UNIVERSITI PUTRA MALAYSIA

RELATIONSHIP OF SCROTAL CIRCUMFERENCE AND TESTICULAR VOLUME TO AGE AND BODY WEIGHT IN DORPER SHEEP

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RELATIONSHIP OF SCROTAL CIRCUMFERENCE AND TESTICULAR VOLUME TO AGE AND BODY WEIGHT IN DORPER SHEEP

by

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It is hereby certified that I have read this project entitled "Relationship of Scrotal Circumference and Testicular Volume to Age and Body Weight in Dorper Sheep", by Nur Ain Sakinah Binti Ishak and in my opinion it is satisfactory in terms of scope, quality, and presentation as partial fulfilment of the requirement for the course VPD 4999 – Final Year Project.

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DEDICATIONS

In the name of Allah Subhanahu Wa Ta'ala

I dedicate this thesis to:

My beloved Mummy, Ayah, and my siblings,

lecturers and friends.

Thank you for all the loves and support.

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I am thankful to Allah SWT for the opportunity to be a part of Doctor of Veterinary Medicine society and providing me strength and health throughout the study period.

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Scrotal Circumference	: SC
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ABSTRAK

Abstrak daripada kertas projek yang dikemukakan kepada Fakulti Perubatan Veterinar untuk memenuhi sebahagian daripada keperluan kursus VPD 4999 – Projek Tahun Akhir

HUBUNGKAIT ANTARA LILITAN SKROTAL DAN ISI PADU TESTIS DENGAN UMUR DAN BERAT BADAN KAMBING BEBIRI DORPER

oleh

Nur Ain Sakinah Binti Ishak

2017

Penyelia: Prof. Madya Dr. Rosnina Hj. Yusoff

Kajian ini dijalankan untuk menilai parameter pembiakan yang boleh digunakan sebagai petunjuk untuk menganggar kesuburan kambing bebiri Dorper. Lilitan skrotal (SC) dan isipadu testis (TV) adalah parameter pembiakan yang diukur untuk dikolerasikan dengan umur dan berat badan. Sebanyak 32 kambing bebiri jantan Dorper dibahagikan kepada dua kumpulan: Kumpulan A (berusia <12 bulan) dan Kumpulan B (berusia >12 bulan). Terdapat enam ekor kambing bebiri jantan di dalam Kumpulan A dan 26 ekor kambing bebiri jantan di dalam Kumpulan B. SC kambing

bebiri jantan tersebut diukur. Panjang, lebar dan ketinggian testis kiri dan kanan telah diukur untuk mengira TV. Semua data telah dianalisiskan secara statistik. Keputusun terkini menunjukkan bahawa semua parameter berkolerasi secara positif antara satu sama lain. SC dan TV lebih berhubung kait dengan berat badan berbanding dengan usia. SC berkolerasi positif dengan umur (r=0.605), berat badan (r=0.824) dan TV (r=0.925). TV berkolerasi positif dengan umur (r=0.535), berat badan (r=0.873) dan SC (r=0.925). Kajian ini menunjukkan bahawa kambing bebiri jantan berusia lebih daripada 12 bulan dengan berat badan sekurang-kurangnya 45 kg mempunyai SC dan TV yang lebih tinggi. Oleh itu, umur, berat badan, lilitan skrotal dan isipadu testis boleh digunakan sebagai salah satu kriteria dalam pemilihan baka induk.

Kata Kunci: *Kambing bebiri Dorper, lilitan skrotal, isipadu testis*

ABSTRACT

An abstract of the project paper presented to the Faculty of Veterinary Medicine in partial fulfilment of course VPD 4999 – Final Year Project.

RELATIONSHIP OF SCROTAL CIRCUMFERENCE AND TESTICULAR VOLUME TO AGE AND BODY WEIGHT IN DORPER SHEEP

by

Nur Ain Sakinah Binti Ishak

February, 2017

Supervisor: Assoc. Prof. Dr. Rosnina Hj. Yusoff

This study was conducted to evaluate reproductive parameters that can be used as indicators to estimate fertility status of Dorper sheep. Scrotal circumference (SC) and testicular volume (TV) were the reproductive parameters that were measured to correlate with age and body weight. A total of 32 Dorper rams were divided into two groups: Group A (< 12 months old) and Group B (> 12 months old). There were six rams in Group A and 26 rams in Group B. The SC of the rams was measured. The length, width and height of left and right testes were measured to calculate TV. All the data were analysed statistically. The present results showed that all parameters are positively correlated to each other. The SC and TV are more correlated to body weight compared with age. The SC is positively correlated with age (r=0.605), body

weight (r=0.824) and TV (r=0.925). The TV is positively correlated with age (r=0.535), body weight (r=0.873) and SC (r=0.925). This study shows that the rams of more than 12 months with body weight of at least 45 kg have higher SC and TV. Therefore, age, body weight, scrotal circumference and testicular volume can be used as criteria in selection of sires.

