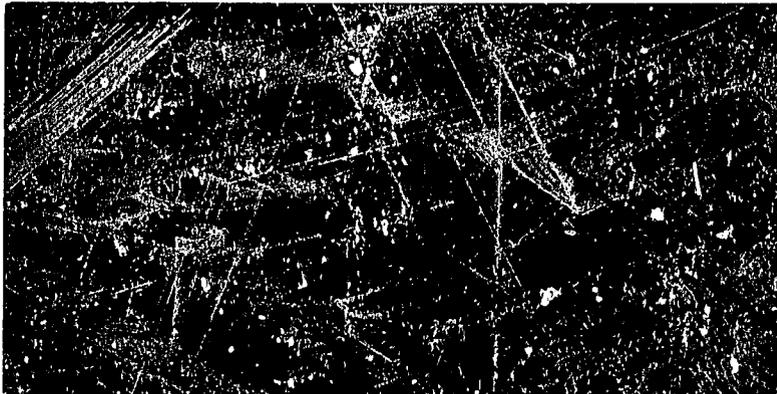


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CENTRAL SIERRA OF PERU**

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PUBERTY IN CORRIEDALE, CRIOLLO AND JUNIN
MALE SHEEP IN THE CENTRAL SIERRA OF PERU

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SUMMARY

This study was conducted during three years (April 1981 - March 1984) in the Central Sierra of Peru (12° South latitude, 76° West longitude and approximately 3,800 m elevation). Four lambs per breed (Corriedale, Criollo and Junin) grazed on native pasture were used to measure the age, live body weight and scrotal circumference at time of penis detachment from the prepuce and first ejaculation containing live sperm cells using the electroejaculator. Semen characteristics were also studied beginning at the first ejaculation through 18 months of age. Breeds differed significantly in the mean age at penis detachment (6.4, 6.6 and 7.9 months; $P < 0.01$), at first ejaculation (7.0, 7.3 and 8.8 months; $P < 0.05$), live body weight at penis detachment (24.1, 30.5 and 28.0 kg; $P < 0.01$), live body weight at first ejaculation (22.7, 31.7 and 35.3 kg; $P < 0.05$), scrotal circumference at penis detachment (25.8, 24.8 and 17.3 cm;

P < 0.05), scrotal circumference at first ejaculation (25.3, 24.5 and 21.0 cm; P < 0.05), for Criollo, Corriedale and Junin ram lambs, respectively. Mean semen characteristics from the first ejaculation to 18 months of age were: ejaculate volume, 0.8, 0.7 and 0.6 ml (P < 0.05); sperm motility, 52.4, 41.9 and 27.9% (P < 0.05) and sperm concentration, 1.5, 1.0 and 0.7 x 10⁹/ml (P < 0.05) for Criollo, Corriedale and Junin, respectively. The Criollo rams showed earlier penis separation and first ejaculation than Corriedale and Junin lambs.

PUBERTAD EN MACHOS OVINOS CORRIEDALE, CRIOLLO Y JUNIN EN LA SIERRA CENTRAL DEL PERU

RESUMEN

Este estudio fue conducido durante tres años (Abril 1981 - Marzo 1984) en la Sierra Central del Perú (12° Latitud sur, 76° Longitud oeste y aproximadamente 3,800 m de elevación). Cuatro animales por raza (Corriedale, Criollo y Junín) mantenidos en pradera nativa fueron utilizados para establecer la edad, peso vivo y la circunferencia escrotal a la separación del pene del prepucio y a la primera electroeyaculación con presencia de células espermáticas. Las características de semen fueron estudiadas desde la primera eyaculación hasta los 18 meses de edad. Las razas difirieron significativamente en la edad promedio a la liberación del pene (6.4, 6.6 y 7.9 meses, P < 0.01), a la primera eyaculación (7.0, 7.3 y 8.8 meses, P < 0.05), peso vivo a la liberación del pene (24.1, 30.5 y 28.0

kg; $P < 0.01$), peso vivo a la primera eyaculación (22.7, 31.7 y 35.3 kg; $P < 0.05$), circunferencia escrotal a la liberación del pene (25.8, 24.8 y 17.3 cm; $P < 0.05$), circunferencia escrotal a la primera eyaculación (25.3, 24.5 y 21.0 cm; $P < 0.05$) para Criollo, Corriedale y Junín, respectivamente. Las características promedio de semen desde la primera eyaculación hasta los 18 meses de edad fueron: volúmen eyaculado 0.8, 0.7 y 0.6 ml ($P < 0.05$), motilidad 52.4, 41.9 y 27.9% ($P < 0.05$) y concentración, 1.5, 1.0 y 0.7 x 10⁹/ml ($P < 0.05$) para Criollo, Corriedale y Junín, respectivamente. La liberación del pene y la primera eyaculación en machos Criollo fue anticipada a la observada en las razas Corriedale y Junín.

