FACTORS ASSOCIATED WITH THE ATTAINMENT OF PUBERTY IN THE FEMALE IN BREEDS OF HAIR SHEEP IN NORTHEAST BRAZIL

A.A. Simplicio, W.C. Foote†, J.F. Nunes and A.E.F.D. Silva

EMBRAPA/CNPC, Sobral CE, 62.100, Brazil and †Department of Animal, Dairy and Veterinary Sciences, Utah State University, Logan, UT 84322, U.S.A.

Introduction

The attainment of puberty signals the beginning of reproductive life. Age at puberty establishes the minimum period at which reproduction can be initiated which in turn influences reproductive performance. The occurrence of this phenomenon is influenced by environmental and genetic factors. The purpose of this study was to measure the influence of some of these factors on the attainment of puberty in hair sheep in Northeast Brazil.

Experimental Protocol

This research was conducted at the EMBRAPA/CNPC facilities at Sobral Ceara State, Northeast Brazil (3°S latitude, 40°W longitude). Three separate experiments were conducted as follows:

Experiment 1

This experiment was carried out with 112 ewe lambs (32 Morada Nova, 63 Brazilian Somali and 17 Santa Ines) grazed on native range (from 0700 to 1600 hr) at the National Goat Research Center. Fifty of the lambs were from single and 62 were from multiple births. Lambs were weaned in groups averaging 112 d of age. Body weights were recorded at birth and at 4 wk intervals until puberty. Age at puberty was determined as date, and body weight at puberty as weight, on the date of first estrus detected by the use of a teaser rams. From 40-46 hr after observed estrus the ovaries of each ewe were observed via laparotomy to determine the occurrence and rate of prepuberal (corpora albicantia) and puberal (corpora lutea) ovulation periods.

Experiment 2

A total of 63 Brazilian Somali ewe lambs were used in this experiment to measure the influence of year on age and weight at puberty (9 to 24 ewes for each of 4 yr). The animals were managed similar as described for Experiment 1.

Experiment 3

A total of 72 ewe lambs (24 each of Marada Nova, Santa Ines and Brazilian Somali breeds) were assigned equally at weaning to two nutrition management systems (held and fed in confinement or grazed on native pasture). The ewes in confinement received freshly chopped elephant grass ad libitum plus 1% of their body weight of a concentrate mixture (cottonseed meal and chopped corn containing 16% crude protein and 75% TDN). Measurements taken, were body weight and age at puberty (first estrus detected by teaser rams) and ovulation rate measured as the number of corpora lutea observed by laparotomy during the first 12 d following puberal estrus.

Results and Discussion

Least square means of birth and weaning weights and the weight and age at puberty by breed and type of birth of ewe lambs are shown in Table 1. The body weights both at birth and at weaning differed significantly among breeds ($P<0.01$). Brazilian Somali (2.0, 13.2 kg) were lighter than Santa Ines (2.6, 19.1 kg); the Morada Nova (2.2, 16.4 kg) breed was intermediate.

TABLE 1. Least squares means of ewe body weight (kg) at birth, weaning (112 d) and puberty and age (d) at puberty in Experiment 1

	N	Birth wt.	Weaning wt.	Wt. at puberty	Age at puberty
Breed:					
Morada Nova	32	2.2^{b}	16.4^{b}	21.2^{a}	296.8
B. Somali	63	2.0^{a}	13.2^{a}	19.7^{a}	306.8
Santa Ines	17	2.6^{c}	19.1^{c}	24.0^{b}	322.2
Type of birth:					
Single	50	2.6^{b}	18.4^{b}	21.1	312.4
Multiple	62	2.0^{a}	14.0^{a}	22.1	304.8
Overall	112	2.1	14.5	20.7	306.3

^{a,b,c}means in same column with unlike superscripts within main effects differ ($P<0.05$)

The Santa Ines breed (24.0 kg) was significantly ($P<0.05$) heavier at puberty than the Morada Nova (21.2 kg) and Brazilian Somali (19.7 kg) breeds. These latter two breeds did not differ statistically ($P>0.05$). No statistically significant differences were found ($P>0.05$) among breeds for age at puberty. Single born lambs had heavier body weights than

lambs from multiple births ($P<0.01$) at birth (2.6 vs 2:0 kg) and at weaning (18.4 vs 14.0 kg), however, weight and age at puberty did not differ ($P>0.05$) for single born lambs (21.1 kg and 312.4 d) and multiple-born lambs (22.1 kg and 304.8 d).