Keywords: *Dorper sheep, scrotal circumference, testicular volume.*

1.0 INTRODUCTION

The livestock industry is important in the agricultural sector of Malaysia. The contribution of livestock production to the Gross Domestic Product (GDP) is inconsistent. Even though there was a decreased in contribution of livestock industry to GDP in the 90's, but in 2005, livestock industry contribution to GDP was slightly increased (0.8%) (Government of Malaysia Economic Report 1990 – 2005, as cited in Mohamed, 2007). The livestock industry includes non-ruminant and ruminant industries. The non-ruminant industry comprises swine and poultry, while the ruminant industry are cattle, buffaloes, goats and sheep. However, goats and sheep play a minor role in livestock industry. The sheep population in Malaysia has increased from 116 387 in 2006 to 132 900 in 2011 (Ministry of Agriculture and Agro-Based Industry Malaysia, 2011). Furthermore, the number of sheep slaughtered from 2006 to 2011 has also increased from 3 554 to 4 171 heads.

Most rams reach puberty at age between 5 and 7 months old. Breeding soundness evaluation is done to predict the potential fertility of the males. It includes physical examination of the animals, assessment of the reproductive organs and semen evaluation. The scrotal circumference is an important measurement as it is related to the current semen production capacity of the rams (Hahn et al., 1969). Studies have shown that age can influence the scrotal circumference and semen characteristics (Toe et al., 1994). This shows that age is directly related to the testicular size and at the same time related to the sperm output. This study was done in hope to enable farmers to

identify suitable sires to be used in breeding programme based on parameters such as age, body weight, scrotal circumference and testicular volume.

Although there is information regarding the relationship of scrotal circumference to age and body weight in sheep, goats and bulls, reports about these in Dorper sheep is inadequate. Therefore, this study was performed to correlate the scrotal circumference and testicular volume to age and body weight in Dorper rams.

2.0 LITERATURE REVIEWS

2.1 Dorper Sheep

Dorper sheep was first developed by crossing breeds between Dorset Horn and Blackhead Persian in the 1930's in South Africa. It is one of the fast growing meat producing breed that can survive in arid environment. The hardiness and adaptability of the Dorper led to a rapid increase in popularity.

Dorpers can be found throughout southern and central Africa, North Africa and the Middle East as well as on other continents, such as Northern America and Australia (Marais & Schoeman, 1990, as cited in Cloete et. al, 2000). Nowadays, this breed has a potential to become popular in Malaysia.

2.2 Breeding Soundness Examination (BSE)

Productivity of a farm is usually related to the reproductive performance of the animals. Selection of sire is important since rams make significant contributions to the flock and it is the fastest and greatest way for genetic change. Breeding soundness examination (BSE) of rams is a thorough evaluation of their capability to impregnate ewes during breeding seasons (Kimberling & Parsons, 2007). In other words, BSE is performed to determine the fertility of the males. Therefore, several parameters can be used for selective breeding.

According to the Bedford-Guaus (2010) in the Merck Veterinary Manual, 10th edition, BSE includes mating ability and libido, general examination and inspection of genital organs, and assessment of sperm production and quality.

2.3 Testicular size and sperm production

There are several studies done in different species and breeds and showed that scrotal circumference has high correlation to age and body weight. Those studies include Bongso *et al.* (1984) in swamp buffaloes, Mukasa-Mugerwa & Ezaz (1992) in Menz rams, Salhab *et al*. (2001) in Awassi rams, Koyuncu, *et al*. (2005) in Kivircik (Western Thrace) rams, and Perumal (2014) in Tho Tho bulls.

Scrotal circumference is highly correlated with sperm production and semen quality, and it is important during the examination of yearling bulls (Devkota *et al.*, 2008). According to Brito *et al*. (2004), the scrotal circumference is easy to measure and shows a high correlation with body weight and reproductive capacity (sperm production and semen quality). During the study of libido in breeding rams, Wahid & Yunus (1994) showed that a correlation between scrotal circumference and libido of rams existed based on number of ram's service in a given time. This study proved that healthy normal rams with large scrotal circumference will have good libido.

However, according to Bailey *et al.* (1996) and Unanian *et al.* (2000) as cited by Boligon *et al.* (2010), testicular volume is more accurate as a selection criterion for reproductive performance than scrotal circumference in Zebu cattle. Testicular volume reflects spermatogenesis, in which 70 – 80 % of testicular mass consists of seminiferous tubules and thus, associated with total sperm count, sperm motility, morphology and daily production (Gouletsou *et al.,* 2008). According to Gouletsou & Fthenakis (2010), scrotal circumference and testis volume are highly correlated and rams with normal and large testis are likely to produce large quantities of good-quality semen.

