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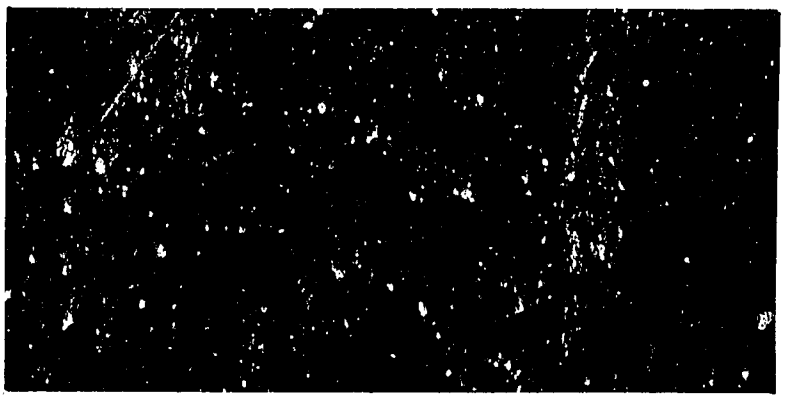

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SCROTAL CIRCUMFERENCE AND SEMEN CHARACTERISTICS OF CRIOLLO, CORRIEDALE AND JUNIN RAMS IN THE HIGH CENTRAL SIERRA OF PERU

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SCROTAL CIRCUMFERENCE AND SEMEN CHARACTERISTICS OF CRIOLLO, CORRIEDALE AND JUNIN SHEEP IN THE HIGH CENTRAL SIERRA OF PERU

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SUMMARY

This study was conducted in the Central Sierra of Peru (12° South latitude, 76° West longitude, 962 mm rainfall, 3,800 m elevation) with 12 Criollo, 12 Corriedale and 12 Junin rams of 1.5, 2.5 and 3.5 years of age. All rams were grazed together on native pasture from April 1981 to March 1984. Monthly semen samples were obtained by means of an electroejaculator to study the semen characteristics. Live body weights and scrotal circumference were also recorded. The mean live body weight differed statistically ($P < 0.05$) among breeds, 41.7, 50.6 and 64.6 kg for Criollo, Corriedale and Junin, respectively. Rams 1.5 years of age were significantly ($P < 0.05$) lighter in body weight than rams 2.5 and 3.5 years of age. A high statistical difference ($P < 0.01$) occurred among breeds for scrotal circumference (Criollo, 29.4; Corriedale, 31.1 and Junin 32.5 cm), ages (1.5, 30.3; 2.5, 31.2 and 3.5, 31.7 cm) and seasons (dry, 30.3 and

rainy, 31.8 cm). Ejaculated volume was similar for the Corriedale and Junin (1.2 ml; $P > 0.05$), and larger than the Criollo (1.1 ml; $P < 0.05$). No differences were found among ages, years and seasons ($P > 0.05$). The mean sperm concentration was similar ($P > 0.05$) for the Criollo and Corriedale (2.2 and 2.1 x 109/ml, respectively). These two breeds were superior ($P < 0.05$) to the Junin (1.9 x 109/ml). Age of the rams and season of the year did not differ statistically ($P > 0.05$) on the number of sperm cells ejaculated. The sperm motility did not differ ($P > 0.05$) among seasons or age of animals. Sperm motility of Criollo (56.4%) was higher than for Junin (51.9%); Corriedale (54.8%) was intermediate and failed to differ from the other breeds ($P > 0.05$).

CIRCUNFERENCIA ESCROTAL Y CARACTERISTICAS DE SEMEN DE CARNEROS CRIOLLO, CORRIEDALE Y JUNIN EN LA SIERRA CENTRAL DEL PERU.

RESUMEN

Este estudio fue conducido en la Sierra Central del Perú (12° Latitud sur, 76° Longitud oeste, 962 mm de precipitación pluvial, 3,800 m de elevación) con 12 carneros Criollo, 12 Corriedale y 12 Junín de 1.5, 2.5 y 3.5 años de edad. Todos los carneros fueron mantenidos en pradera nativa desde Abril 1981 a Marzo de 1984. Muestras mensuales de semen fueron obtenidas por medio de electroeyaculación para establecer las características de semen. El peso vivo y la circunferencia escrotal tambien fueron obtenidos. El peso vivo fue estadísticamente diferente entre razas ($P < 0.05$), 41.7, 50.6 y 64.6 kg para Criollo, Corriedale y

