

Reproductive Behavior of Anglo Nubian Goats in an Arid Environment in Peru

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1. INTRODUCTION

Information on the reproductive behavior of goats of European origin under tropical conditions is limited and mostly based on observations of a limited number of animals. For the present study the records, for the period between 1962 and 1977, of an Anglo Nubian herd imported from the USA in 1961 by the Peruvian Ministry of Agriculture, are evaluated.

2. MATERIALS AND METHODS

The herd is kept near the city of Lambayeque on the northern coast of Peru; elevation, 20 m above sea level. The climate is dry and fresh, for its location at 11 degrees South, due to the influence of the Humboldt Stream. The station has a yearly average of 31 mm of rain and a mean temperature of 21.7°C.

Between 1962 and 1973 the herd was kept for the sole purpose of producing breeding stock that could be sold to farmers. The herd was grazed on bush land dominated by *Prosopis angustifolia* and on some inundated areas planted with the grass *Brachiaria mutica*. The feeding was supplemented with freshly-cut alfalfa and sorghum. The kids were allowed to suckle and were weaned at 12 to 14 weeks of age.

Milking of the does was initiated in July 1973. After this date the kids were bucket-fed. The kids received 63 kg of milk in 9 weeks, concentrates up to a maximum of 400 g/day, and chopped sorghum and alfalfa *ad libitum*. Until July 1973 a

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buck was run with the herd. After this date the mature does were hand-mated at first estrus, four months post partum. Yearlings were hand-mated once they reached nine months of age and 30 kg live-weight.

The data collected include distribution of parturitions throughout the year, age at first kidding, kidding interval, gestation length, prolificacy, and sex-ratio at birth. Means and deviations are analyzed using chi-square and t-tests (Otto, 1958).

3. RESULTS

3.1 *Distribution of parturitions*

Kiddings occurred in all months of the year (Table 1), with a tendency for a higher than average incidence during the months of June, July and September, and below the average in January, February and March. Like other goat breeds from temperate regions, at latitudes above 25 degrees North or South, the Anglo Nubian show a seasonal sexual cycle. Estrus is induced by the reduction in day-length during autumn with kiddings in late winter and spring (Horst and Grell, 1973; Macfarlane, 1982). This poses a difficulty for a consistent, yearround supply of milk. Hormonal as well as light treatments are used to induce estrus during the normal anestrus season (Ashbrook, 1982). In the tropics, on range conditions, the deficient fodder supply during the dry season may cause an anestrus period (Sands and Mc Dowell, 1978), but under an adequate feeding regime as the present results show (Table 1), estrus occurs in sufficient number to assure a fairly constant milk production throughout the year.

It is of interest that estrus and fertility were highest during the hottest months of the year (December through March). This is contrary to what has been reported for other species, such as by Mc Dowell (1972) for cattle and Bhattacharya (1974) for buffaloes. In a separate study of a Peruvian Criollo goat herd kept some 30 km from the station on dryland pastures, a similar distribution of the parturitions was also observed. Results of this study are presented in Table 1 for comparative purposes. In Venezuela, Gonzales and Castillo (1971) also found that 82o/o of all estrus and 89o/o of all conceptions occurred during the hottest months.

Table 1. Monthly distribution of parturitions in percentage:(1)

Month	Anglo Nubian		Peruvian Criollo(3)
	percent	signif.(2)	percent
Jan	5.47	.01	7.80
Feb	6.12	.05	4.89
Mar	8.62	n.s.	4.52
Apr	3.71	.001	5.36
May	9.36	n.s.	12.72
Jun	11.12	.01	14.54
Jul	12.05	.001	20.67
Aug	7.69	n.s.	7.27
Sep	12.88	.001	4.00
Oct	8.62	n.s.	7.58
Nov	7.04	n.s.	7.65
Dec	7.32	n.s.	3.00
Total parturitions	1079		9733

(1) Anglo Nubian 1962-1977; Peruvian Criollo 1973-1977

(2) chi square, deviation from an even distribution

(3) Vélez, M. and M. A. Callacná, 1979

3.2. Age at first kidding and parturition interval

Though goats born after July 1973 reached puberty at an earlier age than those previously reared with their dams (Table 2), the age at first parturition (519.9 days) is still high compared with standards for temperate regions where most goats kid at approximately one year of age. Goats that miss the first season

in temperate regions are usually those kids born late in the spring and therefore still too small by autumn for mating (Epstein and Herz, 1964; Quittet, 1975).

Table 2. Age at first kidding.

Group	n	Age in days	±s
1	192	643.9	217.9
2	52	519.9	126.6

Group 1. Reared with mother, weaned at 4 months.

Group 2. Milk in buckets, 63 kg in 9 weeks.

Cattle moved from temperate to hot areas have a reduced secretion of gonadotrophin, particularly luteinising hormone (Madam and Johnson, 1973). Reduced gonadotrophin output is usually accompanied by reduced fertility. Selection, within the herd studied, for more adapted genotypes may not have gone long enough. In the West Indies, Devendra (1973) had results similar to those in the present report for the age at first kidding in imported Anglo Nubian goats.