3.0 MATERIALS AND METHODS

3.1 Study area and sample size

This study was conducted at the PJ Livestock Sdn Bhd farm in Puchong, Selangor. It is a sheep farm that focuses on meat production and breeders which practice an intensive farming system. The farm imported Dorper and Merino sheep from Australia. A total of 32 Dorper rams of different ages were selected and grouped into two group; Group A (less than 12 months old) and Group B (more than 12 months old). The age of each animal was estimated according to their dentition.

3.2 Body condition score

Each of the sheep was weighted using an electronic weight scale available at the farm. The body condition score of each sheep can be categorized from score 1 to 5, where 1 is very thin and 5 is very fat. Scoring is based on palpating the muscle thickness and fat deposition over and around the vertebrae in the loin region, according to Thompson & Meyer (1994).

3.3 Testicular measurement

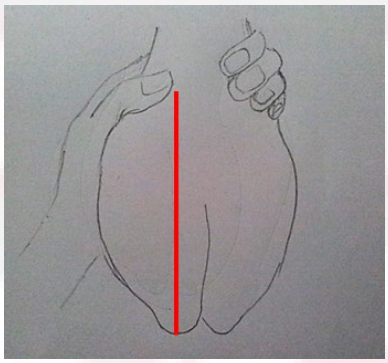
Testes of each sheep were measured for length (L), width (W), and height (H), using a pair of digital Vernier callipers. Testicular length was measured from anterior aspect to posterior aspect of each testis (as shown in Diagram 1), while width of each testis was measured from medial aspect and the other at the lateral aspect (as shown in Diagram 2), at point of maximum width. Testicular height was measured from proximal end to distal end of the testes (as shown in Diagram 1). These values were used to calculate testicular volume using the formula; Volume = 0.5233 x Length x Width x Height (Love, 1992, as cited by Pukazhenthi *et al*, 2011). The total volume of left and right testes from that formula was summed up to get the total testicular volume for each sheep.

The scrotal circumference was measured by firmly pulling the testes down to lower part of scrotum and placed the measuring tape around the widest part of the scrotum (as shown in Diagram 3). All the measurements were recorded.

3.4 Statistical analysis

Statistical analysis was performed using the IBM SPSS version 22. All data collected on age, body weight, body condition score, scrotal circumference and testicular volume were tabulated and analysed for descriptive statistics. All the parameters between the two groups were analysed using Independent t-test except for body condition score that was analysed using Mann-Whitney test to observe any significance difference among the mean. The Pearson's correlation technique was performed to see the relationship between all parameters. Correlation coefficients were correlated significantly from 0 at $p<0.01$. regression analysis was used to mathematically described relationship between variables.

Diagram 1: Caudal view for the measurement of height (left) and length (right) of the testis.



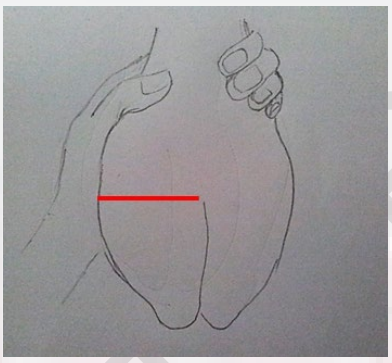


Diagram 2: Lateral view for the measurement of width of the testis.

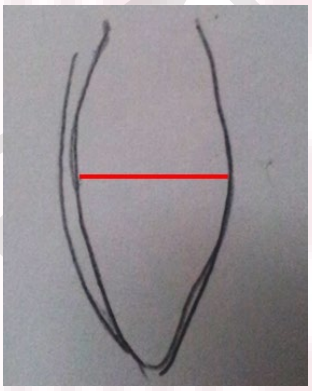


Diagram 3: Measurement of scrotal circumference (retrieved from http://veteriankey.com/livestock-reproduction/)

4.0 RESULTS

Comparison between testicular volume in left and right testes of both age groups are shown in Figure 1. It showed that the testicular volume of left and right testes for both age groups have almost similar testicular volume. Meanwhile, Figure 2 showed the total testicular volume of both left and right testes for both age groups. It revealed that group B has higher total testicular volume compared to group A.

Figure 1: Comparative testicular volume in left and right testes of Dorper sheep.