Introduction

High reproductive efficiency in sheep is a result of many different processes in both sexes. The net flock fertility levels might be lowered if the breeding males are not properly selected for fertilizing capability. Genetic improvement in the lifetime productivity and the generation interval depend in part, on the age when replacements reproduce.

The live body weight and age at which the young rams can first mate is of considerable practical importance in management. The influence of body weight, size of testicle, age, penis detachment from the prepuce, first ejaculate containing live sperm cells and development of sexual maturity have been extensively studied (Wiggins and Terrill, 1953; Symington, 1961;

Louw and Joubert, 1964; Skinner and Rowson, 1968; Skinner et al., 1968; Dyrmundsson, 1973).

No information on this matter is available for indigenous sheep breeds in the high Central Sierra of Peru. The subject therefore requires investigation under local conditions where uncastrated lambs run with their dams and siblings year-round, and the possibility of undesirable matings cannot be ruled out.

The purpose of this study was to determine the influence of breed, body weight and age on testicle size, penis detachment from the prepuce and semen characteristics from weaning up to 18 months of age in Criollo, Corriedale and Junin sheep.

Materials and Methods

This study was conducted in collaboration with the SAIS Tupac Amaru in Consac. high Central Sierra of Peru (12° South latitude and 76° West longitude, 3,800 m elevation). Four ram lambs of each breed (Criollo, Corriedale and Junin) were used in three consecutive years (April 1981 to March 1984) to obtain the age and weight at penis detachment and the first ejaculation. During the experiment, all animals were managed and grazed on native pasture.

Information on live body weights, stage of penis detachment from the prepuce and size of testis were obtained at monthly intervals. Attempts to collect semen by electrical stimulation were made beginning at six months of age. Following the first

semen collection, data on age, body weight, testicle size, ejaculated volume, motility and sperm cell concentration were recorded monthly until the animals reached 18 months of age.

Analyses of variance were performed under a completely randomized design arranged as a 2 x 3 factorial. Simple correlation coefficients were also calculated among different traits observed.

Results and Discussion

The relationship between age, live body weight, and scrotal circumference at the time of penis detachment from the prepuce and at the first ejaculation containing sperm cells are given in Table 1. Penis detachment from the prepuce occurred for all breeds combined at seven months of age, 27.5 kg of body weight and 22.6 cm of scrotal circumference. The first ejaculation was collected three weeks later, 2.4 kg live body weight heavier and 7.3 cm greater scrotal circumference. The ram lambs reached puberty at 57.2 percent of adult body weight (52.3 kg) for breeds combined (Vivanco et al., 1986) compared to 50-55 percent (Land, 1978), 35-45 percent (Dyrmundsson, 1972) and 65 percent (Skinner and Rowson, 1968) of adult live body weight of Finn, Merino and Finn x Merino; Clun Forest; and Suffolk rams, respectively.

In the immature lambs, the penis is completely adhered to the prepuce. A gradual breakdown of the adhesions occurs until the penis became free from the tip to the base, as reported by

Louw and Joubert (1964). Well-grown lambs exhibited detachment of the penis before the smaller and lighter lambs. These results agree with the consensus opinion that the penis detachment is more closely related to the body weight than to chronological age (Wiggins and Terrill, 1953; Symington, 1961).