Even so, the reduction in age after the change in the feeding of young animals (Table 2) as well as the high variation coefficient (33.80/o before and 24.40/o after) would indicate that there is room for further reduction in the age at first kidding through selection and improved rearing of the young animals.

The parturition interval between 529 kiddings averaged 335.1 ± 129.6 days (Table 3). Considering that between 1962 and 1973 a buck ran with the herd, and afterwards no effort was made to obtain long lactations, the interval is too long and probably related to the reduction in fertility mentioned above. In another group of Anglo Nubians of the same import lot kept near Lima in a more temperate environment, Nolte (1969) found an average parturition interval of 286 days. In the West

Indies, Devendra (1973) found an average of three kiddings in two years (243 days) for Anglo Nubian goats.

Table 3. Parturition interval.

Parturition	n	days	±s
1st to 2nd	178	353.2	144.0
2nd to 3rd	127	333.7	120.8
3rd to 4th	91	320.6	106.6
4th to 5th	59	326.3	131.8
5th to 6th	34	326.4	124.2
6th to 7th	21	300.2	68.3
7th and more	19	326.8	159.8
Total	529	335.1	126.9

3.3 Gestation length

The average length of 275 gestations recorded during the years 1973-1977 was 150.5 ± 4.2 days. In grouping the parturition by number and sex of the kids born (Table 4), only in the case of triplets was there a reduction in the gestation period. Probably due to the small number of parturitions in this category, this reduction did not reach significance.

3.4 Prolificacy

In the 16 year period of this study an average of 1.43 kids were born in 1,070 parturitions (Table 5). This figure is close to the one found by Nolte (1969) of 1.48 in the other part of the imported lot of Anglo Nubians. Both figures are on the lower limit of results quoted by Devendra and Burns (1970) in their revision of the literature. They reported a range in kids per parturition between 1.43 in Malaysia and 2.23 in Mauritius.

Table 4. Gestation length by sex and number of kids born.

Sex of kids	Kids/parturition	n parturitions	Gestation length	
			days	\pm s
M	1	84	150.6	4.4
F	1	57	150.8	4.3
M	2	32	150.6	3.3
F	2	25	150.8	4.2
M + F	2	67	150.4	3.9
M + F	3	10	147.1	5.5
Total	—	275	150.5	4.2

Table 5. Prolificacy.

Parturitions	1070
Average number kids per parturition	1.43
Single kiddings	638 (59.63o/o)
Twins	409 (38.22o/o)
of the twins with two male kids	29.1o/o
two female kids	19.8o/o
male and female	51.1o/o
Triplets (total of 39 male and 27 female kids)	22 (2.05o/o)
Quadruplets (1 male and 3 female kids)	1 (0.01o/o)

In 805 kiddings, of does of known age, prolificacy increased between the first and the second, as well as between the second and third parturitions, after which it stabilized (Table 6). Larger increases have been reported from other breeds of goats. Reports have been made of increases from 1.67 in the first to 2.33 in the third parturition of Criollo goats in Guadeloupe (Cognie et al.,

1973), and from 1.2 in Malabar does under two years of age to 2.3 in does over 5 years (Mukundan and Rajagopalan, 1971). The low prolificacy found in this study may be attributed at least partially to the high proportion of first and second parturitions (31.0/o and 22.9/o respectively) of the total evaluated.

Table 6. Effect of age of dam on prolificacy.

Nr. of kidding	Kiddings	Kids/Parturition	
		n	± s.e.
1	250	1.30	.47
2	184	1.35	.48 (a)
3	133	1.56	.58 (a)
4	96	1.56	.56
5	65	1.48	.53
6	35	1.63	.38
7	23	1.70	.56
8, 9, 10	19	1.58	.51

(a) Increase from 1st to 2nd and 2nd to 3rd significant $P = 0.001$

A repeatability coefficient for multiple kiddings (r) of 0.32 was estimated using 96 does which kidded four consecutive times from an analysis of variance (Table 7) in which:

s^2_e = environmental variance

s^2_g = genetic variance

k = observations per animal

$$r = \frac{s^2_g}{s^2_g + s^2_e}$$

The repeatability estimated in the present study is higher than the one estimated by Moulick et al. (1966) of 0.145 in Black Bengal goats, and the estimates in Malaysia (Mahmud and Devendra, 1970) of 0.08, 0.14 and 0.20 for native, 1/2 native-1/2 Anglo Nubian, and 3/4 Anglo Nubian respectively.

Table 7. Analysis of variance used to estimate repeatability of multiple kiddings.

Source	S.Q.	D.F.	s^2	
Total	113	383		
Between does	55	95	.58	$s^2 + ks^2g$
Rest	58	288	.20	s^2e

Table 8. Sex ratio of kids at birth.