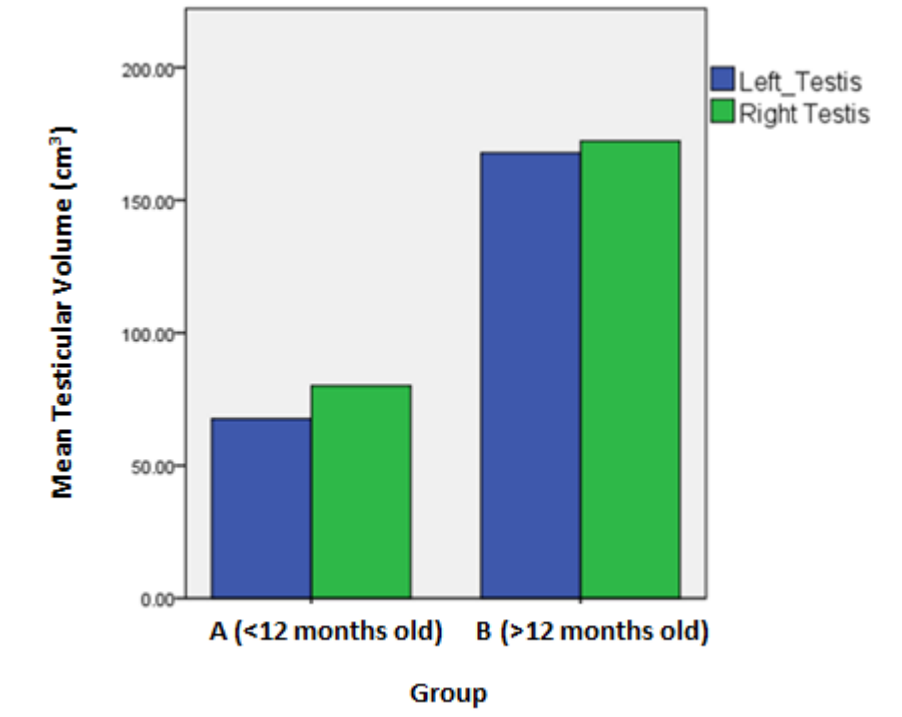


Figure 2: Total testicular volume of two different age group.

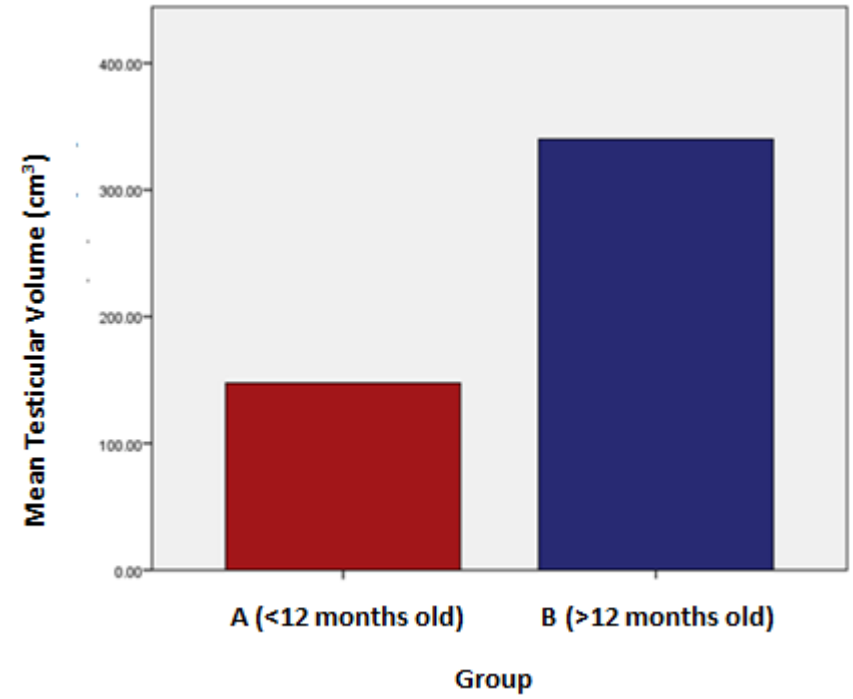


Figure 3: Distribution of mean on all parameters.