Junín, respectivamente. Carneros de 1.5 años de edad pesaron significativamente menos ($P < 0.05$) que los carneros de 2.5 y 3.5 años de edad. Una diferencia altamente significativa ($P < 0.01$) para circunferencia escrotal fue encontrada entre razas (Criollo, 29.4; Corriedale, 31.1 y Junín 32.5 cm) y estación del año (Seca, 30.3 y lluviosa, 31.8 cm). El volúmen eyaculado fue similar para Corriedale y Junín (1.2 ml; $P > 0.05$) y mayor que para Criollo (1.1 ml; $P < 0.05$). No hubo diferencia significativa ($P > 0.05$) entre edades, años y estaciones. La concentración espermática promedio fue similar ($P > 0.05$) para Criollo y Corriedale (2.2 y 2.1 x 109/ml), respectivamente. Estas dos razas superaron ($P < 0.05$) a la raza Junín (1.9 x 109/ml). El número total de células espermáticas eyaculadas, no fue diferente entre edades ni entre estaciones en del año. La motilidad espermática en Criollo (56.4%) fue mayor ($P < 0.05$) que en Junín (51.9%). La motilidad en Corriedale fue intermedia (54.8%) y no discrepó estadísticamente de las otras dos razas ($P > 0.05$).

Introduction

In the sheep industry, levels of reproduction establish the limits of overall productivity. The fertility rate of any flock can be influenced by the fertility of the male. The inability to select males based on potential reproductive parameters restricts the selection of high reproductive performance of the ewes (Islam and Land, 1977).

The available literature indicates differences in semen characteristics due to breed (Islam and Land, 1977; Desjardins, 1981), season (Islam and Land, 1977; Lincoln, 1978), age (Bearden and Fuquay, 1984; Colas, 1983), nutrition (Tilton et al., 1964, Leathem, 1966) and high elevation (Monge, 1945). The size (Coulter et al., 1976) and the consistency (Foote et al., 1972) of the testicle are highly inherited. The scrotal circumference as an indirect estimation of testes size is highly correlated with body growth (Kilgour and Blockey, 1980) and ovulation rate of female progeny (Land, 1973). The genetic selection for increased fertility in the female could be based on the reproductive characteristics of the male (Land, 1973). The production of sperm cells, the gonadal and extragonadal reserves are related to testes development (Amann, 1970).

No information is available on these traits for the indigenous breeds of Peru.

This paper presents the results of ram semen evaluation and scrotal circumference between breeds, ages and seasons in the high Central Sierra of Peru.

Materials and Methods

The experiment was conducted at the SAIS Tupac Amaru, Consac, Central Sierra of Peru (12° South latitude and 76° West longitude, 962 mm annual rainfall, 3,800 m elevation) from April 1981 to March 1984. A total of 36 rams per year (12 Criollo, 12 Corriedale and 12 Junin) were used. In each breed, the rams were

evenly divided into three age groups, 1.5, 2.5 and 3.5 years of age. The second and third year, rams 1.5 and 2.5 years of age were assigned to the next older age group. The oldest group of rams were discarded from the experiment each year when they became 4.5 years of age. A new group of 1.5 year old rams per breed was added in the second and third year.

All rams were managed and grazed together on typical Central Sierra native pasture during the total experimental period.

Monthly semen samples were collected from each ram by means of a transistorized electroejaculator. The ejaculated volume (V, ml), sperm motility (M, %) and sperm concentration through photocolorimeter (C, x 10^9/ml) were evaluated and recorded immediately after collection, with precautions to avoid cold shock. The day before semen collections, measurements of live body weight (BW, kg) and scrotal circumference (SC, cm), using flexible metric tape applied at approximately the widest part of the scrotum with testes included, were also made.

The data were subjected to least square statistical analysis, and levels of significance were determined by Duncan's multiple range test.

Results and Discussion

Data on live body weight, scrotal circumference, ejaculated volume, sperm concentration, total sperm per ejaculate and sperm motility as they relate to the three breeds of sheep examined by age, year and season are given in Table 1.

Live Body Weight

The mean live body weight differed significantly ($P < 0.05$) among breeds. The Criollo rams were lighter (41.7 kg) followed by Corriedale (50.6 kg) and Junin (64.6 kg). The live body weight was also statistically different among ages ($P < 0.01$). Rams 1.5 years old showed statistically ($P < 0.05$) lighter body weight (47.5 kg) compared to similar ($P > 0.05$) performance of 2.5 (54.8 kg) and 3.5 (55.7 kg) year old rams. The body weight was also influenced by the year ($P < 0.01$). However, the season of the year (dry vs. rainy) had no influence on the body condition of the rams. The monthly mean live body weight variation is shown in Figure 1A. Higher body weights for all breeds combined were recorded in June and December, and the lowest body weights were recorded during February and March, when the grazing time was short because this period coincides with the heavy rainy season.

