Statistical analysis**
The semen, testicular and epididymal parameters were expressed as mean ± standard error of mean (Mean±SEM). The testicular and epididymal parameters were subjected to correlation coefficients analysis in relation to semen quality using SPSS version 20.0`

**RESULT**
The results revealed that the mean left testicular length was 15.7 ± 0.55 cm while that of the right was 15.9 ± 0.61 cm. The mean left and right testicular circumference was 26.83 ± 0.51 cm. The mean left and right testicular volume were 1482 ± 64.37 $cm^3$ and 1503 ± 74.27 $cm^3$ respectively
All the semen parameters did not have a specific pattern of correlation with the testicular and epididymal biometry (Table 1). Some parameters were positively correlated while others were negatively correlated. The sperm concentration was positively correlated with all the testicular parameters except with the right and left testicular circumference in which the correlation was negative. Reaction time and normal sperm count also positively correlated with all the testicular parameters except with the right and left testicular length in which it was negatively correlated (TABLE 1). Bent tail correlated negatively and significantly with the right and left testicular circumference (r=-0.516). The right and left testicular length correlated positively and significantly with the free tail (r=0.525) and (r=0.497) respectively. With both correlating negatively with the normal sperm cells (r=-0.270) and (r=-0.122).
The relationship between the semen parameters and the left epididymal head and tail parameters and right epididymal head and tail parameters did not follow a specific pattern because some parameters were positively correlated while others were negatively correlated (TABLES 2 and 3). The semen volume significantly correlated with the left and right epididymal head's long axis

**TABLE 1**: Relationship between the venier caliperic measurement of the testes and semen parameters (n =15)

| | | V | M | pH | C | RT | L | D | NC | FH | FT | CT | BT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RTL | R | 0.355 | -0.296 | -0.294 | 0.433 | -0.034 | -0.269 | 0.269 | -0.270 | 0.331 | 0.522* | -0.101 | 0.022 |
| RTC | R | -0.436 | 0.076 | 0.415 | -0.107 | 0.443 | 0.305 | -0.305 | 0.476 | 0.034 | -0.480 | -0.131 | -0.516* |
| RTV | R | -0.085 | -0.152 | 0.111 | 0.225 | 0.346 | 0.054 | -0.054 | 0.170 | 0.236 | 0.005 | -0.165 | -0.360 |
| RT Weight | R | -0.085 | -0.152 | 0.111 | 0.225 | 0.346 | 0.054 | -0.054 | 0.170 | 0.236 | 0.005 | -0.165 | -0.360 |
| LTL | R | 0.454 | -0.436 | -0.269 | 0.418 | -0.147 | -0.360 | 0.360 | -0.122 | 0.057 | 0.497 | -0.184 | 0.019 |
| LTC | R | -0.436 | 0.076 | 0.415 | -0.107 | 0.443 | 0.305 | -0.305 | 0.476 | 0.034 | -0.480 | -0.131 | -0.516* |
| LTV | R | 0.026 | -0.260 | 0.103 | 0.216 | 0.215 | -0.039 | 0.039 | 0.247 | 0.012 | 0.024 | -0.224 | -0.312 |
| LTWeight | R | 0.026 | -0.260 | 0.103 | 0.216 | 0.215 | -0.039 | 0.039 | 0.247 | 0.012 | 0.024 | -0.224 | -0.312 |

* Correlation is significant at the 0.05 level (2-tailed). ** Correlation is significant at the 0.01 level (2-tailed). V (Volume), M (Motility), pH, C (Concentration), RT (Teaction time), L (Live sperm), D (Dead sperm), NC (Normal cells), FH (Free Head), FT (Free Tail), CT (Coiled Tail) and BT (Bent Tail). RTL (right testicular length), RTC (right testicular circumference), RTV (right testicular volume), RTWeight (right testicular weight), LTL (left testicular length), LTC (left testicular circumference), LTV (left testicular volume), LTWeight (left testicular weight), R (Pearson correlation coefficient), and PV (p-value)