A strong tendency existed for heavier lambs to reach puberty at a younger age than lighter lambs when data from the three breeds were pooled. This is shown by the significant ($P<0.05$) negative correlation between body weight at weaning ($r=-0.485$) and at puberty ($r=-0.290$) with age at puberty. Also, significant positive ($P<0.05$) correlation coefficients existed between live body weight at puberty and at birth ($r=0.595$) and at weaning ($r=0.719$) (Table 2).

TABLE 2. Simple correlations for birth and weaning (112 d) weight, weight at puberty and age at puberty for the three breeds in Experiment 1 (N=112).

	Weaning wt.	Wt. at puberty	Age at puberty
Birth wt.	0.612**	0.595**	-0.135
Weaning wt.		0.719**	-0.485**
Wt. at puberty			-0.290**

**P<0.01

Table 3 illustrates the ovarian activity in terms of the occurrence of ovulation and ovulation rate at puberty and during the prepuberal period (corpora albicantia indicating regressed or regressing CL). Significant differences did not occur among breeds ($P>0.05$) in occurrence or rate of ovulation and the breeds were combined. All ewes ovulated at

TABLE 3. Incidence and rate of ovulation, prepuberal and at puberty (first estrus), by breed of ewe in Experiment 1†

	Morada Nova	B. Somali	Santa Ines	Overall
Incidence of ovulation (%):				
Prepuberty	84.4 (27)‡	76.2 (48)	77.6 (13)	78.6 (88)
Puberty	100.0 (32)	100.0 (63)	100.0 (17)	100.0 (112)
Ovulation rate:				
Prepuberty	1.11 (27)	1.14 (48)	1.17 (13)	1.13 (88)
Puberty	1.34 (32)	1.31 (63)	1.24 (17)	1.31 (112)

†prepuberty ovulation was identified by the presence of regressing CL and CA 40-46 hr after beginning of estrus. Ovulation at puberty refers to the ovulation associated with first estrus and was identified by the presence of corpora hemorrhagica 40-46 hr after beginning of estrus.

‡numbers in parentheses are number of observations

puberal estrus with a mean ovulation rate of 1.31. During the prepuberal period 78.6% of the ewes ovulated with an ovulation rate of 1.13. This indicates that the majority of prepuberal ewe lambs ovulate at least once prior to first estrus. This ovulation is then followed by ovulation accompanied by behavioral (puberal) estrus.

Table 4 summarizes Experiment 2 and shows a significant ($P<0.05$) influence of year on the weight (16.0 to 20.4 kg) and age (284.4 to 344.2 d) at puberty in the Brazilian Somali breed.

In Experiment 3 the overall mean age and weight at puberty, regardless of breed and nutrition-management, was 303.5 d and 25.2 kg, respectively (Table 5). A statistically significant effect was shown of nutrition-management on both age and weight at puberty. For the three breeds combined the lambs in confinement reached puberty at 250.2 d of age and 28.2 kg body weight compared to 356.8 d of age and 22.2 kg body weight for ewes on native pasture ($P<0.01$). The Brazilian Somali (21.9 kg) and Morada Nova (23.9 kg) had significantly ($P<0.01$) lower body weights than the Santa Ines (29.8 kg) at puberty. The Brazilian Somali attained puberty at an older age (335.4 d) than either the Morada Nova (292.1 d) or Santa Ines (283.0 d). Differences in ovulation rate approached statistical significance ($P<0.10$) among breeds combined for both levels of nutrition-management and also between nutrition-management systems combined for all breeds (Table 5).

TABLE 4. Least squares means for weight and age at puberty in Brazilian Somali ewe lambs in different years (Experiment 2)

Year	N	Weight (kg)	Age (d)
1978	15	19.3[b]	284.4[a]
1979	9	16.0[a]	344.2[b]
1980	15	16.7[a]	392.8[c]
1981	24	20.4[b]	289.6[a]
Overall	63	18.7	320.8

[a,b,c]means in same column with unlike supersripts differ ($P<0.05$)

The differences noted in these experiments show a significant influence of level of nutrition on age at puberty. These ages at puberty are considerably older than those reported for the same breeds and location by de Figueiredo et al (1983): Santa Ines, 219.7; Maroda Nova, 214.5; Brazilian Somali, 283.9 d. These ages are more similar to those reported here for ewes fed in confinement (250.2 d) and might possibly reflect a similar response to

improved nutrition and management.

