UNIVERSITI PUTRA MALAYSIA

LIBIDO AND SEMEN QUALITY OF GOATS AT UPMKB FARM

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By

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A Project Report Submitted in Partial Fulfilment of the Requirement
for the Degree of Bachelor of Bioindustry Science in the
Faculty of Agriculture and Food Sciences
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DEDICATION

To

My *parents*; Hasan Basari bin Mohd Adnan and Radziah bte Hj Melan

My *brothers and sister*; Mohd Danial, Akmal Faris and Kamilia Nur Husna

My *friends*

ABSTRACT

Three bucks each of Local Crossbred and Boer were used to study libido and semen quality. Bucks were about two years of age and their weights ranged between 18 to 45 kg. An artificial vagina was used to collect semen at 3 days intervals starting in December 2007 and ending in February 2008. The study showed that the Local Crossbred possessed the greatest libido by recording the shortest time to mount (10.78 ± 1.10 sec) and the shortest time to ejaculate (42.83 ± 8.60 sec) as compared to Boer (57.90 ± 6.03 sec) and (90.27 ± 9.25 sec). The Boer showed the least number of mounts per ejaculation (2.72 ± 0.20) as compared to Local Crossbred (2.82 ± 0.33). Compared to Boer the Local Crossbred produced greater volume of semen (0.88 ± 0.03 mL), had greater percentage of live sperm (78.38 ± 1.25%) and possessed the greatest sperm count of 3.78 ± 0.08 × 10^9 sperm/mL. The testicle circumference and breadth of bucks was highly correlated ($P < 0.01$) with volume, percentage live of sperm and concentration of sperm between Local Crossbred and Boer and negatively correlated with libido test in Boer only. Volume of semen, time to mount, time to ejaculate, testicle circumference and breadth were significantly greater in Local Crossbred as compared with Boer. The data indicated that the libido was better and semen quality and quantity was greater in Local Crossbred goats as compared to the Boer. It can be said that the relationship between testicle size with libido and semen quality can be used to select bucks for breeding.

ABSTRAK

Tiga ekor kambing jantan bagi baka Kacukan Tempatan dan Boer telah digunakan dalam kajian mengenai libido dan kualiti air mani. Kambing-kambing jantan dalam lingkungan 2 tahun dan beratnya antara 18 hingga 45 kg telah digunakan. Vagina tiruan digunakan untuk mengumpul air mani pada setiap 3 hari sekali bermula pada bulan Disember 2007 dan berakhir pada bulan Februari 2008. Kajian ini menunjukkan Kacukan Tempatan mempunyai libido yang terbaik dengan mencatatkan masa yang paling singkat untuk memanjat (10.78 ± 1.10 saat) dan masa yang pendek untuk berejakulasi (42.83 ± 8.60 saat) berbanding baka Boer (57.90 ± 6.03 saat) dan (90.27 ± 9.25 saat). Baka Boer telah menunjukkan bilangan memanjat yang paling sedikit (2.72 ± 0.20) berbanding Kacukan Tempatan (2.82 ± 0.33). Baka ini menghasilkan isipadu air mani yang lebih (0.88 ± 0.03 mL), peratus sperma hidup yang tinggi (78.38 ± 1.25%) dan bilangan kepekatan sperma yang tinggi iaitu 3.78 ± 0.08 × 10^9 sperma/mL berbanding Boer. Ukur lilit dan lebar testikel kambing jantan mempunyai hubungan yang tinggi ($P < 0.01$) dengan isipadu air mani, peratus sperma hidup dan kepekatan sperma pada Kacukan Tempatan dan Boer dan hubungan yang negatif dengan ujian libido pada Boer sahaja. Isipadu air mani, masa untuk memanjat, masa untuk berejakulasi, ukur lilit dan lebar testikel adalah berbeza pada Kacukan Tempatan apabila dibandingkan dengan Boer. Data yang diperolehi menunjukkan saiz testikel, ujian libido dan kualiti air mani pada Kacukan Tempatan adalah lebih tinggi dan lebih baik daripada Boer. Hubungan antara saiz testikel dengan libido dan kualiti semen juga boleh digunakan dalam pemilihan baka.

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APPROVAL SHEET

I certify that this research project report entitled "Libido and Semen Quality of Goats at UMPKB Farm" has been examined and approved as a partial fulfillment of the requirement for the degree of Bachelor of Bioindustry Science in the Faculty of Agriculture and Food Sciences, Universiti Putra Malaysia Bintulu Campus.

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CHAPTER I

INTRODUCTION

Background

Goat is one of the main livestock in Malaysia and goat farming industry is accorded high priority in the Third National Agriculture Plan (NAP 3). It has been reared for many years. Goats have adapted to be raised in most regions of the world including temperate and tropical countries. Many breeds and production systems are used. Goats make a significant contribution to society worldwide by supplying meat, milk, wool, mohair, and other resources. In many cultures they are also important in religious ceremonies.

There are different types and breeds of goat, for example the breeds in temperate countries are Boer, Saanen, Toggenburg, Alpine and Anglo Nubian while in tropical countries are Katjang, Jamnapari, Local Crossbred and Etawah (Jamnapari x Local Indonesia). In temperate zones, goats are more preferred for their milk while in tropical zones, goats are preferred for their meat. It is also low in fat compared to other meats such as cattle and sheep. Nonetheless, there are more than 465 million goats worldwide currently producing more than 4.6 million tons of milk and 1.3 million tons of meat (Thambi, 2007).

Sexual behaviour and semen quality are the main factors that limit male reproductive efficiency. These factors could vary according to the breed, geographical location, season of the year (Chemineau, 1986, Canedo *et al.*, 1996 and Karagiannidis *et al.*, 2000), testicular size (Islam and Land, 1977, Lincoln and Short, 1980, Dufour *et al.*, 1984 and Ahmad and Noakes, 1995) and circulating gonadotropins (Lincoln and Short, 1980, Sanford *et al.*, 1984, Pelletier and Almeida, 1987, Perez and Mateos, 1995 and Kaya *et al.*, 1999).

Male reproductive traits are affected by nutrition and also by genotype, season, management, disease and parasite infestation levels (Barth and Oko, 1989; Dowsett and Knott, 1996; Bielli *et al.*, 2000; Karagiannidis *et al.*, 2000). Season of the year seems to be the principle cue affecting semen quality in goats especially in temperate countries.

The goat is important because it can be a major source of animal protein in the tropics. Because of the high demand for goat meat and milk, a lot of research has been done to improve the quality and quantity of meat and milk of goats. Research has also been done on various aspects of production including semen quality and quantity.

Objectives

Though, a lot of researches had been done on libido and semen quality of goats in the West but in Malaysia information is limited except for the studies by Abdul Wahid and Jaafar (1989, 1991) and Murugaiyah and Abdul Wahid (1991). Actually, there is no information at all on the libido and semen quality of goats at Universiti Putra Malaysia Campus Bintulu (UPMKB).

The overall aim of this research was to study the incidence of libido and semen quality of goats at UPMKB farm. The study would be able to determine the following information:

- Testicle size of the goats at UPMKB farm,
- Libido of the goats,
- Semen quantity and quality of the goats,
- Relationship between testicle size and libido, and
- Relationship between testicle size and semen quantity and quality.

CHAPTER II

LITERATURE REVIEW

Testicle Size

Testes, vas deferens, accessory glands, and the penis are the primary structures of the male reproductive tract. The testicles which descend from the body cavity in late fetal life and are protected by the scrotum produce male sex cells (spermatozoa or sperm) and sex hormones (Wilson and Kevin, 2000). According to Brackett (2004), the male reproductive system functions to produce spermatozoa and to ensure sperm maturation and the deposition of sperm in the female reproductive tract for sexual production of offspring to perpetuate the species in late fetal life.

The production of sperm is very temperature dependent, occurring at temperatures 4-7 °C lower than normal body temperature (Salamon, 1976). The body has developed several mechanisms to maintain proper temperature control and the testes begin development in the abdominal cavity, but descend from the abdomen to the scrotum (Damron, 2006).

At the same time, Damron (2006) and Herren (2000) reported that the scrotum protects the testes and allows quick cooling for the testes to maintain proper temperature. The scrotum contains many thermosensors, which determine the outside temperature and cause several reactions, including scrotal sweating to dissipate the

heat. If the body is not able to dispense enough heat and the testes become too warm, sperm production may stop (Damron, 2006).

Testes play two roles of major biological importance: (1) the production of spermatozoa through the process of spermatogenesis and (2) the production of steroid hormones, especially androgens primarily testosterone (Brackett, 2004). Within the testis is a series of long coiled tubes, the seminiferous tubules, where the sperm are produced and undergo maturation. Other cells between the seminiferous tubules called interstitial cells are responsible for the production of the male hormone, testosterone.

Testicular traits are important variables closely associated with sperm features and animal fertility (Mekasha, 2007). The shape and content of the scrotum are associated with fertility parameters (Coulter and Foote, 1977). Scrotal circumference and testicular consistency have been widely used in predicting the reproductive capacity of male domestic animals. This is because scrotal circumference is an indirect measurement of testicular mass and a reliable indicator of testicular growth (Daudu, 1984). Circumference of the two testes in the scrotum approximates 42 cm (Hahn *et al.*, 1969). Testicular weight is reliable variable for estimating the sperm production capacity of males. It can be used to select males for testicular size at puberty (Coulter *et al.*, 1975).

The size and firmness of the testes are important in selecting breeding stock. These are the producing structures, and sperm production is related to size. Scrotal circumference may be measured with a flexible tape and is more closely related to testicular size than is testicular length (Hahn *et al.*, 1969).

Testicular development is rapid at an early age, which is followed by a period of slow growth in goat kids (Nsoso *et al.*, 2004). Brito *et al.* (2002) also demonstrated that scrotal circumference increases rapidly in young bulls, but only gradually in mature bulls, and even decreases in old bulls. Similarly, Bongso *et al.* (1982) reported that scrotal circumference increases rapidly in young bucks, but only gradually in mature bucks, and even decreases in old bucks and they mentioned that in goat bucks too, the increase in testicular is curvilinearly related to age. However, comparing the growth of male animals and testicular mass, growth of the latter was slow especially at later ages. Similar result were found by Nishimura *et al.* (2000), that increment in testicular weight as percentage of body weight was higher before 12 months of age, but was lowered by 24 months, in the Tokora (Japanese) goat.