Scrotal Circumference

Analysis of variance indicated a high statistical difference ($P < 0.01$) among breeds, ages, years and season. Criollo sheep showed less scrotal circumference (29.4 cm) compared to the Corriedale (31.1 cm) and the Junin (32.5 cm). These results therefore reinforce the observation of Land (1973) and Land and Carr (1975) that testicle size differs among breeds.

Rams of 1.5 years of age showed significantly ($P < 0.05$) less scrotal circumference than rams of 2.5 and 3.5 years of age.

The scrotal circumference among years (1981 - 1982, 1982 - 1983, 1983 - 1984) differed significantly ($P < 0.05$) among each other.

There was an indication of seasonal variation in scrotal circumference (Islam and Land, 1977; Ortavant, 1977). In this study, due to the close proximity to the equator lane, the photoperiod seems to have no effect in scrotal circumference. However the rainy season (October - April) characterized by better feeding conditions showed greater scrotal circumference than the dry season (May - September), in contrast to the findings of Islam and Land (1977), Ortavant (1977) and Schanbacher (1979) for other breeds.

Non significant ($P > 0.05$) monthly variation in scrotal circumference is shown in Figure 1A. However, when the data were pooled by dry or wet season, the difference became significant ($P < 0.05$).

Under all effects observed, breed, age, year and season, the scrotal circumference was found to be associated with live body weight in agreement with results reported by Land and Carr (1975). Rams with higher body weight also had higher scrotal circumference. The scrotal circumference as an estimate of testes size is an important criterion for the amount of sperm cells produced, the ovulation rate of daughters of the rams when selected on testes size and finally for earlier attainment of puberty (Braun et al., 1980).

Semen Ejaculate Volume

Differences were observed between breeds for semen ejaculate volume (Table 1). Ejaculate volume was similar for the Corriedale and Junin (1.2 ml; $P > 0.05$) and was greater for both than the Criollo (1.1 ml; $P < 0.05$). Earlier workers (Skinner and Rowson, 1968) have reported differences among Merino, Persian, Sarper and Suffolk breeds in ejaculated volume, which agrees with the findings of this study.

The season and age of rams did not significantly ($P > 0.05$) affect the magnitude of the ejaculate volume (Figure 1). However, working with younger rams and greater seasonal variation, the quality of semen is strongly influenced by the age of the rams, which improves steadily with advancing age (Louw and Joubert, 1964; Skinner and Rowson, 1968) and different seasons (Salamon and Robinson, 1962; Smyth and Gordon, 1967) primarily due to the day length (photoperiod) and temperature (Ortavant, 1977). In this study, the two higher peaks of ejaculated volume were recorded in January and June, and the lowest were recorded from October to December (Figure 1B).

Sperm Cell Concentration

The mean sperm concentration/ml or the total sperm harvested per ejaculate was similar ($P > 0.05$) for the Criollo and Corriedale rams. However, these two breeds were superior ($P < 0.05$) to Junin rams (Table 1). Age of the rams and the season of the year failed to differ statistically ($P > 0.05$) for the number of sperm cells per ejacualte. A tendency to produce higher sperm concen-

tration was observed during August to October compared to the remaining months (Figure 1B). Breed difference in sperm output found in this study agree with the reports of earlier workers (Islam and Land, 1977; Mittal and Ghosh, 1979) using breeds in England and India.

Sperm Motility

Data in Table 1 show that in the ram, sperm motility did not differ among seasons or age of animals ($P > 0.05$). However, a tendency for better motility was observed during the dry sesaon concomitantly with a similar trend in sperm cell concentration (Figure 1B). Sperm motility differed significantly ($P < 0.05$) between the Criollo (56.4%) and Junin (51.9%) breeds; the Corriedale breed was intermediate and failed to differ from either ($P > 0.05$).

It is important to determine the fertility of rams because of its effect on the fertility of the flock. The in vitro evaluation of semen is easily accomplished but is much less accurate than the actual fertility of male based on pregnancy or lambing rates. Correlation among in vitro classical semen characteristics evaluated and the fertility in vivo is low (Lees, 1978).