Sex	Type of birth						
	Singles		Multiples (a)		Total		
	n(b)	o/o	n(b)	o/o	n(b)	o/o	
Males	326	51.10	487	54.84	813	53.28	
Females	312	48.90	401	45.16(c)	713	46.72(c)	
Total						1526	

(a) 818 twins, 66 triplets, 4 quadruplets

(b) number of kids

(c) difference of males to females significant $P = 0.01$

3.5. Sex ratio at birth

Of 1,526 kids born, 53.28o/o were males and 46.72o/o females (Table 8). The number of males born was significantly higher ($P = 0.01$) in the general average and among multiples. Among singles the difference in sex ratio was not significant.

4. DISCUSSION

The Anglo Nubian breed of goats is being introduced in Peru as well as in other tropical countries to improve the local breeds. The present study, as well as others, shows that at least in the reproductive traits and under good feeding conditions the breed performs satisfactorily in a tropical environment. The following points may also be made.

First, with an adequate feed supply throughout the year estrus does not show a marked seasonality. Thus an even, year-round milk production is possible.

Second, the prolificacy recorded was low. This may be due to the fact that some 55% of the parturitions recorded were of young animals. A rather high repeatability of multiple births found should merit a selection for this characteristic, if so wished. In an intensive dairy operation a high fertility would permit a higher selection intensity of replacements and therefore a faster genetic progress. Under extensive conditions the benefits of a high prolificacy would be doubtful, as the available fodder may not always be enough for the production of enough milk to rear two or even more kids and still leave a marketable surplus.

Third, the average age at first kidding was high. The reduction in age after the changes in the feeding regime of the kids (milk rations, concentrates and green chop instead of running with their mothers), and the large variation in this trait shows that a further reduction should be possible through further improvements in the feeding of young animals.

Fourth, the breeding interval depends not only on the animal, but also on the management and feeding regimes in the herd. In a dairy operation, as opposed to one dedicated to the production of as many kids as possible, long intervals would be in any case the aim if accompanied by good milk production.

5. SUMMARY

Sixteen years of reproduction records of an Anglo Nubian goat herd kept in the northern coast of Peru are analyzed. Does did not show a strict seasonality, though of 1,079 kiddings significantly ($P = 0.01$) more occurred in June, July and September. The mean age at first kidding of 192 does reared under

semi-intensive conditions was 643.9 days. With early weaning (63 kg of milk in 9 weeks) and the feeding of concentrates, the age at first kidding was reduced to 519.9 days in 52 does. Kidding interval ($n = 519$) was 335.1 days. Average litter size was 1.43 kids. For first, second and third kiddings, the average litter size was 1.30, 1.35 and 1.56 kids respectively; the increases being significant ($P = 0.001$). Repeatability of litter size estimates on 96 does with four consecutive kiddings was 0.32. Overall sex ratio of 1,526 kids born was 53.28o/o males to 46.72o/o females. The proportion of males was higher among multiple kids (54.84o/o) than among single ones (51.10o/o).

RESUMEN

En base a 16 años de registros (1962-1977) se analizó el comportamiento reproductivo de un rebaño de cabras Anglo Nubian importadas de los EE.UU. en 1961, a una granja estatal en la ciudad de Lambayeque, en la costa Norte del Perú, en un clima desértico. Si bien hubo partos en todos los meses del año, del total de 1079 partos, 36o/o ocurrieron en junio, julio y setiembre, como resultante de concepciones ocurridas durante los meses de mayor calor. La edad promedio al primer parto de 197 cabras criadas con la madre, en condiciones semi-intensivas fué de 643.9 ± 217.9 días. En 1973 se inició el ordeño de las cabras, 52 cabritas criadas en confinamiento (63 kg. de leche en 56 días, más forrajes y concentrados) parieron a la edad promedio de 519.9 ± 126.6 días. El intervalo entre partos ($n = 519$) fue de 335.1 días. El promedio de cabritos por parto en 805 partos fue de 1.43. En el primero, segundo y tercer parto el promedio fué de 1.30, 1.35 y 1.56 respectivamente, los aumentos fueron significativos ($P = 0.001$). El coeficiente de repetibilidad de partos múltiples estimado en base a 4 partos consecutivos de 96 cabras, fué de 0.32. El porcentaje de machos nacidos del total de 1526 cabritos fué de 51.1o/o en partos simples, 54.84o/o en partos múltiples y 53.28o/o en el promedio general.

La cabra Anglo Nubian se ha importado a diferentes países del trópico con objeto de mejorar las razas locales. El presente estudio, así como otros citados, indican que, al menos en el aspecto reproductivo, la cabra Anglo Nubian se adapta bien a condiciones tropicales. La falta de una estacionalidad marcada indica que una producción más o menos constante de leche es posible, caso contrario de lo que ocurre en países de zonas templadas.

La edad promedio al primer parto fué elevada, pero la alta variación encontrada sugiere posibilidad de reducirla recurriendo a la selección y al manejo. La prolificidad fué baja, pero el coeficiente de repetibilidad encontrado sugiere una base genética lo suficientemente alta como para mejorar rápidamente esta característica si se desea.

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