Libido

Barkawi *et al.* (2005) reported that weak sexual behavior is the main factors that limit male reproductive efficiency during the year. Adult male and female sexual behavior depends on a variety of factors – physiological, environmental, and psychological – for its expression (Katherine, 1998). Libido and the capability of completing the mating act can only be measured by actual testing of the male (Sorensen, 1979).

Development of the sexual behavior in male goats is a gradual process. The clear signs of libido observed in young bucks before semen production are caused by secretion of testosterone prior to the onset of active spermatogenesis, and is responsible for the collection of clear transparent yellowish secretion before appearance of spermatogonia in the ejaculate (Abdul Wahid and Jaafar, 1989).

Ejaculation is the propulsive discharge of semen from the penis coincidental with the male climax or orgasm, the peak of sexual excitement. It is the result of a series of events normally initiated with libido on the part of the male. Libido or sexual desire is caused by testosterone, the male sex hormone, and is present to some extent continually in the male (Brackett, 2004 and Sorensen, 1979).

Wilson and Kevin (2000), also reported the same statement that testosterone is responsible for the characteristics that govern the behavior and appearance of the male (secondary sex characteristics). Without testosterone the animal would not have male appearance, male temperament, or libido. State of health dictates to some extent

the level of libido, since animals in poor health have less desire to mate. The presence of a female in estrus increases sexual activity of the male although it will also try to mount females that are not in estrus (Sorensen, 1979).

Castration of males is a routine procedure in a reproductive management program. The depressing action of castration varies with the species, the individual, and the physiological and behavioral status of the animal at the time of operation. Two parameters of normal sexual behavior are the animal's desire to mount and the ability to ejaculate and it has been reported that the desire to mount is retained for a longer period than the ability to ejaculate. The attainment of an erection is the last aspect of normal sexual behavior to disappear after castration (Hafez *et al.*, 2000).

Kamal *et al.* (2005) indicated that the Saanen bucks were found to have a definite breeding season (early autumn to winter), and libido was significantly higher ($P < 0.05$) in autumn with an average value of 61.98 seconds (sec). Nubian bucks had normal libido (summer and autumn) with an average value of 35.2 sec.

Jainudeen *et al.* (2000) reported that in temperate zone, the length of the sexual season varies with day length, breed, and nutrition. They also reported that sexual activity of the buck is influenced by day length. Peak sexual activity occurs during the fall and same with the rise in plasma testosterone level during the fall breeding season.

According to the research done by Abdul Wahid and Jaafar, (1989) about variability in libido and semen quality of purebred and crossbred Katjang bucks, they found that the back cross of (Saanen × Katjang) × Katjang possessed the greatest libido by recording the shortest time to mount (12.62 ± 1.98 sec), the shortest time to ejaculate (17.67 ± 4.22 sec) and (1.21 ± 0.11) as the least number of mounts per successful ejaculation. Libido was positively and significantly correlated with environmental temperature only in back cross (Anglo Nubian × Katjang) × Katjang.

According to Kamal *et al.* (2005), the Saanen bucks were found to have a definite breeding season in early autumn to winter and libido was significantly higher ($P < 0.05$) in autumn with an average value of 61.98 sec. Nubian bucks had normal libido in summer and autumn with an average value of 35.2 sec. Bucks showed the best libido in summer, using fewer number of mounts ($P < 0.01$) and shorter reaction time ($P < 0.01$), while the lowest libido was observed in spring (Barkawi *et al.*, 2005).

Puberty marks that time in an animal's life when it attains breeding capability. The male attains puberty when androgens are produced, sperm are produced and the reproductive organs matured (Sorensen, 1979). The time taken for male goats to reach puberty varies based on genotype, nutrition, season and other environmental factors (Abi-Saab *et al.*, 1997). Depending on nutritional status and breed, most tropical male goats attain puberty at approximately eight months of age (Delgadillo *et al.*, 1997; Madani and Rahal, 1988) while Payne and Wilson (1999) reported that tropical male goats reach puberty at approximately 97 days and sexual maturity at 132 days of age.

These result contrast with reports of Chakraborty *et al.* (1989) who found male Nubian goats reaching puberty at 32 weeks of age, based on the first collection of an ejaculate containing motile spermatozoa. These obvious variations in findings could be attributed to differences in breed, nutritional management, frequency of semen collection and other environmental factors (Mekasha, 2007).

Semen Quantity and Quality

Semen is the liquid cellular suspension containing spermatozoa, the male gametes, and secretions from the accessory organs of the male reproductive tract (Hafez *et al.*, 2000) and it is the product of ejaculation. The importance of the male lies in its ability to produce good quality semen. The quality of semen in an ejaculate not only depends on the producing ability of the male but on factors such as temperature, nutrition and breed (Murugaiyah and Abdul Wahid, 1989) and in temperate country, season of the year seems to be the principle cue affecting semen quality in goats (Barkawi *et al.*, 2005).

The most practical semen collection method for domestic species involves use of an artificial vagina (AV; Bracket, 2004). When using an AV, false mount may increase ejaculate volume. Sperm are unique and their quality and quantity should be assessed immediately after collection (Ax *et al.*, 2000).

According to Ax *et al.* (2000), buck semen is grayish white to yellow and color varies more than in ram semen. Ejaculate volume is 1.0 mL with a range of 0.5 and 1.2 mL. Sperm concentration of buck is lower than the ram and it ranges from 2.5×10^9 to 5.0×10^9 sperm/mL. Compiled characteristics of semen for goats from Bearden and Fuquay, (2000), and Cole and Garrett, (1980), showed that ejaculate volume is 0.8 mL, sperm concentration is 2.4×10^9 mL and percentage of motile sperm is 80%.

The volume and concentration of semen within species varies depending on the climatic conditions, age, nutrition, breed and health status of the animal and frequency of use (Salamon, 1976) Breed is one factor that influence seminal traits in animals. This has been demonstrated in alpine, Saanen and Damascus goat breeds, in which differences between breeds affected most seminal characteristics (Karagiannidis *et al.*, 2000), while Ax *et al.* (2000) mentioned that semen collection procedure and season of the year also influenced total volume and sperm concentration. Weak semen quality is the main factors that limit male reproductive efficiency during the year (Barkawi *et al.*, 2005).

In study done by Zamiri and Heidari (2006) about reproductive characteristics of Rayini male goats of Kerman province in Iran, showed that semen volume, sperm concentration, percentage live and dead sperm were significantly higher during the summer months. They also reported that the average semen volume, percentage live sperm and percentage abnormal sperm varied between 1 and 1.4 mL, 60 and 78% and 7 and 13% respectively. They also indicated that semen quantity and quality of Rayini bucks were higher during summer and early autumn.

Kamal *et al.* (2005) made a Comparative Studies on Reproductive Performance of Nubian and Saanen bucks under the climatic conditions of Khartoum. They found that semen of Saanen and Nubian bucks were 0.77 and 0.88 mL in volume, concentration of 2.77×10^{10} and 2.08×10^{10} sperm/mL, possessed 68.7 and 82.78% live sperm and 15.49 and 6.1% dead sperm. The poorest quality semen was collected during summer, with the highest abnormality (19.32%).

During autumn, bucks recorded the highest ejaculate volume (0.98 mL) and the maximum output of sperm (4565×10^6), as well as a lower percentage of sperm abnormalities (8.8%). It can be said that Zaraibi bucks have distinct seasonal activity, with poor semen characteristics during winter and spring, which may be a critical obstacle for implementing intensive systems of three kiddings in 2 years when natural mating is applied (Barkawi *et al.*, 2005).

Webb *et al.* (2004) indicated that the semen volume (1.77 ± 0.3 mL) of indigenous bucks was marginally higher compared to the Gorno Altai but sperm concentration was higher ($P < 0.05$) in Gorno Altai ($161.3 \pm 83.6 \times 10^6$ sperm/mL) than in indigenous bucks ($126.5 \pm 73.2 \times 10^6$ sperm/mL) particularly during winter and early spring. Semen volume in May (mid autumn) and in August (winter) differed significantly ($P < 0.05$) between the Gorno Altai (2 ± 0.52 mL and 1.55 ± 0.24 mL) and indigenous bucks was (1.77 ± 0.3 mL) higher than Gorno Altai (1.28 ± 0.25 mL).

Ahmad and Noakes, (1996) reported through their study about seasonal variations in the semen quality of young British goats, that the physical appearance of the ejaculates varied from a whitish yellow colour during September to December to a creamy white colour during the remainder of the year. Ejaculate volume decreased from 0.96 ± 0.06 mL in October to the minimum value of 0.39 ± 0.03 mL in April and 0.38 ± 0.02 mL in July, after which there was a sharp increase to the highest value (1.04 ± 0.05 mL) in September. Sperm cell concentration per mL was lowest ($3.66 \pm 0.16 \times 10^9$), during November and highest ($6.56 \pm 0.29 \times 10^9$) during May. However, the total sperm per ejaculate were highest during the September and lowest in December. The mass and individual motilities were higher during August to December than in the remainder of the year. The percentages of dead were highest during May. The effect of the months and seasons of the year on all parameters of semen quality were significant ($P < 0.01$).

In study done by Abdul Wahid and Jaafar, (1989) the back cross of (Saanen × Katjang) × Katjang produced slightly lesser volume of semen (0.52 ± 0.03 mL) but possessed the greatest sperm count of $39.95 \pm 2.15 \times 10^8$ sperm/mL. The motility was greatest in (Saanen × Katjang) × Katjang group followed by Anglo Nubian × Katjang group. They also reported that the motility was increased, the number of dead sperm was reduced and sperm count was increased when Katjang blood in (Saanen × Katjang) × Katjang group was increased.

Relationship between Testicle Size and Libido

The sexual activity of the buck is also influenced by day length. Peak sexual activity occurs during the fall and coincides with the sharp rise in plasma testosterone one level during the fall breeding season (Jainudeen *et al.*, 2000). They also mentioned that puberty in the buck is associated with a marked in crease in testosterone secretion, spermatogenesis, and mating behavior.

Larged sized breeds grow faster but mature sexually later than small sized breeds. Likewise, larged sized breeds are heavier and have larger testicular measurements than small sized breeds, and continue to grow until late in their maturation (Al-Ghalban *et al.*, 2004). It also supported by genotype differences in testicular size (Tegegne *et al.*, 1992).

In study done by Abdul Wahid and Jaafar, (1989) sperm count was strongly correlated with time to mount and time to ejaculate in purebred Katjang, first cross of Saanen × Katjang, back cross of (Anglo Nubian × Katjang) to dam breed Katjang, back cross of (Saanen × Katjang) to dam breed Katjang and except in first cross of Anglo Nubian × Katjang. The false mounts possibly increased the quality of sperm due to multiple contractions of the musculature of the testes to release the sperm into the vas deferens.