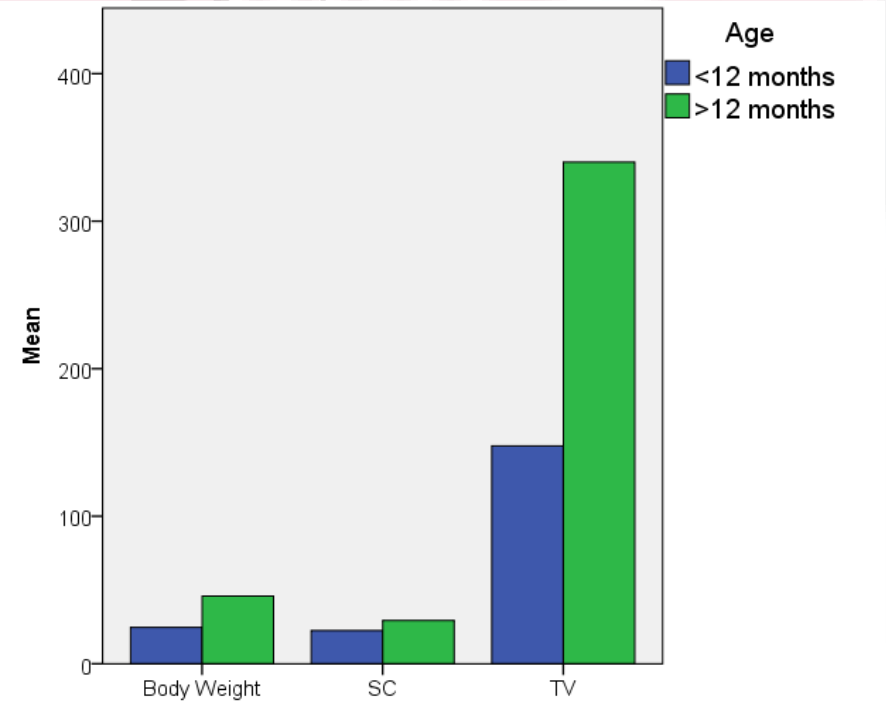


Table 1: Evaluation of reproductive parameters in Dorper sheep.

Parameters	Groups	Mean±SE	Range	P-value
Body Weight (kg)	A	24.67±1.09	20.00 – 27.00	0.000
	B	45.85±2.63	26.00 – 75.00	
Body Condition Score	A	1.83±0.17	2 – 2.5	0.004
	B	2.81±0.15	2 – 4	
Scrotal Circumference (cm)	A	22.50±1.78	15.00 – 27.00	0.000
	B	29.27± 0.67	24 .00 – 38.00	
Right testis height (cm)	A	8.10 ± 0.83	4.50 – 10.50	0.000
	B	11.13 ± 0.29	8.00 – 14.30	
Right testis length (cm)	A	4.35 ± 0.29	3.70 – 5.50	0.004
	B	5.33 ± 0.70	4.10 – 6.70	
Right testis width (cm)	A	4.02 ± 0.30	2.70 – 4.80	0.000
	B	5.36 ± 0.57	4.50 – 6.40	
Right testis volume (cm^3)	A	80.07 ± 16.74	23.52 – 145.06	0.001
	B	172.28 ± 11.65	82.89 – 302.93	
Left testis height (cm)	A	7.45 ± 0.80	4.30 – 10.10	0.000
	B	11.04 ± 0.31	.50 – 14.30	
Left testis length (cm)	A	4.22 ± 0.29	3.50 – 5.10	0.003
	B	5.28 ± 0.15	4.20 – 6.90	
Left testis width (cm)	A	3.85 ± 0.18	3.20 – 4.50	0.000
	B	5.22 ± 0.15	4.10 – 6.80	
Left testis volume (cm^3)	A	67.58 ± 14.14	29.16 – 121.30	0.003
	B	167.77 ± 14.11	67.58 – 343.75	
Total Testicular Volume (cm^3)	A	147.64±30.65	52.69 – 266.36	0.002
	B	340.04±25.45	150.47 – 646.67	

SE = Standard error of mean, n = 32, Mean differ significantly ($p<0.05$)

The mean and standard error values of body weight, scrotal circumference and testicular volume for the two different age groups are shown in Table 1. Among the two groups, there were significant difference for all the parameters. There was a significant difference between two age groups on the body condition score, however the mean value between the two age group was almost similar. The body condition score for Group A ranged from 2 to 2.5, while for Group B from 2 to 4.

The testicular volume can represent the sperm content of the sheep testes. The data showed that Group B has higher testicular volume compared to Group A. The descriptive analysis showed that there were significant differences between the two age groups in the testicular volume.

Correlation coefficient (r) between age, body weight, body condition score, scrotal circumference, testicular volume and testicular measurement in Dorper sheep are presented in Table 2. Pearson linear correlation showed that all the parameters are correlated to each other. It showed that scrotal circumference and testicular volume were correlated more to body weight compared to age. Figure 4 showed that the scrotal circumference increases as body weight and age of the rams increased.

The scrotal circumference was positively correlated with age (r=0.605), body weight (r=0.824), BCS (r=0.596) and TV (r=0.925). The testicular volume was positively correlated with age (r=0.535), body weight (r=0.873), BCS (r=0.584) and SC (r=0.925).