In general, this study showed that the semen characteristics observed coincide with reports of earlier authors. However, motility values were lower. This may reflect actual levels of

semen characteristic or possibly an effect of semen collection with the electroejaculator.

The simple linear correlation among variables observed in this study (Table 2) indicates a clear relationship between body weight and scrotal circumference, sperm ejaculated volume and sperm motility, scrotal circumference and ejacualted volume, ejaculated volume and sperm concentration and sperm motility and ejaculated volume.

No single factor was detected as responsible for some decreased semen characteristics observed. It might be due to high altitude, low level of nutrition and generally low management procedures.

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Table 1. Mean (± SEM) live body weight and scrotal circumference of sheep in the High Central Sierra of Peru.

Main Effects	Live Body Weight (kg)		Scrotal Circumference (cm)	
	no. observation	mean	no. observation	mean
Breed				
Criollo	165	41.7 ± 0.52a	251	29.4 ± 0.16a
Corriedale	145	50.6 ± 0.78b	243	31.1 ± 0.19b
Junin	177	64.6 ± 0.69c	270	32.5 ± 0.18c
Age[1]				
1.5	164	47.5 ± 0.79a	260	30.3 ± 0.20a
2.5	157	54.8 ± 1.02b	253	31.2 ± 0.18b
3.5	166	55.7 ± 1.08b	251	31.7 ± 0.19c
Year				
81-82	109	53.6 ± 1.52b	49	33.3 ± 0.59c
82-83	165	54.1 ± 0.90b	334	31.3 ± 0.16b
83-84	213	51.1 ± 0.83a	381	30.5 ± 0.16a
Season				
Dry	335	52.9 ± 0.73a	388	30.3 ± 0.16a
Rainy	152	52.2 ± 0.96a	376	31.8 ± 0.15b

$P < 0.05$ for means with different superscript letters within main effects.

1Age in years.

Table 2. Mean (± SEM) semen characteristics of sheep in the High Central Sierra of Peru.

Main Effects	Ejaculated Volume (ml)		Sperm Concentration ($\times 10^9$/ml)		Total Sperm per Ejaculate ($\times 10^9$)		Motility (%)	
	No. observation	mean	No. observation	mean	No. observation	mean	No. observation	mean
Breed								
Criollo	351	1.1 ± 0.03^b	338	2.2 ± 0.07^b	338	2.4 ± 0.01^b	348	56.4 ± 1.05^b
Corriedale	296	1.2 ± 0.04^{ab}	284	2.1 ± 0.10^b	284	2.5 ± 0.01^b	295	54.8 ± 1.20^{ab}
Junin	381	1.2 ± 0.03^a	368	1.9 ± 0.08^a	368	2.3 ± 0.01^a	379	51.9 ± 0.08^a
Age[1]								
1.5	349	1.2 ± 0.04^a	337	2.0 ± 0.08^a	337	2.4 ± 0.01^a	347	55.8 ± 1.16^a
2.5	336	1.1 ± 0.04^a	324	2.1 ± 0.08^a	324	2.3 ± 0.01^a	335	52.7 ± 1.25^a
3.5	343	1.2 ± 0.04^a	329	2.1 ± 0.09^a	329	2.5 ± 0.01^a	340	54.2 ± 0.09^a
Year								
81-82	316	1.3 ± 0.04^b	316	2.2 ± 0.07^b	316	2.9 ± 0.01^b	315	63.5 ± 1.01^c
82-83	334	1.1 ± 0.04^a	334	1.7 ± 0.09^a	334	1.9 ± 0.01^a	334	48.0 ± 1.14^a
83-84	378	1.1 ± 0.03^a	340	2.2 ± 0.08^a	340	2.4 ± 0.01^b	373	52.1 ± 1.02^b
Season								
Dry	515	1.1 ± 0.03^a	512	2.1 ± 0.06^a	512	2.3 ± 0.01^a	511	55.3 ± 0.97^a
Rainy	513	1.2 ± 0.03^a	478	2.0 ± 0.07^a	478	2.4 ± 0.01^a	511	53.3 ± 1.01^a

$P < 0.05$ for means with different superscript letters within main effects.

[1]Age in years.

Table 3. Simple linear correlation coefficients (r) among variables.