Relationship between Testicle Size and Semen Quantity and Quality

By selecting males with larger testicle, more females could be bred per sire, resulting in greater production efficiency. Larger scrotal circumference is associated with greater ejaculate volume, higher sperm concentration, better seminal quality, and higher daily sperm production (Coulter *et al.*, 1977).

Tegegne *et al.* (1994) and Roca *et al.* (1992) reported that a strong correlation between body weight and scrotal circumference, but no signifigant correlation was observed between body weight and scrotal circumference in study done by Webb *et al.* (2004) because the number of animals was rather small. He reported that negative correlations were recorded between body weight and the percentage of live sperm and semen colour and positive correlations were found between semen volume and semen concentration (r = 0.27) and percentage of live sperm (r = 0.22).

Abnormal sperm was more prevalent at a younger age, gradually decreasing after sexual maturity, but becoming higher again at an older age (Soderquist *et al.*, 1991; Dowsett and Knott, 1996; Amann *et al.*, 2000). This is apparently due to immature spermatogenesis at a younger age, a slight propensity to testicular degeneration with age and slight disturbances in epididymal function at older ages (Jackson and Dowsett, 1994 and Dowsett and Knott, 1996).

Abdul Wahid and Jaafar, (1989) indicated that number of dead sperm was negatively correlated with rainfall especially in Katjang × Katjang group and Saanen × Katjang group but they also mentioned that the weight was negatively correlated with rainfall in the same breed groups. The number of dead sperms and the body weight were strongly but negative correlated with rainfall because of the reduction in the number of dead sperms. Rainfall results in low temperature and increased the survivability of the sperms. They also showed that the breed group which was adapted to the hot and humid climate performed better in less rainy areas especially in Katjang goat as a component breed.

CHAPTER III

METHODOLOGY

Location

The study was conducted from December 2007 till February 2008 at the goat unit of UPMKB farm.

Animal

Three bucks each of the two breeds and does were used for this study. The animals were about two years and their body weight ranged between 18 to 50 kg and were in good health. The bucks were housed in wooden sheds separated from the females. During the period of this study, they were fed on mixed pastures and provided with salt lick and fresh water. Before initiating collection of the semen, the bucks were trained for 3 weeks to mount the teaser and deposit the semen into an artificial vagina (AV). A doe was used as a teaser.

Table 1: Average body weight and age of bucks use for study

	Local Crossbred	Boer
N	3	3
Body weight	27 kg	24 kg
Age	2 years 4 months	2 years

Data Collection Procedures and Measurements

Testicle Size

Cloth measuring tape and plastic caliper were used to measure the testicle size. Testicular circumference was measured by using a cloth measuring tape. Testis length and breadth, however, was measured by using plastic caliper (Figure 1).

Figure 1: Measuring of the testicle size

Libido Test

The bucks were released from a distance of three meters from the teaser stand (Figure 2).

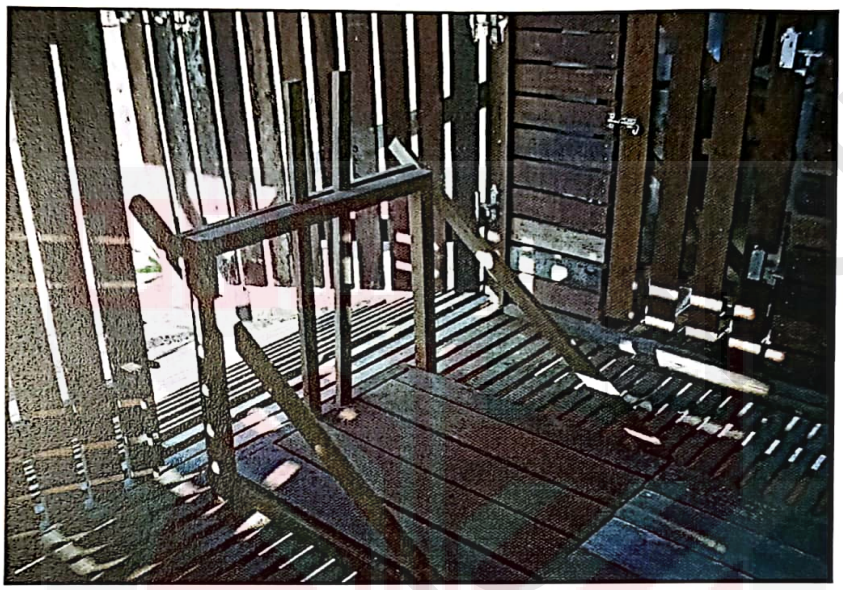

Figure 2: Teaser stand

Two stopwatches were used to record the time. Libido parameters that were quantified were:

i. Time taken to mount the teaser

ii. Time taken to ejaculate, and

iii. Number of mounts per successful ejaculation

Two stopwatches were clicked and when the buck mounted the teaser, one of the stopwatches was stopped. The other stopwatch was only stopped when the buck ejaculated semen into the vagina (Figure 3). The number of mounts made by the buck before it actually ejaculated was recorded.

Figure 3: Performing libido test

Semen Quantity and Quality

For semen quantity and quality, an AV was used to collect semen from the bucks. To collect the semen, the male was allowed to mount the teaser and the penis is diverted into the AV where the buck ejaculated. It was better to allow the male to thrust into the AV rather than trying to slide the AV into the male's penis (Figure 4).

Figure 4: Collection of semen using an Artificial Vagina

After collection, each ejaculate was evaluated for:

i. Volume (mL) - Volume of the semen was assessed in graduated test tube which ranged from 0-5 mL.

ii. Colour – It is pertinent that color of the semen samples should be immediately recorded after a collection using naked eyes. The colour of semen was classified as pearly white to grey or creamy white and translucent.

iii. Gross motility (grade 0-3) – Examination was made as soon as possible after collection. To be made on a clean and warm microscope slide by placing a small drop of semen, spreading it gently and preventing it from drying. The same magnification low power magnification (10×) on the microscope was always used. Scoring system was recommended by Salamon, (1976) was (0-5), however for this study of recording motility was used (0-3):

Table 2: Scoring system of recording motility

Score	Description
3	Good motility
2	Fair motility
1	Poor motility
0	No motility

- Score 3 was for a dense very rapid vigorous waves, changing direction very rapidly and about 80% or more of the spermatozoa are alive and active.
- Score 2 was fair motility that from 50 to 75 % of spermatozoa are alive, there are no or only small and slow waves.
- Score 1 was from 10 to 45 % of spermatozoa are alive, but their motility is poor and no waves are formed.
- Score 0 showed all spermatozoa dead.

iv. Percentage live and dead sperm – Eosin-Nigrosin stain was used to determine percentage live and dead sperm. To make a smear, one drop of semen was placed on a clean and dry glass slide and a drop of the above stain was added. The mixture is drawn out with the edge of another clean slide to form a thin film. Examining the smear under microscope, not less than a total of 100 spermatozoa counted and examined the more reliable the estimate will be. Sperms were counted on the smear under the microscope using magnification (100×) after 2 minutes. The dead sperm was showed in pink or red colour while live sperm remained clear with a blue or black background.

v. Concentration of sperm/mL – Haemocytometer was used to determine the concentration. Separate counts were made in five large squares on each side of the haemocytometer by using microscope under low magnification (40×). Prior to counting the sperm, they had to be killed to prevent movement, which was accomplished by adding a small amount of formal saline to the semen. Formal saline (9.99 mL) was drawn into a testube. Raw semen (0.01 mL) was added into the formal saline and mixed, and then allowed to stand for a few minutes. A cover slip was placed over the haemocytometer, and the mixed semen with formal saline was drawn into a pipette. The tip of the pipette was touched at the edge of the haemocytometer and a dropped of diluted semen was allowed to run under the coverslip. Care was taken not to form bubbles. The semen was allowed to settle for 3-4 minutes and the numbers of sperms were then counted under the microscope. Four corners and the centre were counted. When counting, counted only those cells on the lines of two sides of the large square to avoid counting cells twice.

The formula for counting the total number of sperms using the haemocytometer was:

$$(a) \times 1000\ (b) \times 10000\ (c) \times 5\ (d) = \text{total sperm cells}$$

Where a, b, c and d were number of sperm counted, dilution factor, area of the haemocytometer and total number of squares in the haemocytometer (Figure 5).