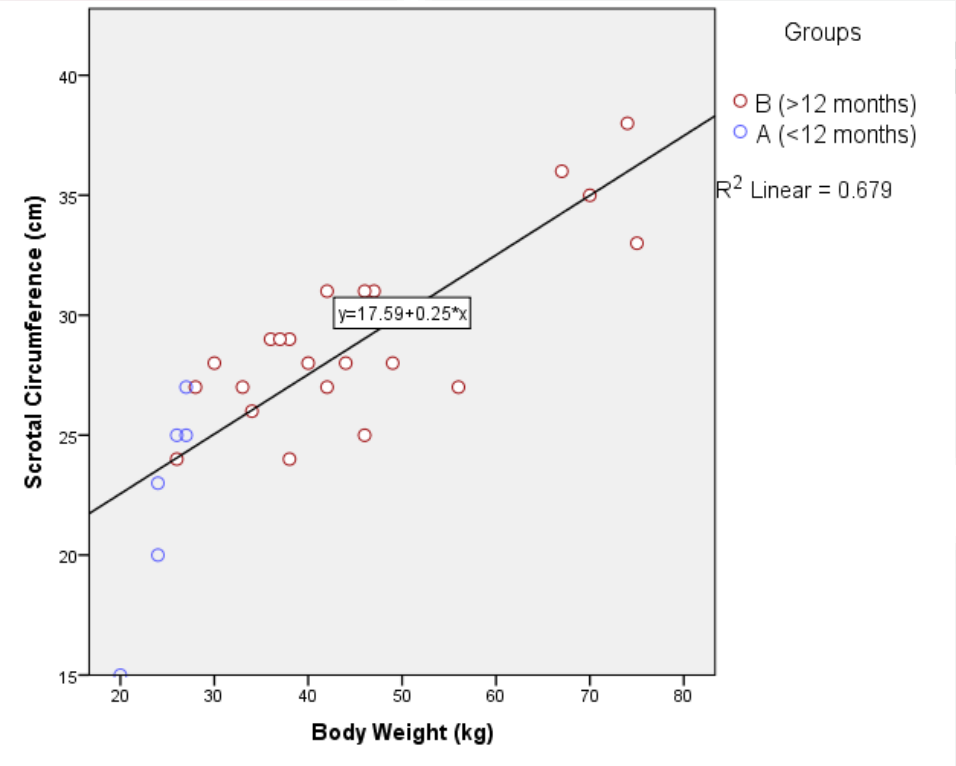
In Figure 4, regression analysis shows a significant relationship between scrotal circumference and body weight at p-value of 0.000 and regression equation of y =17.59 + 0.25x, where y is scrotal circumference (cm3) and x is body weight.

Table 2: Correlation coefficient (r) between age, body weight, body condition score, scrotal circumference and testicular volume in Dorper sheep.

No	Parameters	2	3	4	5	6	7	8	9	10	11	12	13
1	Age	0.571**	0.487**	0.605**	0.613**	0.489**	0.671**	0.548**	0.657**	0.502**	0.604**	0.515**	0.535**
2	Bwt		0.688**	0.824**	0.778**	0.753**	0.78**	0.847**	0.800**	0.829**	0.861**	0.880**	0.873**
3	BCS			0.596**	0.557**	0.438**	0.538**	0.542**	0.573**	0.560**	0.572**	0.610**	0.584**
4	SC				0.916**	0.860**	0.940**	0.927**	0.916**	0.900**	0.906**	0.907**	0.925**
5	Right testis height					0.834**	0.931**	0.927**	0.965**	0.853**	0.847**	0.869**	0.904**
6	Right testis length						0.842**	0.939**	0.832**	0.875**	0.900**	0.873**	0.912**
7	Right testis width							0.934**	0.929**	0.903**	0.880**	0.885**	0.916**
8	Right TV								0.915**	0.934**	0.942**	0.962**	0.989**
9	Left testis height									0.877**	0.881**	0.900**	0.915**
10	Left testis length										0.921**	0.954**	0.954**
11	Left testis width											0.966**	0.966**
12	Left TV												0.992**
13	Total TV												1.000**

**Correlation is significant at the 0.01 level (2-tailed)

Figure 4: Relationship between scrotal circumference and body weigth for two different age groups in Dorper rams.



5.0 DISCUSSIONS

The reproductive performance of the ram is influence by age, breed and body conformation. Simple and reliable techniques to measure the fertility of the rams are needed mostly by the farmers to ease their work in selection of sires.

In the present study, the results revealed that scrotal circumference of Dorper rams have been correlated with the testicular measurement (height, length and width) and testicular volume (r= 0.860 – 0.927, $p<0.01$). This result is in agreement with the findings by Schoeman & Combrink (1987) in Dorper, Dohne Merino and crossbred rams, Salhab *et al.* (2001) in Awassi rams, Fourie *et al.* (2004) in Dorper rams, Koyuncu *et al.* (2005) in Kivircik rams, Koyuncu & Altincekic (2013) in Kivircik, Karacabey Merino and Tahirova rams, and Omar (2016) in Karadi rams, Therefore, scrotal circumference of Dorper rams can be used to predict the testicular measurement and volume in which it can be used as an indicator in the selection of suitable breeding males.