TABLE 5. Ovulation rate, body weight and age at puberty of three breeds of hair sheep under two nutrition management systems (Experiment 3)

	N	Ovulation rate	Weight (kg)	Age (d)
Breed:				
B. Somali	24	1.14	21.88[a]	335.4[a]
Santa Ines	24	1.04	29.75[b]	283.0[b]
Morada Nova	24	1.23	23.88[a]	292.1[b]
Nutrition management system:				
Confinement	36	1.09	28.16[a]	250.2[a]
Native Pasture	36	1.17	22.18[b]	356.8[b]

[a,b]means same coumn with unlike superscripts within main effect differ ($P<0.05$)

Age at puberty for other breeds of hair sheep reported in the literature include the Pelibuey (Peliguey, Tabasco) in Mexico: 245 d on pasture with supplement (Gonzalez-Reyna et al., 1983) and from 306.0 to 429.4 d when in confinement or on pasture for different grazing periods (Zarazua and Padilla, 1983); West African in Venezuela: 305 d on pasture only and 269 d on pasture with supplement and parasite control (Stagnaro, 1983); Nigerian Dwarf in Nigeria: 335 d when fed roughage only and 262 d when concentrate supplement was added (Orji and Steinbach, 1976); Djallonke (Dwarf) in Ivory Coast: 259 d when on pasture plus supplement (Berger, 1983); St Croix in the United States: 184 and 153 d for two different years when supplemented and in St. Croix, Virgin Islands, 166 d when fed grass hay and concentrate supplement and 214 and 171 d when on pasture only or on pasture plus supplement, respectively (Evans et al., 1991).

In our second experiment the significant effect of year on age at puberty may have been due, at least in part, to differences noted in body weight, which likely reflected differences in pasture quality or quantity.

An average of 78.6% of the ewes for all three breeds combined in Experiment 1 had ovulated prior to the ovulation associated with first estrus; there was no difference in the incidence among breeds. The occurrence of ovulation prior to puberal estrus has been reported earlier for wool sheep (Foote et al., 1970).

Body growth and development as indicated by weight hastens puberty. This is shown from several of the references listed above and is shown again in this study. A negative relationship can be seen between weight and age at puberty in each of the experiments; significant ($P<0.01$) simple correlations of -0.485 were shown between weight at

weaning and weight at puberty and of -.290 between weight and age at puberty. The latter correlation, however, accounts for less than 10% ($R^2=8.4$) of the variation in age at puberty.

Type of birth has been related to age at puberty with single born lambs reaching puberty at an earlier age than multiple born lambs (262 vs 312 d; Stagnaro, 1983). However, we found no affect due to type of birth (single: 312.4 d and multiple: 304.8 d). Differences in weight at birth and weaning had disappeared at puberty (21.1 vs 22.1 kg) and is assumed to account for the lack of differences in age at puberty.

Conclusions

The data from the three experiments reported here indicate the relationship of several genetic and environmental factors on the attainment of puberty. Breed (genetic) differences were shown for several traits. The Santa Ines had the heaviest body weight at birth, weaning and puberty and the Brazilian Somali the lightest; the Maroda Nova was intermediate. The age at puberty did not differ among breeds (296.8 to 322.2 d) when the ewes were maintained on native pasture (Experiment 1). However, significant differences did occur in Experiment 3 when animals kept on native pasture and fed in confinement were combined (Santa Ines, 283.0; Morada Nova, 292.1; Brazilian Somali, 335.4 d). This may suggest an interaction between breed and nutrition-management system.

The authors acknowledge the scientific contribution of Dr. E.A.P. de Figueiredo, EMBRAPA, CNPC, Sobral, Brazil and Dr. G. Simon Riera G., La Paz, Bolivia (deceased).