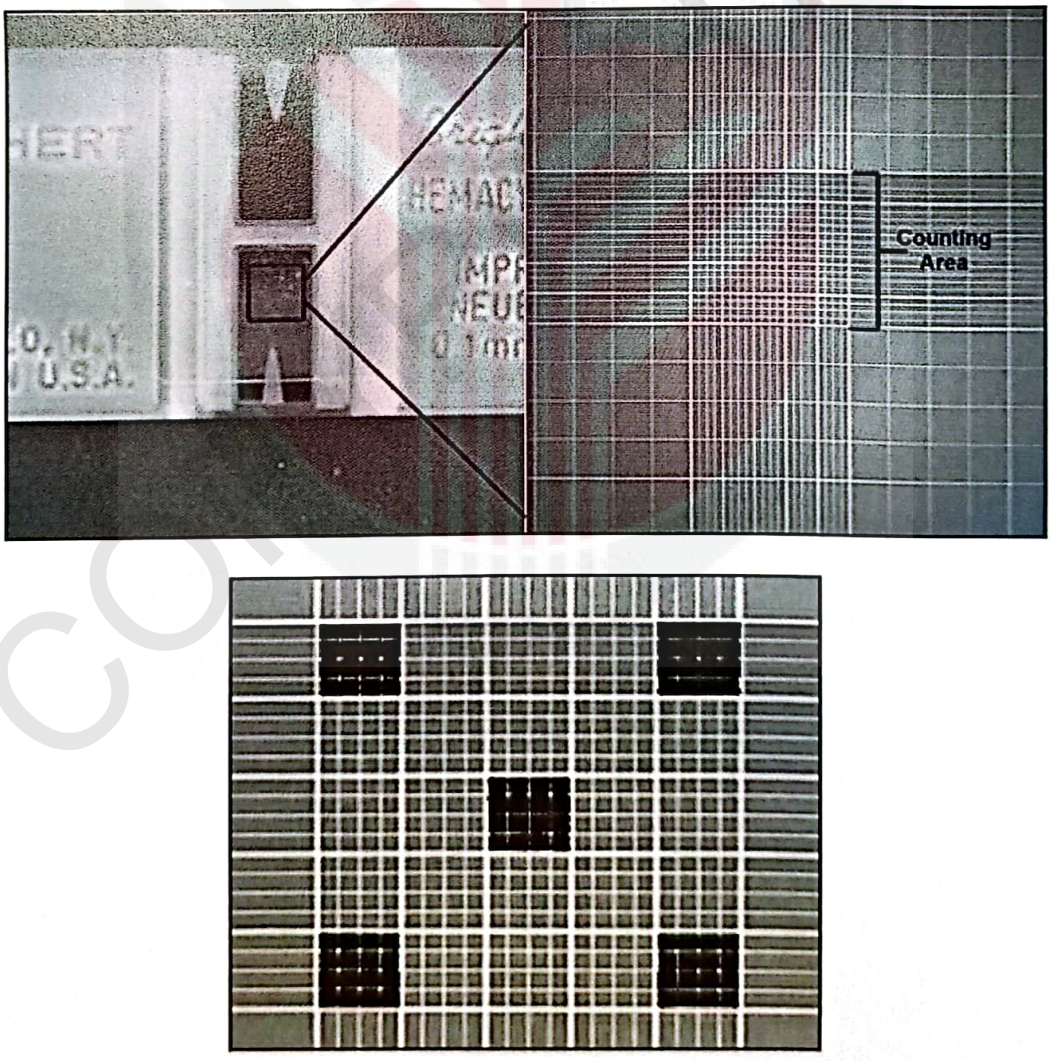

Figure 5: Counting sperm cells with a haemocytometer

Statistical Analysis

The data collected over two months was analyzed using the Statistical Analysis System (SAS) version 9.1. In order to make a comparison of the means of testicular size, libido and quality of sperm between two different breed, upon evaluation of equality of variance, independent sample t-test was used. Proc plot was used to plot the variable means over time period. The correlation between testicle size with libido and semen quality was determined. Mean values were considered to be statistically significant at $P < 0.05$ and $P < 0.01$.

CHAPTER IV

RESULTS

Testicle Size

Testicle is responsible for the production of sperm and male sex hormone. The size and firmness of the testicle are important characteristics in selecting breeding stock. Testicle size is depicted by the circumference, length and breadth of the testicle of the animal. Therefore, it is relevant to show the quality of the animal by separating the superior from the inferior animals based on the testicle measurements.

Testicle Circumference

The mean values of testicle circumference are presented in Table 3. The mean testicle circumference in Local Crossbred and Boer was 23.78 ± 0.19 cm and 22.42 ± 0.14 cm respectively. There was significant difference between means of testicle circumference of Local Crossbred and Boer ($P < 0.05$). The graphical presentation of testicle circumference is shown in Figure 6. Maximum testicle circumference was 26.6 cm for the Local Crossbred and 24.3 cm for the Boer. Minimum testicle circumference was 21.8 and 20.8 cm for the Local Crossbred and Boer respectively. The size of testicle circumference among Local Crossbred and Boer showed an increasing trend with time period. Testicle circumference gradually increased in Local Crossbred. Rapid increase in testicle circumference can also be seen in Boer.

Table 3: Mean values of testicle measurements of two different breed groups

	Local Crossbred	Boer
Testicle circumference (cm)	$23.78^{b} \pm 0.19$	$22.42^{a} \pm 0.14$
Testicle length (cm)	$7.95^{a} \pm 0.05$	$7.95^{a} \pm 0.06$
Testicle breadth (cm)	$8.41^{b} \pm 0.08$	$7.82^{a} \pm 0.05$

Note: Different letters indicate significant difference using independent t-test at $P \leq 0.05$

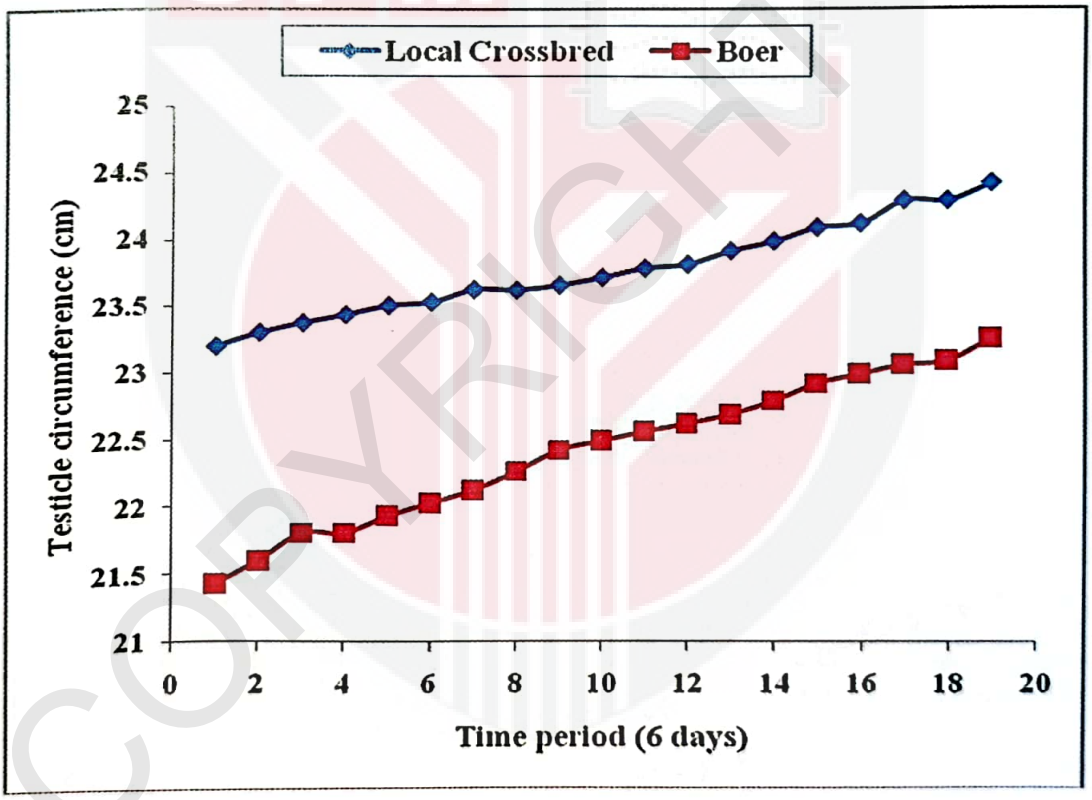

Figure 6: Mean of testicle circumference of two different breed group

Testicle Length

The mean values of length are presented in Table 3. The means testicle length were same (7.95 cm) and not significantly different in Local Crossbred as compared with Boer. The graphically presentation of testicle length during the time period is shown in Figure 7. The range of testicle length was from 7.58 to 8.57 cm in Local Crossbred and 7.43 to 8.55 cm in Boer. Testicle length was constantly increased from time period 1 until 12. Rapid increase in testicle length can be seen resulted from time period 13 to 16 in Local Crossbred. However, the rapid increase in Local Crossbred ceased at time period 15 and gradual increment occurred thereafter. According to the graph, testicle length for Boer was rapidly increased from time period 13 until 14. The length of the Local Crossbred and Boer at time period 18 to 19 was nearly same 8.55 and 8.57 cm, respectively.

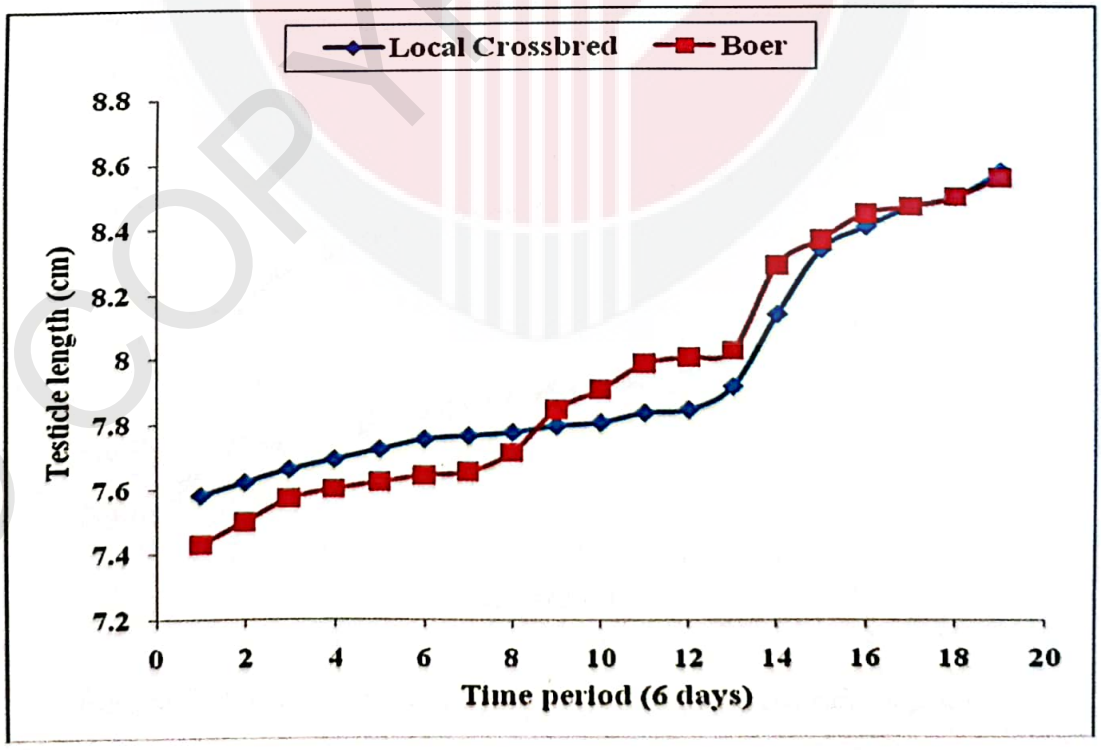

Figure7: Mean of testicle length of two different breed groups

Testicle Breadth

Testicle breadth means are presented in Table 3. During the study, Local Crossbred goats recorded larger testicle breadth (8.41 ± 0.08 cm) compared to Boer bucks (7.82 ± 0.05 cm) respectively. There was significant difference between means of Local Crossbred and Boer on their testicle breadth ($P < 0.05$). Figure 8 show the graph of testicle breadth during the time period. The range of testicle breadth was from 8.06 to 8.75 cm in Local Crossbred and 7.62 cm to 8.01 cm in Boer. The testicle breadth of Local Crossbred and Boer increased in a normal manner. Increment can be seen from early time period until the end of the time period of study in Local Crossbred and Boer. The growth of testicle breadth of Local Crossbred was found to be better than that of the Boer.