The Criollo is characterized by small body size compared to Corriedale and Junin. This is substantiated by the statistically significant ($P < 0.05$) lighter live body weight of Criollo lambs compared to the Corriedale and Junin. These and data on other parameters are summarized in Table 1. In spite of the lighter weight of Criollo, the scrotal circumference (25.8 cm) at penis detachment tended to be greater than in the other two breeds. The Criollo was statistically larger ($P < 0.05$) than the Junin (17.3 cm) and similar ($P > 0.05$) to the Corriedale (24.8 cm). At first ejaculation the scrotal circumference was similar ($P > 0.05$) in all three breeds. Table 1 shows a decrease (1.4 kg) in body weight of Criollo sheep from the time of penis detachment to first ejaculation (2 weeks). This situation resulted because two larger lambs were killed by predators, lowering the mean body weight and scrotal circumference.

The available literature clearly shows breed differences in puberal age and weight (Dyrmundsson, 1973). The Criollo and Corriedale lambs were similar ($P > 0.05$) in age at penis detachment (6.4 and 6.6 months) and first ejaculation (7.0 and 7.3 months). They differed significantly ($P < 0.05$) from Junin

which showed delayed penis detachment (7.9 months) and first ejaculation (8.8 months).

The Criollo though lighter in body weight was more precocious than the Junin in all parameters measured and more precocious than the Corriedale in most parameters. The Junin was later developing than the Corriedale in most parameters measured. These differences are due to genetic factors and are in agreement with the findings of Wiggins and Terrill (1953).

At the beginning of this study when the lambs of all breeds were six months old, before the penis was detached from the prepuce, they were already displaying clear signs of libido. This has also been observed by Symington (1961) and Louw and Joubert (1964) in other breeds.

The overall mean volume, sperm concentration and motility of the ejaculate, when spermatozoa first appeared, was 0.44 ± 0.17 ml, $0.69 \pm 0.20 \times 10^9/\text{ml}$ and 20.4 ± 0.09 percent, respectively. All semen characteristics studied improved from the time of first ejaculation until the lambs reached 18 months of age (0.98 ml, $0.65 \times 10^9/\text{ml}$ and 64%; ejaculated volume, sperm concentration and motility, respectively). This rapid improvement in semen characteristics from puberty to adulthood agrees with findings of Symington (1961) and Louw and Joubert (1964). However, the ejaculate volume obtained in this study was higher than the ejaculate volume found by Symington (1961) and lower than that reported by Louw and Joubert (1964).

Significant ($P < 0.01$) positive correlation coefficients occurred between sperm concentration and motility as well as between sperm concentration and ejaculated volume ($P < 0.01$), and scrotal circumference and ejaculated volume ($P < 0.01$). No direct association was found between scrotal circumference and sperm concentration ($P > 0.05$) except for the Corriedale breed ($P < 0.05$). The sperm motility improved concomitantly with the increase in sperm concentration as reported by Louw and Joubert (1964). The $0.30 \times 10^9/\text{ml}$ sperm cells obtained at first ejaculation increased to $1.62 \times 10^9/\text{ml}$ when the animals were 17-18 months of age. Considerable individual variation in sperm concentration and volume was noted within breeds.

There were significant differences ($P < 0.05$) among breeds in the overall monthly means of live body weight, scrotal circumferences and semen characteristics recorded from the first ejaculation to 18 months of age (Table 2). The Criollo breed differed statistically ($P < 0.01$) in body weight (27.1 kg) from the Corriedale (31.5 kg) and Junin (29.8 kg); the latter two breeds were similar ($P > 0.05$). In scrotal circumference, the breeds differed ($P < 0.05$) from each other with values for Criollo, Corriedale and Junin of 24.5, 23.7 and 22.1 cm, respectively. Junin breed showed significantly ($P < 0.05$) lower ejaculated volume (0.6 ml) than the Criollo (0.8 ml) and the Corriedale (0.7 ml). The latter two did not differ statistically ($P > 0.05$). The sperm concentration, total sperm cells per ejaculate and the sperm motility did differ statistically

($P < 0.05$) among breeds. The Criollo breed showed the highest values followed by the Corriedale and with the least from the Junin.

All semen characteristics observed during the rainy season were statistically ($P < 0.05$) higher than during the dry season. This difference may be due to the confounding effect of increased age at the rainy period (Table 3).

The age at first ejaculation containing sperm cells is usually considered to indicate the age at puberty. Functionally, however, detachment of the penis from the prepuce to allow mating is also a factor. Penis detachment occurs just prior to first ejaculation and may be a practical method of estimating when puberty occurs. This might also be a valuable management tool to indicate the oldest age when ram lambs should be castrated or removed from the flock to avoid undesirable matings.