The correlation coefficient also showed that among the three testicular measurements (height, length and width), the width has higher correlation to total testicular volume. It means that the left or right testes width can be used to predict the total testicular volume either the testicular volume is low or high. This result is similar with findings by Perumal (2014) in Tho Tho bulls. However, it contradicted with findings by Salhab *et al.* (2001) and Koyuncu *et al.* (2005), where they stated that testicular height is correlated more to testicular volume.

According to Salhab *et al.* (2001), Awassi rams of about 7 months old with average body weight of 34.6 kg have increase in testicular dimensions. In the present study, Dorper rams of more than 12 months old with average body weight 45 kg have increased scrotal circumference, and testicular volume. According Pezzanite *et al.* (2010), the minimum scrotal circumference for rams less than 12 months old is ≥32 cm and rams more than 12 months old is ≥33 cm. In this present study, the average scrotal circumference for rams less than 12 months old (6 – 12 months old) was ≥23 cm (ranged from 15 – 27 cm), and rams more than 12 months old was ≥29 cm (ranged from 24 – 38 cm), in which the measurements were low from the one recommended by Pezzanite *et al.* (2010).

Besides that, as would be expected, all parameters which are the age, body weight, scrotal circumference, testicular volume and testicular measurement are correlated to each other in this present study. This result is similar with the study by Schoeman & Combrink (1987), Mukasa-Mugerwa & Ezaz (1992) in Menz rams, Salhab *et al.* (2001), and Koyuncu *et al.* (2005). In Table 2, body weight was more correlated to various testicular parameters compared to age. This can also be seen in study by Salhab *et al.* (2001), Koyuncu *et al.* (2005) and Omar (2016). According to Fourie *et al.* (2004), different management system (intensive or extensive system) can affect the scrotal circumference as there will be a different in nutritional management in both management systems. They suggested that high-energy level in the diet accelerated the testicular development especially in intensive system. Thus, this might explain why body weight was more correlated to various testicular parameters compared to age.

In Figure 4, it showed that there was a relationship between scrotal circumference and body weight in two different age groups. This is in agreement with the results by Mukasa-Mugerwa & Ezaz (1992) and Salhab *et al.* (2001). Thus, as body weight and age increase, the scrotal circumference will also increase.

According to Burito *et al.* (2002), scrotal circumference is a key in examination of yearling bulls, and it is highly correlated with sperm production and sperm quality. However, according to Bailey *et al.* (1996) and Unanian *et al.* (2000) as cited by Boligon *et al.* (2010), testicular volume is more accurate as a selection criterion for reproductive performance than scrotal circumference. The present study reveals that rams in Group B have higher scrotal circumference and testicular volume, which might be due to the fact that all rams in this group have already reached sexual maturity. Thus, both scrotal circumference and testicular volume can be used as selection criteria for reproductive performance.

A study done by Schoeman and Combrink (1987) showed that testicular development and size can be used as indicators of rams' fertility. However, according to Fourie *et al.* (2004), scrotal circumference alone may be misleading when rams are fed high-energy diets prior to measurement, due to possible accumulation of subcutaneous fat in the scrotum.

6.0 CONCLUSIONS AND RECOMMENDATIONS

In conclusion, age, body weight, scrotal circumference and testicular volume are positively correlated ($p<0.01$) with one another. Even though the body condition score is also positively correlated ($p<0.01$) with other parameters, it is still debateable since the body condition score is subjective and may differ from different assessor. This study shows that rams of more than 12 months with body weight at least 45 kg and mean scrotal circumference of ≥ 29 cm can be selected as sire, where they will have testicular volume of 340 cm^3. Therefore, age, body weight, scrotal circumference and testicular volume can be used as one of the criteria in selection of sire.

There are several recommendations to improve this study. The sample size can be increased to at least 50 animals to make the statistical analysis more meaningful. The number of animals per age group should be equal to avoid any biasness and have a specific age groups range. The testicular measurement should be taken at fixed time as testes can reduce in size during hot temperature (Maurya *et al.,* 2015) and may result in inaccurate estimation of testicular volume. It is proven by Fourie *et al.* (2004) that different management system, can affect the scrotal circumference and testes size, therefore, it is recommended to take the sample from one farm only or farms with similar management system. The testosterone concentration of the sheep can be done simultaneously with this study to better evaluate the fertility of the sheep. Furthermore, evaluation of semen can also be done to confirm the present result.

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8.0 APPENDICES

Appendix A: Reproductive parameters in Dorper sheep.

GROUP A

Sheep No.	Age (year)	Bwt (kg)	BCS	SC (cm)	Total TV (cm^3)
21	<1	27.0	2.5	25.0	180.33
22	<1	24.0	2.5	23.0	121.70
23	<1	27.0	2.5	27.0	266.36
24	<1	24.0	2.5	20.0	94.56
29	<1	26.0	2.5	25.0	170.21
32	<1	20.0	2	15.0	52.69

GROUP B

Sheep No.	Age (year)	Bwt (kg)	BCS	SC (cm)	Total TV (cm^3)
1	1	47.0	3	31.0	353.06
2	4	51.0	3	30	378.38
3	3	42.0	2.5	27.0	310.68
4	3	51.0	3	30	274.97
5	2	42.0	2.5	31.0	424.50
6	2	49.0	3	28.0	341.82
7	1	33.0	2	27.0	247.62
8	1	40.0	3.0	28.0	286.76
9	2	56.0	4.0	27.0	284.63
10	1	45.0	2.5	30.0	322.99
11	2	38.0	2.5	29.0	347.78
12	1	38.0	2.5	24.0	227.65
13	2	44.0	2.5	28.0	298.18
14	2	47.0	3	30.0	388.24
15	1	46.0	2.5	31.0	326.63
16	1	46.0	3	25.0	167.21
17	2	67.0	3	36.0	538.35
18	2	74.0	4	38.0	637.87
19	3	75.0	4	33.0	520.96
20	3	70.0	4	35.0	646.67
25	2	30.0	3	28.0	246.37
26	2	34.0	3	26.0	194.81
27	1	36.0	3	29.0	338.89
28	3	37.0	3	29.0	393.82
30	1	26.0	3	24.0	150.47
31	1	28.0	3	27.0	191.80

Appendix B: Testicular volume for left and right testes.

GROUP A

Sheep No.	Left Testicular (cm)			Testicular Volume (cm^3)	Right Testicular (cm)			Testicular Volume (cm^3)
	H	L	W		H	L	W	
21	8.6	4.9	4.0	88.21	8.9	4.6	4.3	92.12
22	7.1	3.7	3.7	50.86	8.9	3.9	3.9	70.84
23	10.1	5.1	4.5	121.30	10.5	5.5	4.8	145.06
24	6.6	3.5	3.2	38.68	7.4	3.7	3.9	55.88
29	8.0	4.5	4.1	77.24	8.4	4.7	4.5	92.97
32	4.3	3.6	3.6	29.16	4.5	3.7	2.7	23.52

GROUP B

Sheep No.	Left Testicular (cm)			Testicular Volume (cm^3)	Right Testicular (cm)			Testicular Volume (cm^3)
	H	L	W		H	L	W	
1	12.3	5.1	5.6	183.83	12.0	4.9	5.5	169.24
2	11.0	5.9	5.0	169.81	12.1	5.4	6.1	208.57
3	11.8	5.0	4.8	148.20	11.5	5.0	5.4	162.48
4	11.5	5.2	4.7	147.08	10.4	4.7	5.0	127.89
5	11.6	6.0	5.5	200.32	11.9	6.0	6.0	224.18
6	11.6	5.2	5.1	160.98	12.1	5.6	5.1	180.84
7	9.8	4.7	4.9	118.11	9.9	5.0	5.0	129.52
8	10.7	4.9	4.6	126.21	11.8	5.0	5.2	160.55
9	10.5	5.3	5.1	148.52	10.2	5.0	5.1	136.11
10	10.0	5.6	5.4	158.25	11.0	5.3	5.4	164.75
11	11.7	5.1	5.2	162.37	11.1	5.6	5.7	185.41
12	9.8	4.7	4.6	110.87	9.9	4.9	4.6	116.77
13	11.0	4.9	4.9	138.21	11.1	5.4	5.1	159.97
14	11.7	5.0	5.7	174.49	12.2	6.2	5.4	213.75
15	11.2	5.1	5.0	149.45	11.4	5.4	5.5	177.18
16	8.3	4.2	4.4	80.27	8.4	4.3	4.6	86.95
17	12.0	6.4	6.8	273.29	12.0	6.7	6.3	265.06
18	14.3	6.8	6.7	340.93	14.3	6.2	6.4	296.93
19	13.0	6.3	6.4	274.29	12.9	6.3	5.8	246.67
20	14.0	6.9	6.8	343.75	13.5	6.7	6.4	302.93
25	9.7	4.6	4.7	109.74	10.1	5.5	4.7	136.63
26	9.5	4.4	4.1	89.68	10.0	4.1	4.9	105.13
27	11.3	5.7	5.3	178.64	10.7	5.3	5.4	160.25
28	12.3	5.7	5.8	212.79	11.9	5.1	5.7	181.03
30	7.5	4.2	4.1	67.58	8.0	4.4	4.5	82.89
31	8.9	4.5	4.5	94.31	9.0	4.5	4.6	97.49