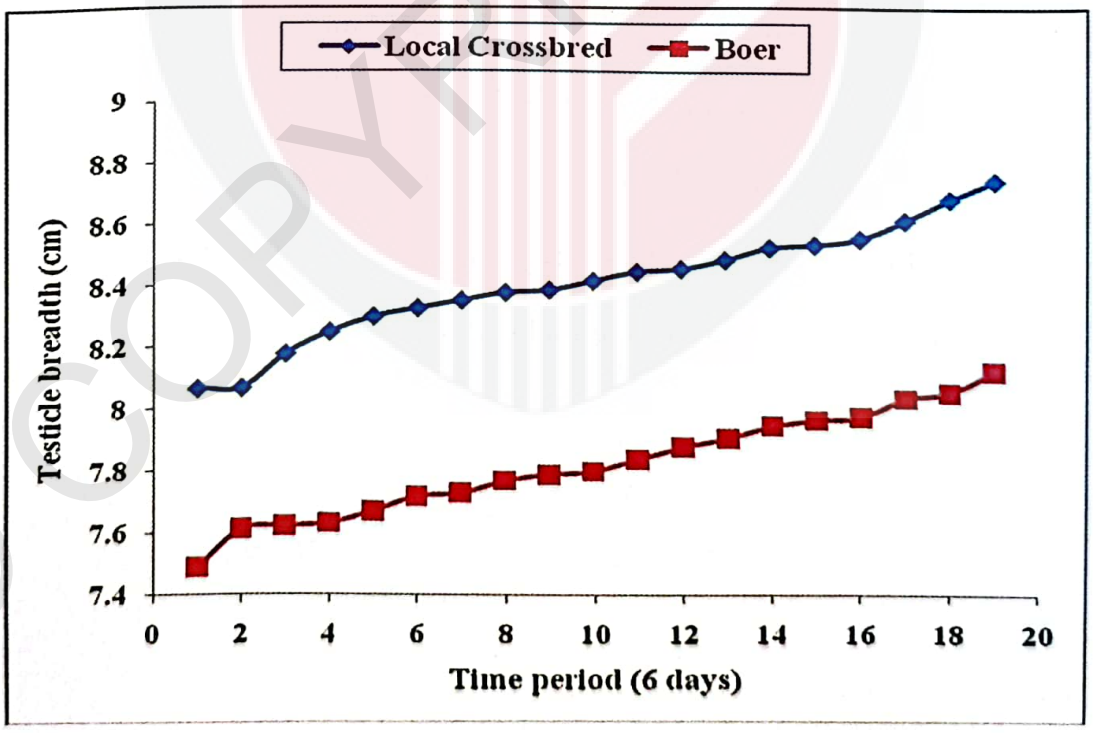

Figure 8: Mean of testicle breadth of two different breed groups

Libido Test

Libido and the capability of completing the mating act can only be measured by actual testing of the male. Bucks must have access to an estrous female, desire to mount, and be physically able to mount and serve the female. Therefore, this study was depicted by three parameters; the time to mount the teaser, time to ejaculate and number of mounts per successful ejaculation of the animal.

Time to Mount

The study showed that the Local Crossbred possessed the greatest libido by recording the shortest time to mount (10.78 ± 1.10 sec) as compared to Boer (57.90 ± 6.03 sec) in Table 4. There was significant difference between means of time to mount of Local Crossbred and Boer ($P < 0.05$). The graphs of time to mount during the time period are shown in Figure 9. It shows that time to mount of Boer fluctuated rather widely between time period to time period. The time to mount was decreased rapidly from the beginning until 13 time period and then plateaued thereafter in Boer while Local Crossbred showed more regular pattern throughout the study.

Table 4: Mean values of libido of two different breed groups

	Local Crossbred	Boer
Time to mount (sec)	$10.78^{b} \pm 1.10$	$57.90^{a} \pm 6.03$
Time to ejaculate (sec)	$42.83^{b} \pm 8.60$	$90.27^{a} \pm 9.25$
No. of mounts	$2.82^{a} \pm 0.33$	$2.72^{a} \pm 0.20$

Note: Different letters indicate significant difference using independent t-test at $P \leq 0.05$

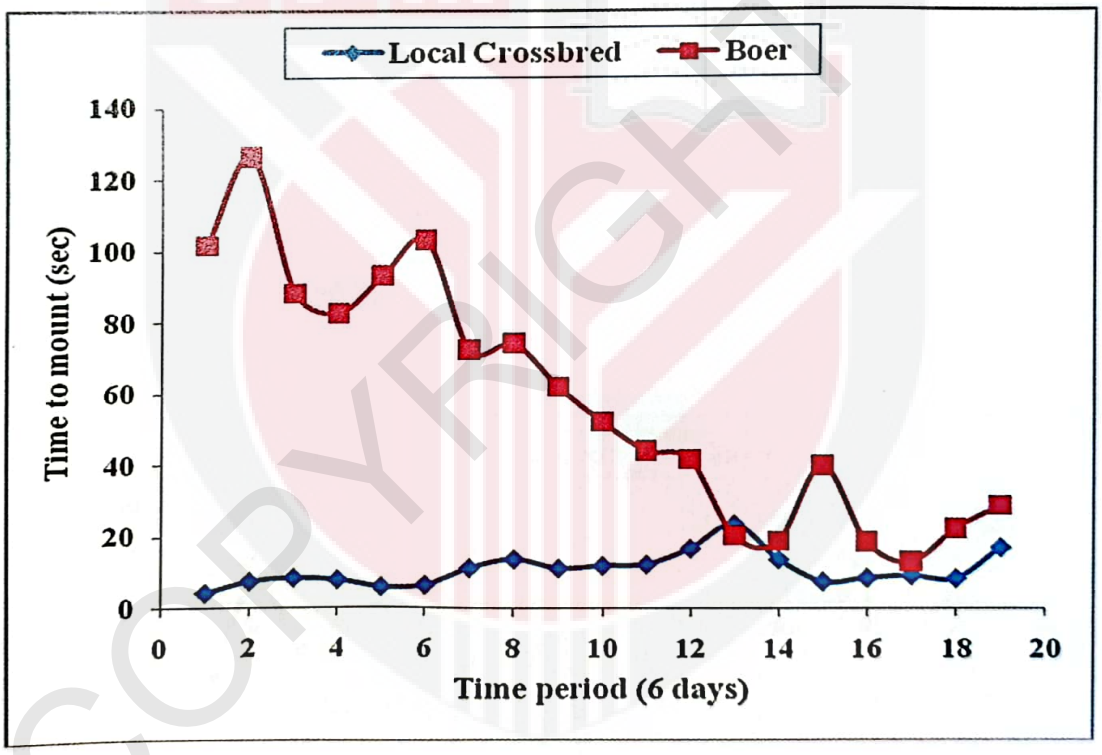

Figure 9: Mean of time to mount of two different breed groups

Time to Ejaculate

Table 4 showed that Local Crossbred have the shortest time to ejaculate (42.83 ± 8.60 sec) as compared to Boer (90.27 ± 9.25 sec). There was significant difference between means of Local Crossbred and Boer on time to ejaculate ($P < 0.05$). Presented in Figure 10 are mean of time to ejaculate by time period for Local Crossbred and Boer. It shows that time to ejaculate of Local Crossbred and Boer has fluctuated rather widely from time period to time period. The time to ejaculate ranged from a low of 12.60 sec in time period 2 and 4 to a high of 141.90 sec in time period 7 and 9. Time to ejaculate in Boer ranged from 25.70 sec in time period 17 to 171.70 sec in time period 2. Except for increment at time period 15, the values for Boer continued to decrease until time period 19 and the time to ejaculate was less in Local Crossbred than in Boer.

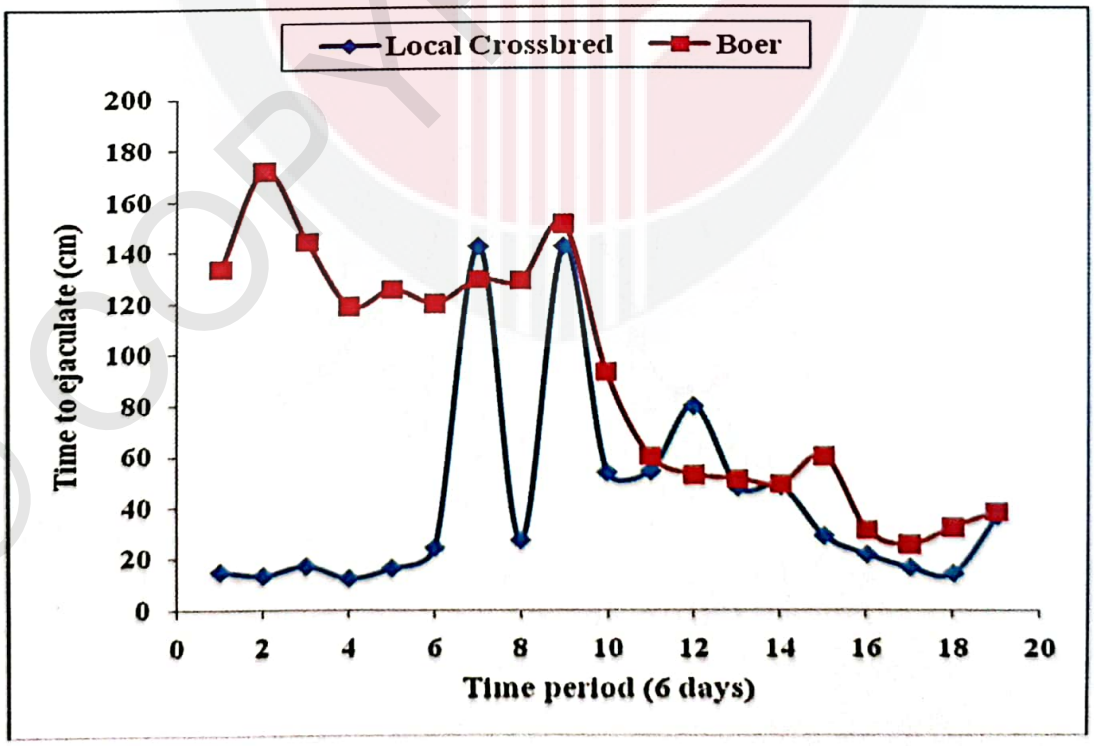

Figure 10: Mean of time to ejaculate of two different breed group

Number of Mounts per Ejaculation

The Boer showed the least number of mounts per ejaculation (2.72 ± 0.20) as compared to Local Crossbred (2.82 ± 0.33), respectively (Table 4). There was not significantly different in Local Crossbred as compared with Boer. Figure 11 shows that number of mounts of Local Crossbred and Boer has fluctuated rather widely from time period to time period. The range of mounts required Local Crossbred over the time period was from 1.00 in time period 17 and 18 and the high was 6.30 in time period 7. The low number of mounts in Boer was 1.70 in time period 12, 15 and 16, and the high was 4.70 in time period 7. It required more mounts for Local Crossbred than Boer.