Correlations[1]	Year		
	1981-82	1982-83	1983-84
BW : SC	0.83**	0.53**	0.53**
BW : EV	0.32**	0.09	0.11
BW : SCo	0.08	-0.19**	-0.15*
BW : M	0.01	-0.06	-0.09
SC : EV	0.59**	0.09	0.08
SC : SCo	0.18	0.03	0.01
SC : M	0.01	-0.04	-0.07
EV : SCo	0.26**	0.37**	0.28**
EV : M	0.18**	0.38**	0.18**
SCo : M	0.43**	0.37**	0.15**

[1]BW = live body weight; EV = semen ejaculated volume; SCo = sperm cells concentration; SC = scrotal circumference; M = sperm motility.

* $P < 0.05$
** $P < 0.01$

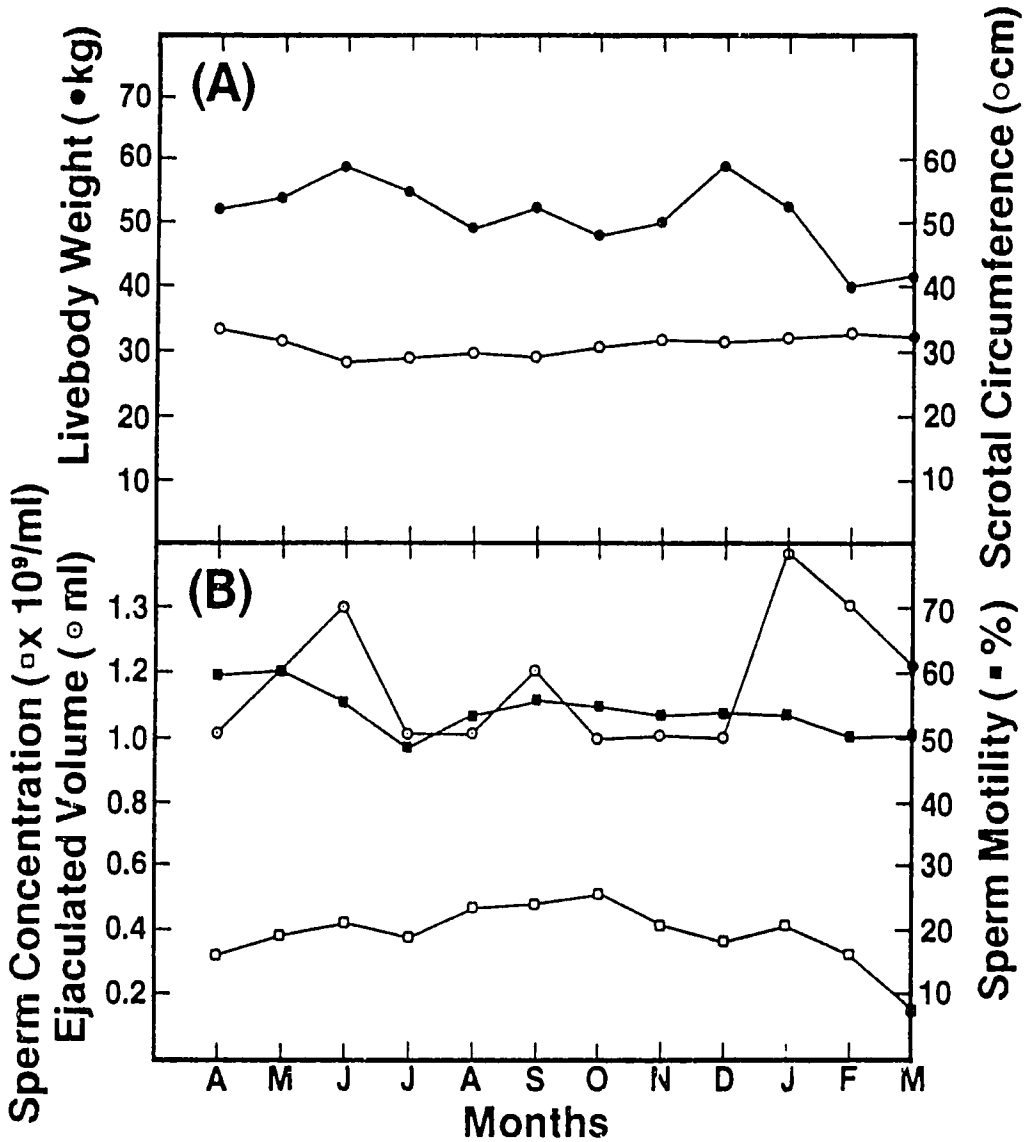

Fig. 1 (A) Livebody weight and scrotal circumference
(B) Ejaculated volume, sperm concentration and sperm motility of rams.