Literature Cited

Berger, Y. M. 1983 Djallonke Hair Sheep in Ivory Coast. In: Hair Sheep of Western Africa and the Americas; A genetic resource for the tropics. (Eds) H.A. Fitzburgh and G.E. Bradford. Westview Press. Boulder, Colorado, U.S.A. p 227.

Evans, R.E. 1991. Aspects of puberal development in St.Croix hair sheep. Proc. Hair Sheep Research Symosium. June 28-29, 1991. St. Croix, Virgin Islands.

Figueiredo, E.A.P, E.R. de Oliveira, C. Bellave and A.A. Simplicio. 1983. Hair sheep performance in Brazil. In: Hair Sheep of Western Africa and the Americas; A genetic resource for the tropics. (Eds.) H.A. Fitzburgh and G.E. Bradford. Westview Press. Boulder, Colorado, U.S.A. p 125.

Foote, W.C., N. Sefidbakht and M.A. Madsen. 1970. Puberal estrus and ovulation and subse-

quent estrous cycle patterns in the ewe. J. Anim. Sci. 30:86.
Gonzalez-Reyna, A., J. De Alba and W.C. Foote. 1983. Reproduction in Peliquey sheep. In: Hair Sheep of Western Africa and the Americas; A genetic resource for the tropics. (Eds.) H.A. Fitzburgh and G.E. Bradford. Westview Press. Boulder, Colorado, U.S.A. p 75.
Orji, B.I. and J. Steinbach. 1976. Puberty in ewes of the Nigerian Dwarf sheep. Nig. Jr. Animal Prod. 3:97.
Stagnaro, C. G. 1983. Commercial hair sheep production in a semiarid region of Venzuela. In: Hair Sheep of Western Africa and the Americas; A genetic resource for the tropics. (Eds.) H.A. Fitzburgh and G.E. Bradford. Westview Press. Boulder, Colorado, U.S.A. p 85.
Zarazua, M. V. and E. G. Padilla. 1983. Pelibuey sheep in Mexico. In: Hair Sheep of Western Africa and the Americas; A genetic resource for the tropics. (Eds.) H.A. Fitzburgh and G.E. Bradford. Westview Press. Boulder, Colorado, U.S.A. p 55.

CIRCANNUAL ESTROUS INTERVALS AND EPISODIC SECRETION OF LUTEINIZING HORMONE AND AUTUMNAL PROGESTERONE AND OVULATION RATE IN CYCLING PELIBUEY EWES CONTINUOUSLY EXPOSED TO TEASER RAMS

A. Gonzalez-Reyna and B.D. Murphy

Reproductive Biology Research Unit, Department of Obstetrics & Gynecology, College of Medicine, University of Saskatchewan, Saskatoon, Saskatchewan S7N OXO, Canada

Introduction

West African hair sheep have become an increasingly important component of the meat industry in Latin American countries, because of their exceptional adaptation to adverse climates and reproductive performance. Wild mammals rely on environmental cues to manipulate reproduction. Temperate wool sheep, as wild mammals, cue on photoperiod (Hafez, 1952; Marshall, 1937) to synchronize their reproductive cycles with the breeding season. Hair sheep of the Western hemisphere (Fitzhugh and Bradford, 1983) lack a true seasonal anestrus (Gonzalez et al., 1986), thus allowing them to cycle year round. However, it is now evident that Pelibuey ewes present reduced estrous behavior and ovulation rates during late Winter and early Spring, which are not apparently due to undernourishment (Gonzalez and Murphy, 1987; Gonzalez et al., 1991; Valencia et al., 1981). It is of scientific and practical importance to determine the environmental cues that Pelibuey sheep rely on to manipulate their reproductive cyclicity.

This study was designed to determine annual estrous intervals and episodic secretion of luteinizing hormone (LH) and correlate them with ovulation rate and progesterone during the Fall in cycling Pelibuey ewes continuously exposed to teaser rams.

Experimental Protocol

This study was carried out at the Mexican Association of Animal Production Training Center (CAMPA), located at the ranch El Apuro, Aldama, Tamaulipas, Mexico. The center is located at an elevation of 15 m a.s.l. and a latitude of 22°29'30"N and a longitude of 97°55'12"W. The climate is classified as semi-arid tropic with an average annual precipitation of 1,080 mm. Most rainfall occurs from May through October, with sporadic showers occurring from November through February. The Pelibuey flock at