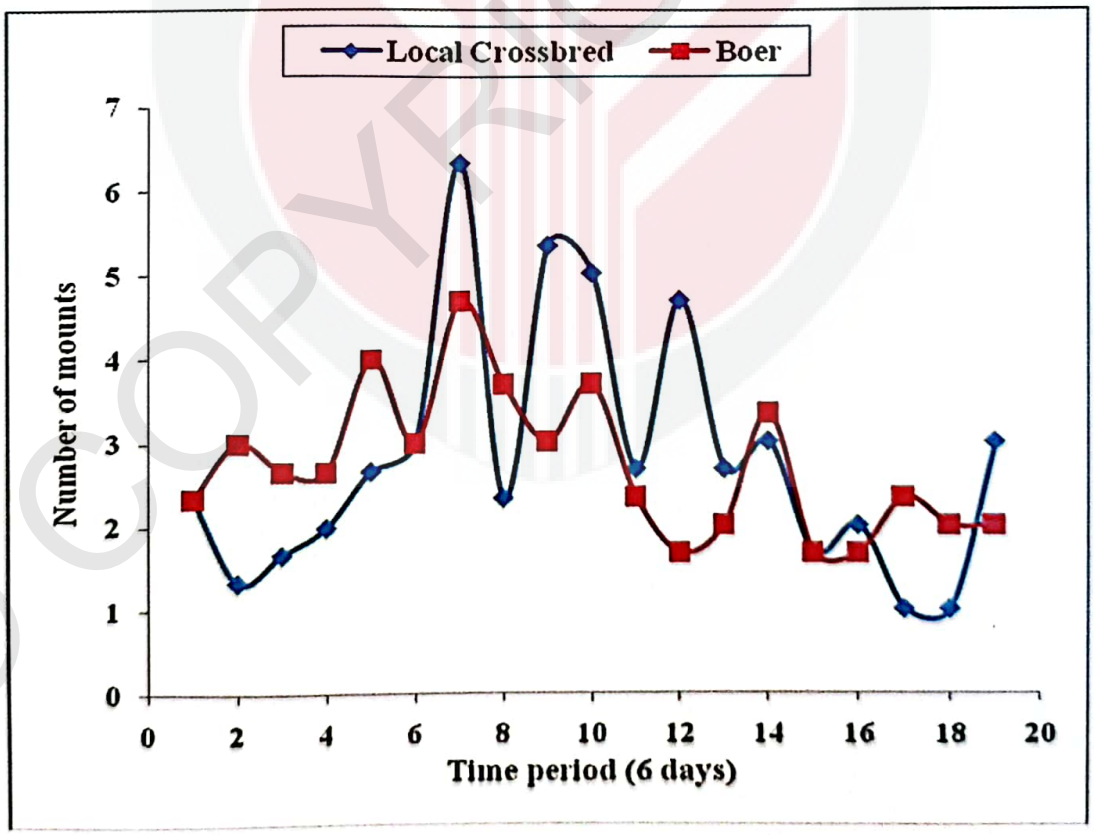

Figure 11: Mean of number of mounts per ejaculation of two different breed groups

Semen Quantity and Quality

No single test accurately predicts fertility of a sperm sample, however examining various physical characteristics of semen can determine greater fertility potential. Therefore, semen quantity and quality is depicted by the volume, percentage live sperm and sperm concentration.

Volume (mL)

As shown in Table 5, Local Crossbred produced more volume of semen (0.88 ± 0.03 mL) as compared to Boer (0.65 ± 0.04 mL). There was significant difference ($P < 0.05$) between the volumes of Local Crossbred and Boer. The mean semen volume by time period for Local Crossbred and Boer are presented in Figure 12. It shows that volume of Local Crossbred and Boer has fluctuated rather widely from time period to time period. The range of volume in Local Crossbred was from 0.60 mL in time period 12 to 1.00 mL in time period 1, 7, 8 and 9. Volume of Boer ranging from a low as 0.50 mL in time period 12 to as higher 0.80 mL in time period 4.

Table 5: Mean values of semen quality of two different breed groups

	Local Crossbred	Boer
Semen volume (mL)	$0.88^{b} \pm 0.03$	$0.65^{a} \pm 0.04$
Live sperm (%)	$78.38^{a} \pm 1.25$	$77.00^{a} \pm 1.01$
Sperm concentration ($\times 10^{9}$)	$3.78^{a} \pm 0.08$	$3.67^{a} \pm 0.06$

Note: Different letters indicate significant difference using independent t-test at $P \leq 0.05$

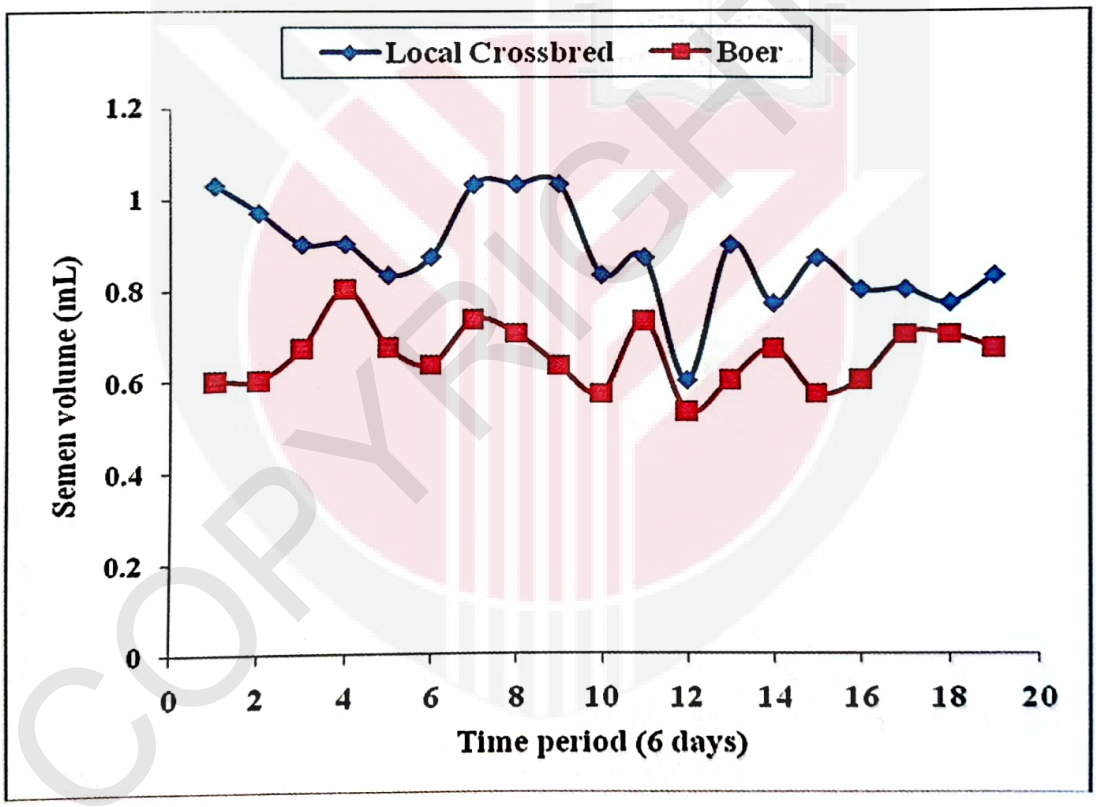

Figure 12. Mean of semen volume of two different breed groups

Gross Motility (grade 0-3)

The study showed that the percentage of Local Crossbred in score 3 was 59.65% as compared to Boer 50.88% (Table 6). Gross motility in Local Crossbred was 40.35% in score 2 while Boer was 43.86%. Percentage of Boer in score 1 was 5.26%.

Table 6: Scoring system of recording motility and colour of semen of two different breed groups

Score	Local Crossbred	Total	%	Boer	Total	%
3	2 (Thick creamy), 32 (Creamy)	34	59.65	2 (Thick creamy), 27 (Creamy)	29	50.88
2	20 (Creamy), 3 (White creamy)	23	40.35	23 (Creamy), 2 (white creamy)	25	43.86
1	-	0	0	1 (Creamy), 2 (White creamy)	3	5.26
0	-	0	0	-	0	0

Percentage of Live Sperm

The mean of percentage live sperm reached to 78.38 ± 1.25% in Local Crossbred, comparison with 77.00 ± 1.01% in the Boer, respectively (Table 5). However this difference was not statistically difference between the breeds throughout the study. Percentage of live sperm for Local Crossbred ranged from as low as 69.30% in time period 10 to as high as 85.54% in time period 4, while in Boer it ranged from 71.65% in time period 1 to 82.08% in time period 4 (Figure 13).