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Table 1. Mean age, body weight and scrotal circumference at penis separation and first ejaculation in lambs¹.

	Criollo		Corriedale		Junin		Total	
	n	mean	n	mean	n	mean	n	mean
<u>Penis Detachment</u>								
Age (months)	8	6.4 ^a	8	6.6 ^a	7	7.9 ^b	23	7.0
Live body weight (kg)	6	24.1 ^a	6	30.5 ^b	5	28.0 ^b	17	27.5
Scrotal circumf. (cm)	7	25.8 ^b	6	24.8 ^b	3	17.3 ^a	16	22.6
<u>First Ejaculation</u>								
Age (months)	8	7.0 ^a	8	7.3 ^a	5	8.8 ^b	21	7.7
Live body weight (kg)	4 ²	22.7 ^a	6	31.7 ^b	3	35.3 ^b	13	29.9
Scrotal circumf. (cm)	5	25.3 ^a	6	24.5 ^a	1	21.0 ^a	12	23.6

¹P < 0.05 for means with different superscript letters among breeds.

²Two rams were killed by predators. This affected the mean body weight and scrotal circumference.

Table 2. Mean (\pm SE) live body weight, scrotal circumference and semen characteristics of lambs from the first ejaculate to 18 months of age¹.

	Criollo		Corriedale		Junin	
	n	mean	n	mean	n	mean
Body weight (kg)	52	27.1 \pm 0.12 ^a	46	31.5 \pm 0.20 ^b	48	29.8 \pm 1.11 ^b
Scrotal circum. (cm)	84	24.5 \pm 0.09 ^b	56	23.7 \pm 0.26 ^c	71	22.1 \pm 0.08 ^a
Ejaculate volume (ml)	120	0.8 \pm 0.13 ^b	101	0.7 \pm 0.47 ^b	99	0.6 \pm 0.17 ^a
Sperm concen. (x10 ⁹ /ml)	114	1.5 \pm 1.65 ^c	95	1.0 \pm 0.07 ^b	96	0.7 \pm 0.12 ^a
Sperm cells per ejaculate (x10 ⁹)	114	1.2 \pm 0.21 ^c	95	0.7 \pm 0.03 ^b	96	0.4 \pm 0.02 ^a
Motility (%)	117	52.4 \pm 0.12 ^c	96	41.9 \pm 0.20 ^b	98	27.9 \pm 0.26 ^a

¹P < 0.05 for means with different superscript letters among breeds.

Table 3. Mean (\pm SE) live body weight, scrotal circumference and semen characteristics of lambs according to dry and rainy season 1.

Variables	Dry Season		Rainy Season	
	n	mean	n	mean
Live body weight (kg)	107	28.4 \pm 1.35 ^a	39	32.0 \pm 0.46 ^b
Scrotal circumference (cm)	111	22.0 \pm 0.81 ^a	100	25.1 \pm 0.13 ^b
Ejaculate volume (ml)	162	0.5 \pm 0.24 ^a	158	0.9 \pm 0.09 ^b
Sperm concentrate (x10 ⁹ /ml)	157	0.9 \pm 0.12 ^a	148	1.2 \pm 0.26 ^b
Sperm cells per ejaculate (x10 ⁹)	157	0.5 \pm 0.03 ^a	148	1.1 \pm 0.02 ^b
Motility (%)	157	32.6 \pm 0.28 ^a	154	50.4 \pm 0.10 ^b

1P < 0.05 for means with different superscripted letters among seasons.

Table 4. Simple correlation coefficients (r) among variables.

Correlations ^a	Breed		
	Criollo	Corriedale	Junin
BW: SC	0.30**	0.30	0.64**
BW: EV	0.30**	0.38**	0.15
BW: SCo	0.06	0.41**	0.27
BW: M	0.06	0.30*	0.24
SC: EV	0.28*	0.53**	0.31**
SC: SCo	0.21	0.30*	0.18
SC: M	0.09	0.35**	0.56**
EV: SCo	0.30**	0.30**	0.49**
EV: M	0.23*	0.41**	0.50**
SCo: M	0.45**	0.54**	0.53**

^aBW = Live body weight; SC = Scrotal circumference; EV = Ejaculated volume; SCo = Sperm cell concentration; M = Sperm motility (* P < 0.05) (** P < 0.01).