(r=0.599), area (r=0.526), volume (r=0.514) and weakly correlated with the short axis (r=0.328). While the semen volume was negatively correlated with all the left and right epididymal tail parameters (long axis, short axis, area and the volume). Sperm motility correlated negatively with all the left and right epididymal head parameters except with the short axis and correlated positively with all the left and right epididymal tail parameters except with the long axis. Sperm concentration correlated positively with all the left and right epididymal head parameters and negatively with all the epididymal tail parameters. Normal sperm cells correlated negatively with all the epididymal head and tail parameters except epididymal tail long axis (r=0.103). Normal cells of the sperm correlated significantly with the epididymal head's short axis (r= -0.531) and weakly with the area (r= - 0.446) and volume (r= -0.494). Free tail correlated positively with all the

**TABLE 2**: Relationship between the left epididymal measurements and semen parameters (n = 15)

| | | V | M | Ph | C | RT | L | D | NC | FH | FT | CT | BT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LEHLA | R | 0.599* | -0.303 | 0.350 | 0.390 | 0.090 | -0.287 | 0.287 | -0.256 | 0.345 | 0.429 | -0.029 | -0.037 |
| LEHSA | R | 0.328 | 0.045 | 0.204 | 0.450 | 0.055 | 0.099 | -0.099 | -0.531* | 0.358 | 0.464 | 0.402 | 0.123 |
| LEHA | R | 0.526* | -0.097 | 0.249 | 0.473 | 0.126 | -0.041 | 0.041 | -0.446 | 0.443 | 0.541* | 0.178 | 0.017 |
| LEHV | R | 0.514* | -0.002 | 0.180 | 0.498 | 0.152 | 0.069 | -0.069 | -0.494 | 0.476 | 0.596* | 0.211 | 0.020 |
| LETLA | R | -0.041 | -0.279 | 0.629* | -0.108 | 0.023 | -0.257 | 0.257 | 0.103 | -0.073 | -0.240 | -0.139 | 0.131 |
| LETSA | R | -0.036 | 0.009 | -0.145 | -0.047 | -0.083 | 0.127 | -0.127 | -0.108 | -0.003 | -0.013 | 0.241 | -0.001 |
| LETA | R | -0.140 | 0.029 | 0.230 | -0.180 | 0.043 | 0.127 | -0.127 | -0.104 | 0.079 | -0.168 | 0.164 | 0.096 |
| LETV | R | -0.104 | 0.083 | 0.003 | -0.169 | -0.036 | 0.162 | -0.162 | -0.149 | 0.062 | -0.109 | 0.259 | 0.078 |

*Correlation is significant at the 00.05 level (2-tailed). **Correlation is significant at the 00.01 level (2-tailed), V (Volume), M (Motility), pH, C (Concentration), RT (Teaction time), L (Live sperm), D (Dead sperm), NC (Normal cells), FH (Free Head), FT (Free Tail), CT (Coiled Tail) and BT (Bent Tail). LEHLA (left epididymal head's long axis), LEHSA (left epidiymal head's short axis), LEHA (left epididymal head's area), LEHV (left epididymal head's volume), LETLA (left epididymal tail's long axis), LETSA (left epididymal tail's short axis), LETA (left epididymal tail's area), LETV (left epididymal tail's volume), R (Pearson correlation coefficient), and PV (p-value)

epididymal head parameters and negatively with all the epididymal tail parameters. It however, correlate significantly with the epididymal head's area (r=0.541) and volume (r=0.596). (TABLES 2 and 3).