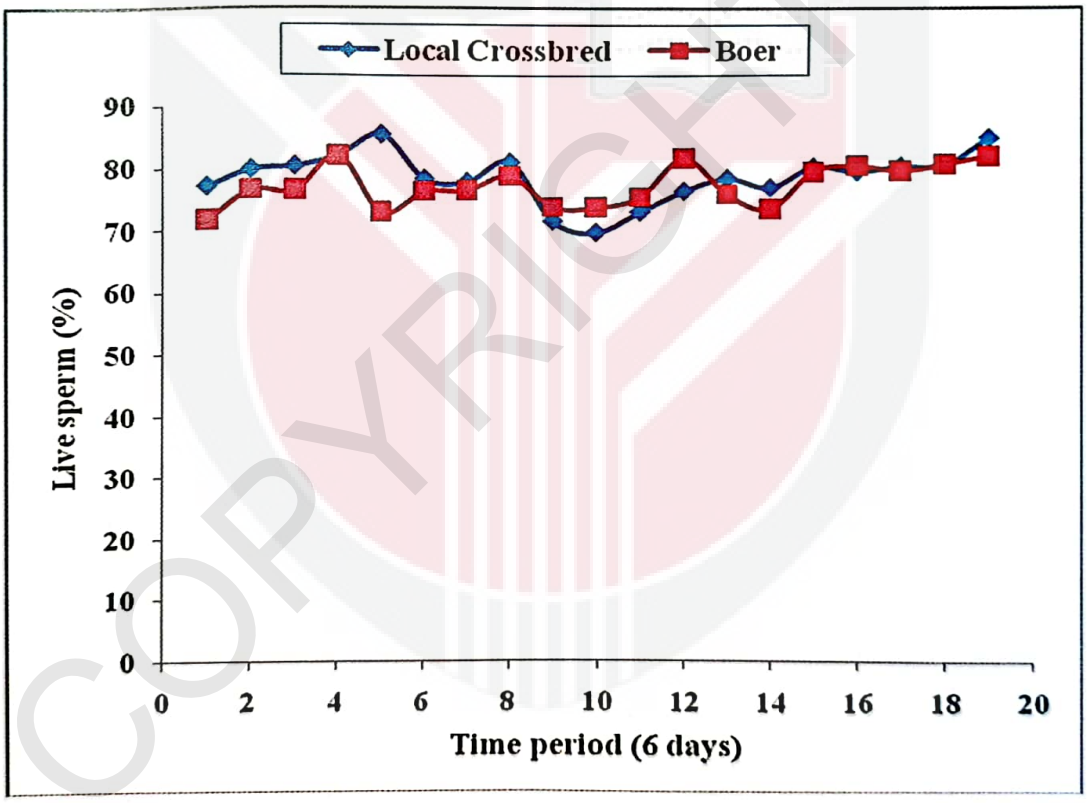

Figure 13: Mean of percentage live sperm of two different breed groups

Concentration of Sperm

There was also no significant difference between Local Crossbred and Boer as regard to sperm concentration. However, Local Crossbred possessed greater sperm concentration ($3.78 \pm 0.08 \times 10^9$) as compared to Boer ($3.67 \pm 0.06 \times 10^9$) in Table 5. The range of concentration of sperm was from 2.85 to 5.00×10^9 in Local Crossbred and 2.89 to 4.95×10^9 in Boer. Presented in Figure 14 are mean sperm concentration ($\times 10^9$) value by period for Local Crossbred and Boer. The range for Local Crossbred was from 3.15 to 4.52×10^9 in time period 1 and time period 7, while for Boer they ranged from 3.25×10^9 in time period 1 to 4.03×10^9 in time period 16.

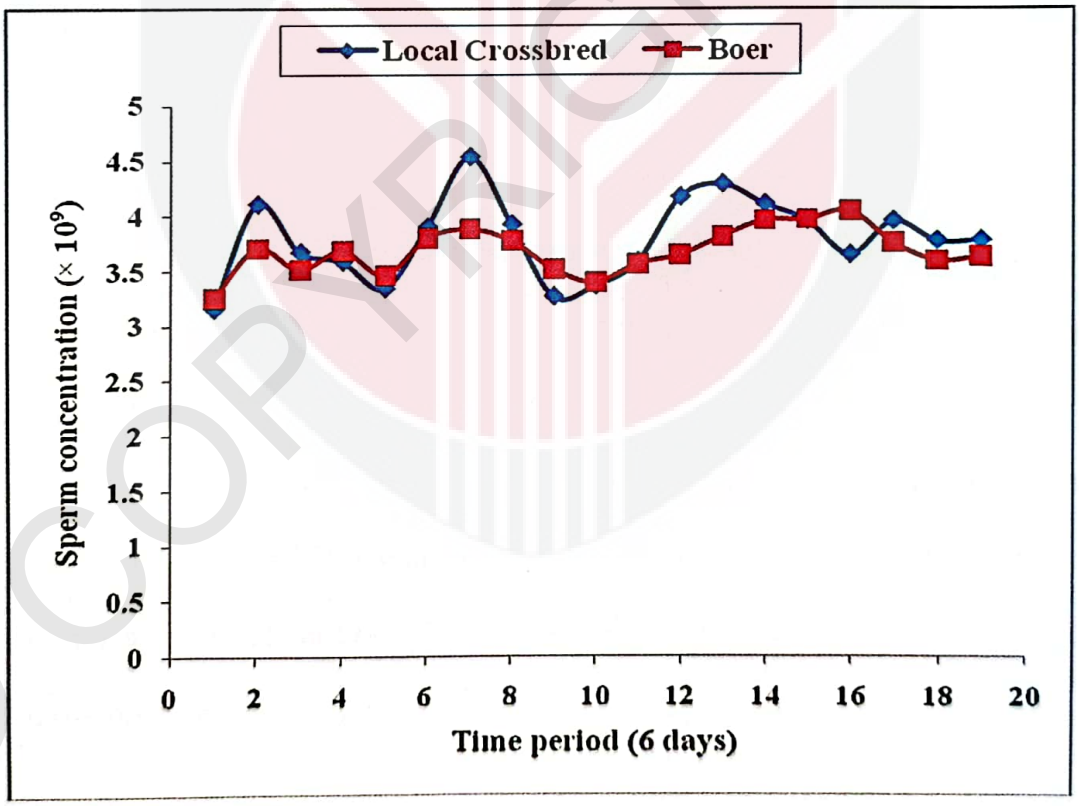

Figure 14: Mean of sperm concentration of two different breed groups

Correlation between Testicle Measurement with Libido

Correlation coefficients between testicle measurement and libido in the two breed groups of goat are shown in Table 6. There was no significant correlation between time to mount with testicle circumference, testicle length and testicle breadth in Local Crossbred even though there was a strong and negative ($P < 0.01$) relationship between time to mount with testicle circumference ($r = -0.53$), testicle length ($r = -0.63$) and testicle breadth ($r = -0.54$) in Boer.

Time to ejaculate was negatively ($P < 0.05$) correlated with testicle circumference ($r = -0.30$) in Local Crossbred compared to Boer there was strong ($P < 0.01$) but negative correlation between time to ejaculate with testicle circumference ($r = -0.55$), testicle length ($r = -0.64$) and testicle breadth ($r = -0.58$).

In Local Crossbred and Boer there was a strong ($P < 0.01$) but negative ($r = -0.36$) and ($r=-0.34$) relationship between testicle circumference and number of mounts per successful ejaculation, respectively. Testicle length was negatively ($P < 0.05$) correlated with number of mounts per successful ejaculation in Local Crossbred ($r = -0.33$) and Boer ($r = -0.37$). Negative correlations were also found between testicle breadth and number of mounts per successful ejaculation ($r = -0.28$; $P < 0.05$) in Local Crossbred and ($r = -0.37$; $P < 0.01$) in Boer.

Table 7: Correlation coefficients between testicle measurement and libido in the two breed groups of goat

Variables	Local Crossbred			Boer		
	Time to mount (sec)	Time to ejaculate (sec)	No. of mounts	Time to mount (sec)	Time to ejaculate (sec)	No. of mounts
Circumference	0.02 (ns)	-0.30*	-0.36**	-0.53**	-0.55**	-0.34**
Length	0.15 (ns)	-0.23 (ns)	-0.33*	-0.63**	-0.64**	-0.37*
Breadth	-0.03 (ns)	-0.02 (ns)	-0.28*	-0.54**	-0.58**	-0.37**

(ns) Not significant

* Significant at P < 0.05

** Significant at P < 0.01

Correlation between Testicle Measurement with Semen Quality

It was also shown (Table 7) that there was a strong and positive ($P < 0.01$) relationship between testicle circumference and volume of semen produced in the Local Crossbred ($r = 0.37$) and Boer ($r = 0.78$). In the Local Crossbred there was no relationship between testicle length and semen volume but in Boer there was strong ($P < 0.01$) relationship between testicle length and semen volume ($r = 0.40$). Testicle breadth was strong and positively ($P < 0.01$) correlated with semen volume of Local Crossbred ($r = 0.40$) and Boer ($r = 0.78$) respectively.

Testicle circumference and testicle breadth showed the largest ($P < 0.01$) correlation with the percentage of live sperm in Boer ($r = 0.53$ and $r = 0.57$) compared to Local Crossbred ($r = 0.34$ and $r = 0.44$) respectively. In Local Crossbred, there was no relationship between testicle length and percentage of live sperm but in Boer, there was positive ($P < 0.05$) relationship between testicle length and percentage of live sperm ($r = 0.32$).

In Local Crossbred there was no relationship between concentration of sperm with testicle circumference and testicle length but for testicle breadth showed the ($P < 0.05$) correlation with the concentration of sperm ($r = 0.28$). In Boer there was a strong and positive ($P < 0.01$) relationship between concentration of sperm with testicle circumference ($r = 0.52$) and testicle breadth ($r = 0.58$). It was also shown that there was a positive relationship ($P < 0.05$) between testicle length and concentration of sperm in Boer ($r = 0.32$).

Table 8: Correlation coefficient between testicle measurement and semen quality in the two breed groups of goat

Variables	Local Crossbred			Boer		
	Volume (mL)	Live sperm (%)	Sperm concentration ($\times 10^9$)	Volume (mL)	Live sperm (%)	Sperm concentration ($\times 10^9$)
Circumference	0.37**	0.34**	0.19(ns)	0.78**	0.53**	0.52**
Length	-0.11(ns)	0.04(ns)	0.07(ns)	0.40**	0.32*	0.32*
Breadth	0.40**	0.44**	0.28*	0.78**	0.57**	0.58**

(ns) Not significant

* Significant at $P < 0.05$

** Significant at $P < 0.01$

CHAPTER V

DISCUSSION

From the study, the mean testicle circumference in Local Crossbred was 23.78 ± 0.19 cm and for Boer was 22.42 ± 0.14 cm. The mean length was same between Local Crossbred and Boer. Local crossbred goats recorded a larger testicle breadth 8.41 ± 0.08 cm compared to the Boer goats (7.82 ± 0.04 cm). This result had clearly indicated that the Local Crossbred was greater in testicle size compared to the Boer. Breed and individual differences in testicle circumference have been found in Local Katjang and crossbred (Katjang × German) bucks (Noran *et al.*, 1998).

Comparable to that of Rayini bucks where the mean of testicle size of body weight group 55 to 60 kg was higher than group 50 to 54 kg. In this case variations in testis size can be explained by changes in body weight, however, it is said that seasonality may have a greater influence on testis size than body weight (Ahmad and Noakes, 1995; Delgadillo *et al.*, 1991). At the same time it also can support the result on this study based on the different weight of Local Crossbred and Boer.

At the same time, the increase of testicle circumference trend for Boer was more rapid than Local Crossbred. Similar result were found by Nishimura *et al.* (2000), that increment in testicular weight was higher before 12 months of age, but was lowered by 24 months, in the Tokora (Japanese) goat. It was indicated that age of Local Crossbred and Boer supported the result.