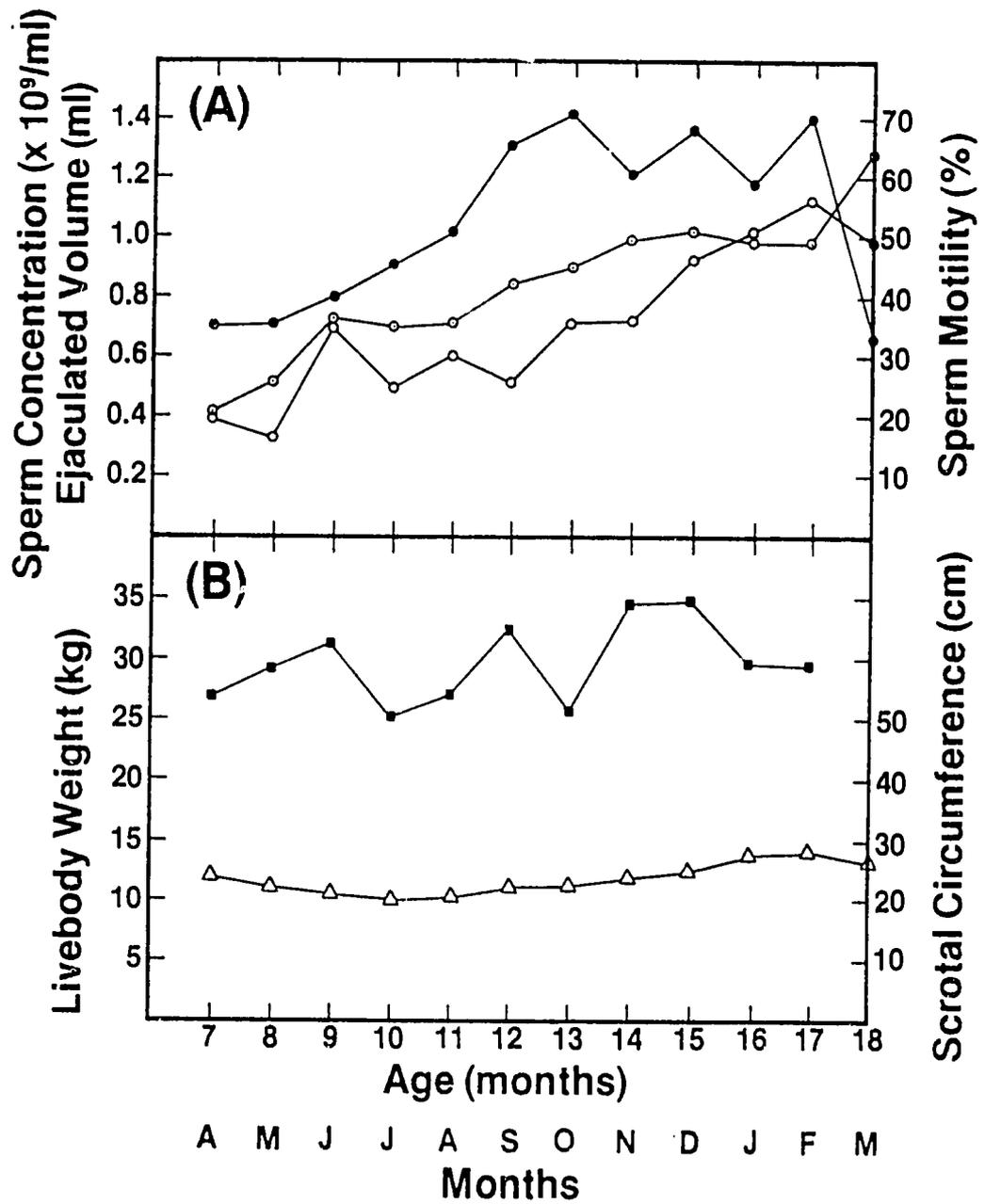


Fig 1. (A) Ejaculated volume (\circ — \circ), sperm concentration (\bullet — \bullet), and sperm motility (\circ — \circ); (B) Body weight (\blacksquare — \blacksquare), and scrotal circumference (\triangle — \triangle) beginning at puberty to 18 months of age.