## DISCUSSION

The mean left testicular length (15.7 ± 0.55 cm) and that of the right (15.9 ± 0.61 cm). This finding was also higher than the value recorded by Abdullahi *et al.* (2012) who reported the mean testicular length of Yankasa rams to be 12.25 ± 0.35 cm. The observed value however agreed with that reported by Wahid and Yunus, (1994) who recorded testicular length to be within the range of 12.53 ± 0.05 - 15.65 ± 0.11, and

**TABLE 3**: Relationship between the right epididymal measurements and semen parameters (n = 15)

| | | V | M | Ph | C | RT | L | D | NC | FH | FT | CT | BT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| REHLA | R | -0.132 | -0.051 | 0.410 | -0.146 | 0.112 | -0.167 | 0.167 | 0.042 | -0.278 | -0.259 | 0.241 | 0.170 |
| REHSA | R | 0.138 | -0.150 | 0.360 | 0.260 | -0.005 | 0.060 | -0.060 | -0.151 | 0.122 | 0.029 | 0.207 | 0.020 |
| REHA | R | -0.023 | -0.128 | 0.459 | 0.050 | 0.075 | -0.031 | 0.031 | -0.058 | -0.081 | -0.163 | 0.267 | 0.107 |
| REHV | R | 0.021 | -0.140 | 0.434 | 0.104 | 0.055 | 0.028 | -0.028 | -0.083 | 0.010 | -0.118 | 0.238 | 0.071 |
| RETLA | R | -0.187 | 0.150 | 0.132 | -0.010 | -0.131 | -0.056 | 0.056 | -0.358 | 0.091 | -0.158 | 0.333 | 0.495 |
| RETSA | R | -0.206 | 0.038 | -0.083 | 0.146 | 0.222 | 0.249 | -0.249 | 0.231 | -0.031 | -0.128 | 0.192 | -0.449 |
| RETA | R | -0.342 | 0.188 | -0.019 | 0.056 | 0.124 | 0.205 | -0.205 | 0.013 | -0.042 | -0.259 | 0.333 | -0.022 |
| RETV | R | -0.285 | 0.162 | -0.117 | 0.158 | 0.148 | 0.279 | -0.279 | 0.070 | -0.001 | -0.169 | 0.348 | -0.239 |

*Correlation is significant at the 00.05 level (2-tailed). **Correlation is significant at the 00.01 level (2-tailed), V (Volume), M (Motility), pH, C (Concentration), RT (Teaction time), L (Live sperm), D (Dead sperm), NC (Normal cells), FH (Free Head), FT (Free Tail), CT (Coiled Tail) and BT (Bent Tail). REHLA (right epididymal head's long axis), REHSA (right epidiymal head's short axis), REHA (right epididymal head's area), REHV (right epididymal head's volume), RETLA (right epididymal tail's long axis), RETSA (right epididymal tail's short axis), RETA (right epididymal tail's area), RETV (right epididymal tail's volume), R (Pearson correlation coefficient), and PV (p-value)

slightly in agreement with Akpa, (2006) who reported the Yankasa testicular length to be within the range of 11.0 ± 0.16 – 14.2 ± 0.19. The mean left and right testicular circumference recorded in this study was 26.83 ± 0.51 cm. This was lower to the value of 35.25 ±1.77 cm reported by Abdullahi *et al.,* (2012). It however agreed with the value of 26.40 ± 0.29 cm reported by Jibril *et al.*, (2011) and also within the range of testicular circumference (25.74 ± 0.08 – 32.06 ± 0.17) observed by Wahid and Yunus, (1994). The observed mean left and right testicular volume was 1482 ± 64.37 $cm^3$ and 1503 ± 74.27 $cm^3$ respectively. This was different from that reported by Abdullahi *et al.,* (2012) in Yankasa rams who reported the testicular volume of 130.50 ± 13.43 ml. The difference might be due to differences in the methods used in determining the volume. Abdullahi *et al.,* (2012) used Archimedes principle of water displacement in a measuring cylinder and this was more sensitive than the venier caliperic method.

All the semen parameters do not have a specific pattern of correlation with the venier

caliperic measurement of the testicular length, circumference, volume and the weight. This disagreed with Wahid and Yunus, (1994) who reported a positive and significant correlation between testicular length with semen volume, sperm motility and concentration. The sperm concentration was however, positively correlated with all the testicular parameters except with the right and left testicular circumference in which was negatively correlated. Reaction time and normal sperm count also positively correlated with all the testicular parameters except with the right and left testicular length in which it was negatively correlated.

The right and left testicular length correlated positively and significantly with the free tail (r=0.525) and (r=0.497) respectively. With both right and left testicular length correlating negatively with the normal sperm cells (r=-0.270) and (r=-0.122), while also correlating negatively with the sperm motility (r=-0.296 and r=-0.436 respectively) it suggested that the testicular length can affect the livability of sperm cells and not sperm production because it positively correlated with the semen volume (r= 0.355 and r= 0.454) as supported by Wahid and Yunus, (1994) who reported a positive and significant correlation between testicular length and semen volume.

Bent tail significantly and negatively correlated with the right and left testicular circumference (r=-0.516). Since testicular circumference was also negatively correlated with the semen volume (r=-0.436 for both left and right testes) it means that testicular circumference can improve the livability of sperm cells and not the semen production. However, Wahid and Yunus, (1994), reported that testicular circumference influence libido in rams.

Testicular size was ultimately correlated with capacity of sperm production, number of sperm ejaculated and testicular circumference had a direct correlation with spermatozoa output as observed by several researchers (Osinowo, 1979; Akpa *et al*., 2012). This disagreed with what was observed in this study in which both the right and left testicular circumference were negatively correlated with the semen volume (r= -0.436). Since the right and left testicular circumference also correlate positively with the life and normal sperm cells (r=0.305 and r=0.476 respectively) this suggested that increase in testicular circumference did not lead to increased sperm production but was necessary for the healthiness or survival of spermatozoans. It was observed that testicular volume weakly correlated with the sperm concentration (r= 0.225). This is not in support of Akpa *et al.,* (2012) who reported that testicular size was strongly correlated with sperm count.

The semen volume significantly correlated with the left epididymal head's long axis (r=0.599), area (r=0.526), volume (r=0.514) and weakly correlated with the short axis (r=0.328) while the semen volume is negatively correlated with all the left epididymal tail parameters (long axis, short axis, area and the volume). This indicated that the head of the epididymes as the sperm reserve could be used to predict the volume of the ejaculate, this was further supported by the fact that sperm concentration correlates positively with all the left epididymal head parameters and negatively with all the epididymal tail parameters. However, this result disagreed with Suchana, (2013) who reported the epididymal volume to be negatively correlated with the semen volume (r=-0.237), but partly in support of England, (1991) who reported the correlation between cross-sectional area of the epididymal tail and the total sperm output (r=0.05).

Normal sperm cells correlated negatively with all the left epididymal head and tail parameters except epididymal tail long axis (r=0.103). Normal cells of the sperm correlate significantly with the left epididymal head's short axis (r= -0.531) and weakly with the area (r= - 0.446) and volume (r= -0.494). This showed that that large size of the epididymes has detrimental effects on the spermatozoan. This was further supported by the fact that left epididymal head area and

volume correlated positively and significantly with the abnormal cells and negatively with the normal cells (r= -0.446 and r= -0.494).

Similar to the findings in this study, Suchana, (2013) reported a positive correlation between epididymal volume and sperm morphology. There was a significant correlation (r=0.56) between the total testicular volume and the cross-sectional epididymal area (England, 1991).

## CONCLUSION

The relationship between the venier caliperic measurement of the testes and semen parameters showed that testicular length affects the viability of sperm cells and not sperm production and increase in testicular circumference did not lead to increased sperm production but was necessary for the healthiness or survival of spermatozoans

The relationship between the epididymal biometry and the semen parameters showed that the epididymes could be used to predict the volume of sperm production

Further study is required to explore the relationship between the epididymal biometry and the semen parameters in predicting future ram breeders.

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