There was also a gradual increase in testicle circumference as the animals increased in size and grew older. As indicated by testicle circumference, length and breadth, testicular size was affected by different age. In goat kids testicular development is rapid at an early age, which is followed by a period of slow growth (Nsoso *et al.*, 2004). On the other hand, Bongso *et al.* (1982) reported that testicle circumference increases rapidly in young bucks, but only gradually in mature bucks.

The goats maybe grazed on low quality grass, and rarely receive any supplemental feed. Therefore, they will likely show great variations in testicle size and seminal characteristics throughout the study, depending on the feed availability which is highly influenced by the climatic conditions in their natural habitat.

It appeared that the Local Crossbred was better than Boer in respect to the mean time to mount (10.78 ± 1.10 sec; 57.90 ± 6.03 sec) and time to ejaculate (42.83 ± 8.60 sec; 90.27 ± 9.25 sec). The Boer showed the least number of mounts per ejaculation (2.72 ± 0.20) as compared to Local Crossbred (2.82 ± 0.33) and there was not significantly different. Variability was also observed between the first few ejaculates and subsequent ejaculates which showed that as the bucks became suitable to the teaser female the preparatory movements were usually reduced and consequently the reaction time was shortened as clearly shown by the Boer.

The libido of male goats has also been shown in various studies (Abdul Wahid and Jaafar, 1989) where it was demonstrated that the back cross of (Saanen × Katjang) × Katjang possessed the greatest libido. The time to mount by the Local Crossbred goats in this study was less than the back cross of (Saanen × Katjang) × Katjang

(12.62 ± 1.98 sec) and the time to ejaculate (17.67 ± 4.22 sec) and number of mounts per ejaculation (1.21 ± 0.11) by the back cross of (Saanen × Katjang) × Katjang was less than the Local Crossbred and Boer due to the difference in genetic composition. The reaction time also was shortened as the animals grew older (Abdul Wahid and Jaafar, 1989).

State of health dictates to some extent the level of libido, since animals in poor health have less desire to mate. The presence of a female in estrus increases sexual activity of the male (Sorensen, 1979). The effect of breeding season and libido has also been shown in various studies (Barkawi *et al.*, 2005; Jainudeen *et al.*, 2000 and Kamal *et al.*, 2005) where it was demonstrated that day length influenced the sexual activity of the buck.

With respect to mating behavior, the relative risk of decreasing the number of mountings before an ejaculate tended to increase slightly independent of the change of teaser, as was also observed in rams in natural mating (Pepelko and Clegg, 1965). Silvestre *et al.* (2004) found that reaction time was increased in the third ejaculation when the female was the same, however when the female changed, reaction time decreased. Even though, Local Crossbred in this study showed that substitution of female in time period 7 and 9 was affected the time to ejaculate and number of mounts per ejaculation to become higher. Conversely, in the majority of experiments studying male reaction times to ejaculate, goats in estrus are normally used as female stimulus.

The effect of new female stimulus on semen variables or sexual response depends on degree of sexual satiation. Changing the female stimulus did not affect the semen characteristics either in adult bucks (Prado *et al.*, 2002) or rams (Lezama *et al.*, 2003). Nevertheless, in Local Crossbred and Boer, if the teaser was substituted, semen volume was notably decreased. In this case, changing the teaser did not affect any semen characteristics (percentage live and concentration of spem), probably due to the fact that young bucks were not too sexually satiated.

During the study period the variability in the production and quality of semen produced was quietly evident because of the short term. The Local Crossbred had the largest quantity of semen (0.88 ± 0.03 mL) compared to Boer (0.65 ± 0.04 mL) which was possibly related to the size of breed. The effect of size and breed on semen production has also been shown in various studies (Abdul Wahid and Jaafar 1989; Ax *et al.*, 2000 and Kamal *et al.*, 2005) where it was demonstrated that breeds of goat with bigger size produced more semen.

The volume of semen produced by the goats in this study was less than produced by ram (1.0 mL) (Ax *et al.*, 2000), indigenous bucks (1.77 ± 0.30 mL) (Webb *et al.*, 2004) and even Zaraibi bucks (0.98 mL) (Barkawi *et al.*, 2005) and which indicate that there is breed difference in semen production. This study also found that the volume of semen produced by Local Crossbred was higher than produced by Saanen bucks (0.77 mL) and Nubian bucks (0.88 mL) (Kamal *et al.*, 2005) even back cross of (Saanen × Katjang) × Katjang (0.52 ± 0.03 mL) (Abdul Wahid and Jaafar, 1989). Zamiri and Heidari, (2006) reported that the average volume of semen produced by

the Rayini male goats varied between 1.00 and 1.40 mL was higher than Local Crossbred (0.60 to 1.00 mL) and Boer (0.50 to 0.80 mL) in this study.

The semen productivity of the males was also attributed to seasonality (Ahmad and Noakes, 1996; Webb *et al.*, 2004; Kamal *et al.*, 2005 and Zamiri and Heidari 2006), although Salamon, (1976) had earlier reported species varied depending on the climatic conditions, age, nutrition, breed and health status of the animal and frequency of use.

Local Crossbred and Boer semen were white creamy to thick creamy and colour varies more on creamy. Most of the score of motility fell in grade 3 in Local Crossbred (59.65%) as compared to Boer (50.88%), some were in grade 2 including 40.35% of Local Crossbred and 43.86% of Boer and some were in grade 3 only for Boer (5.26%). It is most probably because of the crossbreeding and almost identical to that of back cross of (Saanen × Katjang) × Katjang (Abdul Wahid and Jaafar 1989).

The percentage of live sperm was great in Local Crossbred (78.38 ± 1.25%) followed by Boer (77.00 ± 1.01%) and both of the bucks were higher than Saanen bucks (68.70%) and lower than Nubian bucks (82.78%) in study done by Kamal *et al.* (2005). The range of percentage of live sperm in Local Crossbred and Boer were 69.30-85.54% and 71.65-82.08%, respectively. A range of value is found in the other researcher including Rayini male goats (60-78%; Zamiri and Heidari, 2006) was lower than the values of this study. Local Crossbred is not a pure breed but it is actually cross with other breed. With crossbreeding it is indicated that, the

percentage of live and sperm concentration increased. In the case of Boer, there was a reduction in semen volume, percentage of live sperm and concentration of sperm as well as sperm count.

In a study of Saanen and Nubian bucks in Khartoum, Kamal *et al.* (2005) reported that sperm concentration of Saanen and Nubian bucks were 2.77×10^{10} and 2.08×10^{10} sperm/mL lower as compared to Local Crossbred ($3.78 \pm 0.08 \times 10^{9}$) and Boer ($3.67 \pm 0.06 \times 10^{9}$) in this study. Compiled characteristics of semen for goats from Bearden and Fuquay, (2000) and Cole and Garrett, (1980) also showed the lower sperm concentration (2.4×10^{9} mL) than bucks of this study. In study done by Abdul Wahid and Jaafar, (1989) the back cross of (Saanen and Katjang) × Katjang possessed the greatest sperm count of $39.95 \pm 2.15 \times 10^{8}$ sperm/mL than the other breeds. The concentration of semen within species actually varies depending on the climatic conditions, age, nutrition, breed and health status of the animal and frequency of their use (Salamon, 1976). Semen collection procedure also influenced sperm concentration (Ax *et al.*, 2000).

There was a strong ($P < 0.01$) and negative relationship between testicle size and libido in Boer as compared with Local Crossbred but indicating that testicle size of Local Crossbred was bigger than Boer. Time to ejaculate and number of mounts per successful ejaculation was negatively ($P < 0.01$; $P < 0.05$) correlated with circumference, length and breadth in Local Crossbred. It was showed that as the testicle measurements grew bigger they became faster and aggressive. It was also happened in Boer that there was a strong ($P < 0.01$; $P < 0.05$) but negative correlation

between time to mount, time to ejaculate and number of mounts per successful ejaculation with circumference, length and breadth.

In this case, it was showed that as the testicle size and animal grew bigger they became more aggressive and their sexual prowess increased same as study done by Abdul Wahid and Jaafar, (1989). On the other hand, Ahmad and Noakes, (1995) reported in the yearling British goats, the increase in peripheral testosterone concentration and testis size preceded the improvement in libido.

There was no correlation between concentration of sperm with testicle circumference and length in Local Crossbred. Concentration of sperm was positively correlated ($P < 0.05$) only with testicle breadth in Local Crossbred but there was strong relationship ($P < 0.01$) between percentage of live sperm with testicle circumference ($r = 0.53$) and breadth ($r = 0.57$) in Boer suggesting that these two measurement could be used to select good bucks for breeding. Testicle length was correlated ($P < 0.05$) with concentration of sperm ($r = 0.32$) only in Boer as compared with Local Crossbred. It was indicated that this measurement of Boer can also be used to select a good males for breeding.

For the reason of relationship, there is no independent parameter for selection criteria. Therefore we are able to identify which parameter can be used to be breeding selection. For instance, testicle breadth and circumference can be used as variables selection to identify the good breed as supported in this study. It was also shown that the variables selection was different with a breed.

CHAPTER VI

CONCLUSION

It is concluded that Local Crossbred goat was found to be superior to Boer goat in terms of testicle size, libido and semen quality. The breed and age of buck have a clear influence on testicle size, libido and semen quality. The study confirmed that Local Crossbred bucks to have higher reproductive capabilities compared to Boer bucks.

Testicle circumference and testicle breadth were excellent indicators of testicle size, as well as a useful means of estimating time to mount, time to ejaculate, number of mounts per ejaculation, sperm output, percentage of live sperm, concentration of sperm and subsequent testicular development. The relationship between testicle size and libido and semen quality was very helpful for selecting the breed of goat for breeding purposes.

No single test accurately predicts fertility of a sperm sample and libido. However examining various physical characteristics of semen and libido can identify greater fertility potential and libido in bucks. The measurement of testicle size (circumference and breadth) is very important for selecting males for breeding because it is relatively easy to measure, as well as based on the relationship with libido and semen quality.

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PUBLICATION OF THE PROJECT UNDERTAKING

This is to certify that I have no objection to publish the project entitled "Libido and Semen Quality of Goats at UPMKB Farm" by the supervisor in a joint authorship. However, it has to be evaluated by the Faculty of Agriculture and Food Sciences, Universiti Putra Malaysia Bintulu Campus and published in the form approved by the Faculty.

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Date: