EVALUATION OF GOAT BREEDS IN THE TROPICAL NORTH-EAST BRAZIL

I. A STUDY OF BIRTH-RELATED TRAITS OF NATIVE AND EXOTIC GOAT BREEDS[1]

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ABSTRACT - Most of the North-East Brazil is a hot tropical semi-arid area and most of the Brazil's goat population (approximately 6.1 million out of 6.6) exists in this region. In the present study, five breeds were compared for their pre-natal growth. The birth weight was divided by the duration of pregnancy to obtain values of per day foetal gain, and the latter by the mother-doe's weight at parturition to calculate net per day gain per kg of dam's weight. The breeds were: indigenous - (1) Canindé-Repartida, (2) Moxotó, (3) Marota; exotic - (4) Anglo-Nubian, (5) Bhuj. The results showed that the birth weight was not strictly according to the dam's weight at parturition. Although the adult Bhuj were the heaviest followed by Anglo-Nubian and indigenous breeds, the heaviest kids were produced by Anglo-Nubian and the kids of other four breeds, including Bhuj, were much lighter and identical among themselves. This trend was also reflected in average daily gain but not in net gain. The net gain was identical in Anglo-Nubian and indigenous breeds and much lower in Bhuj. Within breeds, dams with larger size appeared to produce kids with greater birth weight and daily gain. Single born kids had a distinct advantage over kids born in multiple pregnancies in all growth traits, but sex of kid, in general, appeared to have no significant effect though the male kids in Marota and Anglo-Nubian breeds were significantly heavier to females and also had a better average daily gain. Adult body weights and gestation lengths varied between breeds but these traits were not influenced by other sources of variation.

Index terms: tropical hot semi-arid region, Moxotó, Canindé-Repartida, Marota, Bhuj, Anglo-Nubian, birth weight, per day pre-natal gain, net gain per unit of body weight, gestation period.

AVALIAÇÃO DE RAÇAS DE CAPRINOS NO NORDESTE DO BRASIL
I. ESTUDO DAS CARACTERÍSTICAS RELACIONADAS COM O NASCIMENTO DE CAPRINOS DE RAÇAS NATIVAS E EXÓTICAS

RESUMO - A maior parte da região Nordeste do Brasil é composta por uma área semi-árida tropical quente e a maioria da população de caprinos do Brasil (aproximadamente 6,1 milhões dos 6,6 milhões de caprinos existentes), encontram-se nesta região. Neste estudo, foram comparadas cinco raças de caprinos com relação ao seu crescimento pré-natal. O peso ao nascer (em kg) foi dividido pelo período de gestação (em dias) para se obter os valores do ganho de peso diário do feto, e este foi dividido pelo peso da mãe ao parto, para se obter o ganho de peso líquido diário, por kilograma do peso da mãe. As raças estudadas foram: nativas - (1) Canindé-Repartida, (2) Moxotó, (3) Marota; exóticas - (4) Anglo-nubiana, (5) Bhuj. Os resultados mostraram que o peso do cabrito ao nascer não estava estritamente relacionado com o peso da mãe ao parto. Ainda que os animais adultos da raça Bhuj fossem os mais pesados, seguidos dos Anglo-nubianos e nativos, os cabritos mais pesados foram produzidos pelas mães da raça Anglo-nubiana, e os cabritos das outras quatro raças incluindo a Bhuj, foram mais leves e semelhantes entre eles. Esta tendência se refletiu também no ganho médio diário, mas não no ganho líquido. O ganho líquido foi semelhante nas raças Anglo-nubiana e nativas, e muito mais baixo na raça Bhuj. Dentro de raça, mães com maior tamanho pareceram produzir cabritos com maior peso ao nascer e maior ganho de peso diário. Cabritos nascidos de partos simples apresentaram uma vantagem distinta sobre os cabritos nascidos de partos múltiplos, em todas as características de crescimento estudadas, mas o sexo do cabrito, em geral, pareceu não ter efeito significativo nessas características ainda que cabritos machos das raças Marota e Anglo-nubiana, fossem significativamente mais pesados do que as fêmeas e também tivessem um melhor ganho médio diário. O peso dos animais àdultos e os períodos de gestação variaram entre raças, mas estas características não foram influenciadas por outras fontes de variação.

Termos para indexação: região quente tropical semi-árida, Moxotó, Canindé-Repartida, Marota, Bhuj, Anglo-nubiana, peso ao nascer, ganho pré-natal por dia, ganho líquido por unidade de peso corporal, período de gestação.

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INTRODUCTION

The North-East Brazil, comprising of nine states, is recognized as the area with severe climate because of extension of the 'polygon of droughts'

in most of the region (Carter 1976). Except for the coastal region, the whole of Maranhão state and a greater part of Bahia state, the remaining is drought prone hot semi-arid tropical region. This region has most of Brazil's goats (6.095 million out of 6.601) as the climate provides the typical ranges and bushy and small trees (caatinga) suitable for goats. All these goats are primarily maintained for meat (Jordão & C. Filho 1952) although their numbers reflect their influence on pelt industry of the region (Domingues 1955).

Recently, there has been an increased emphasis on research for improving productivity of local goats and consequently the National Goat Research Center has been established under the auspices of the Brazilian Agency of Agricultural Research, EMBRAPA (Empresa Brasileira de Pesquisa Agropecuária 1979). In this paper, we are presenting some data on birth related traits with a view to finding if the potential for growth is different in different breeds. Our results on mortality of these goats are appearing elsewhere (Figueiredo & Pant 1981).

MATERIAL AND METHODS

Breeds. The indigenous breeds of goats are loosely characterized into four groups. The Moxotó (Fig. 1) are most predominant and are characterized by medium size (adult female, 30-40 kg), light cream colour which is often almost white with black portions. The black occurs as a line along the vertebral column on the back, over the underbelly and on the points such as feet, legs and face. These are horned animals and ears tend to be of medium size and erect. Repartida and Canindé are less predominant and are similar. Their only difference may be in the extension of black colour over the body. While Canindé (Fig. 2) is black over most of the body regions, except underbelly and the face, the Repartida (Fig. 3) has either the fore-or the hind-quarters black and the rest of the body is yellow as in case of Canindé. Marota (Fig. 4) is totally white and sometimes appears different on account of its longer hair giving a feeling that it might have some Angora or Saanen blood. However, all these breeds are similar in body size and possibly in most of the performance traits and appear to have sufficient interbreeding.

In the present study, three distinct native breed groups were recognized. These were: Moxotó, Canindé-Repartida, and Marota. Mason (1980) is of the view that all these four breeds are similar and there are perhaps no differences in their relative performance. However, Moxotó is the most common variety and Marota is totally white and

FIG. 1. Moxotó doe and kid. There is a feeling that these animals tend to be more uniform than other indigenous breeds of the region.

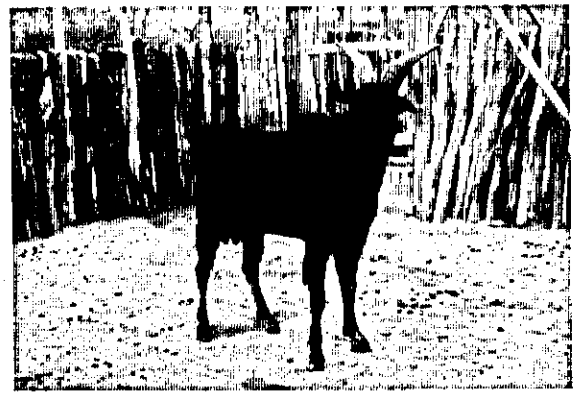

FIG. 2. Canindé buck. This breed is closely similar to Repartida and is supposed to be a better milk producer.

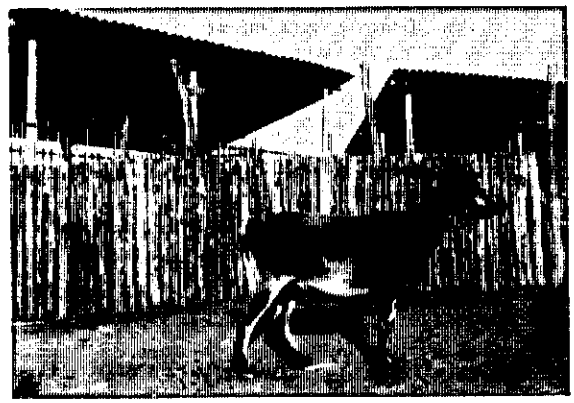

FIG. 3. Repartida doe. As against Canindé, this breed has limited extension of black colour.

FIG. 4. A flock of Marota goats.

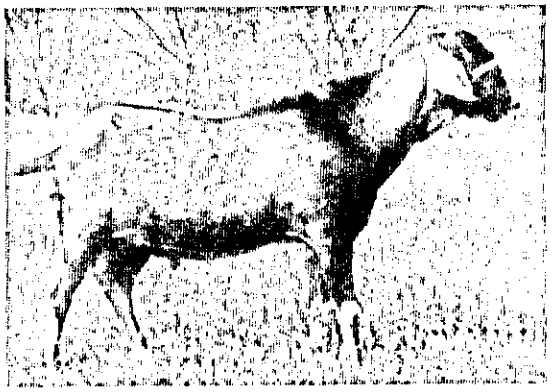

FIG. 5. A buck of Anglo-Nubian breed.

FIG. 6. A Bhuj doe. Note the long legs and white speckled ears.

appears slightly different. We, therefore, arbitrarily considered them separate populations. Canindé and Repartida are almost similar and therefore we combined them and thus we had three groups of indigenous breeds. In addition, we had two exotic breeds, Anglo-Nubian and Bhuj (Figs. 5, 6). The Anglo-Nubian is widely known. Bhuj was imported from India and must have come from around Bhuj in Gujerat. Bhuj does not find a mention in Mason (1969) and is black except in its long, large ears which have white portions and white spottings. It is a leggy breed like Jamnapari (Mason 1969).

Methodology. All the does used for breeding were of the same age group and results of breeding only in one season were utilized. Thus, there were no year, season or parity effects. The potential sources of variation were: Breeds (B), Types of birth (T) and Sex (S). The data were recorded on birth weight (BW), Mother doe's weight at parturition (MW) and Duration of pregnancy (DP). To determine average per day gain of the kids during pregnancy, the individual BW data were divided by their respective DP values and this gave another dependent variable on average Daily gain (GD) and to correct GD for mother-doe's weight, individual GD values were divided by their respective MW values and this gave, what we call, the Net gain (NG). General Linear Models procedure of least square analysis of variance and co-variance was used for analysing the data. For individual dependent variables (Y), the statistical models used were as follows:

(1) $Y = BW$

$$Y_{ijkl} = u + B_i + T_j + S_k + (BT)_{ij} + (BS)_{ik} + (TS)_{jk} + + (BST)_{ijk} + b(MW_{ijkl} - \overline{MW}) + b'(DP_{ijkl} - \overline{DP}) + E_{ijkl}$$

(2) $Y = GD$

$$Y_{ijkl} = u + B_i + T_j + S_k + (BT)_{ij} + (BS)_{ik} + (TS)_{jk} + + (BST)_{ijk} + b\,(MW_{ijkl} - \overline{MW}) + E_{ijkl}$$

(3) $Y = NG$

$$Y_{ijkl} = u + B_i + T_j + S_k + (BT)_{ij} + (BS)_{ik} + (TS)_{jk} + + (BST)_{ijk} + E_{ijkl}$$

(4) $Y = MW$

Model same as for (3) $Y = NG$

(5) $Y = DP$

$$Y_{ijkl} = u + B_i + T_j + S_k + (BT)_{ij} + (BS)_{ik} + (TS)_{jk} + + (BST)_{ijk} + b(MW_{ijkl} - \overline{MW}) + b'(BW_{ijkl} - \overline{BW}) + E_{ijkl}$$

RESULTS

The least square means of birth-related traits are presented in Table 1 and the analysis of variance in Table 2. The birth weight was significantly different in breeds and single born kids were significantly heavier to kids born in multiple pregnancies. The sex of kid had no significant effect on birth weight but breed x sex interaction was significant. An inspection of least square means according to breed and sex revealed that male kids were heavier to females in Marota ($P = 0.0456$) and Anglo-Nubian ($P = 0.0089$) breeds but did not differ in other breeds which gave a significant interaction. No other interactions were significant. The mother doe's weight at parturition ($P = 0.041$) and the gestation length ($P = 0.0566$) appeared to be related to birth weight, but only slightly. The average pre-natal per day gain showed almost a similar trend, breeds, types of birth, breed x sex interaction, and regression of mother-doe's weight at parturition showing significant effects. As in case of birth weight, the average per day gain was maximum for Anglo-Nubian, but Bhuj was not significantly different from indigenous breeds. Similarly, the average daily gain was more for single kids in comparison to twins and was almost similar in male and female kids, sex being of no importance on an overall basis. When the gain was corrected for mother's weight, the net gain of Anglo-Nubian was same as that of indigenous breeds and Bhuj showed significantly lower net gain than all other breeds. Sex again had no significant effect but single born kids clearly had an advantage over twins. The mother-doe's weight at parturition and the gestation length of the kids were significantly different among breeds and the latter appeared to be associated to birth weight of kids ($P = 0.0566$) as described earlier. No other sources in the analysis had any effect of these traits.

TABLE 1. Least Square Means (s.e.) of Birth-Related Traits of Indigenous and Exotic Breeds of Goat in the Tropical North-East Brazil.

Classification	Item	BW (kg)	GD (g)	NG (g)	MW (kg)	DP (days)
Breeds	Canindé-Repartida	1.74 (0.005)^{b}	11.91 (0.37)^{b}	0.436 (0.014)^{a}	27.09 (0.06)^{c}	147.37 (0.47)^{bc}
	Marota	1.73 (0.078)^{b}	11.79 (0.53)^{b}	0.414 (0.020)^{a}	28.45 (0.89)^{c}	146.44 (0.66)^{c}
	Moxotó	1.63 (0.044)^{b}	11.17 (0.29)^{b}	0.410 (0.010)^{a}	27.07 (0.44)^{c}	147.94 (0.36)^{b}
	Anglo-Nubian	2.15 (0.095)^{a}	14.60 (0.61)^{a}	0.427 (0.021)^{a}	35.81 (0.90)^{b}	142.66 (0.80)^{a}
	Bhuj	1.77 (0.124)^{b}	11.93 (0.79)^{b}	0.333 (0.024)^{b}	40.02 (1.03)^{a}	141.95 (0.99)^{a}
Types of birth	Single	1.94 (0.050)^{d}	13.22 (0.34)^{d}	0.442 (0.012)^{d}	31.35 (0.55)^{d}	145.71 (0.44)^{d}
	Multiple	1.67 (0.048)^{c}	11.34 (0.30)^{c}	0.366 (0.011)^{c}	32.03 (0.46)^{d}	144.84 (0.39)^{d}
Sex	Male	1.86 (0.048)^{e}	12.63 (0.31)^{e}	0.414 (0.011)^{e}	31.94 (0.48)^{e}	144.91 (0.39)^{e}
	Female	1.75 (0.049)^{e}	11.93 (0.32)^{e}	0.394 (0.012)^{e}	31.44 (0.53)^{e}	145.63 (0.41)^{e}

Note: The mean comparisons are columnwise and within breeds, types of birth and sex.
The means with same superscript letter do not differ significantly at $P < 0.05$.

DISCUSSION

The native and exotic breeds of goat in North-East Brazil are primarily maintained for meat (Jordão & C, Filho 1952). Thus, apart from prolificacy and survivability, growth would be a trait of much importance. The most promising

TABLE 2. Least Square Analysis of Variance of Birth-Related Traits of Indigenous and Exotic Goat Breeds in Tropical North-East Brazil.

Source of variation	d.f.	SS				
		BW (kg)	GD (g)	NG (g)	MW (kg)	DP (days)
Breed	4	2.781****	132.24****	0.1118***	2868.992 ****	325.312 ****
Type of birth	1	1.948****	98.09****	0.1599****	12.892	18.369
Sex	1	0.267	12.95	0.0356	97.745	5.064
Breed x Type	4	0.310	13.41	0.0111	6.882	14.283
Breed x Sex	4	1.432**	72.66***	0.0514	60.361	53.117
Type x Sex	1	0.006	0.31	0.0000	0.000	0.003
Breed x Type x Sex	4	0.381	19.16	0.0050	59.550	14.325
Regression on MW	1	0.470*	23.90*	-	-	7.908
Regression on BW	1	-	-	-	-	29.494[a]
Regression on DP	1	0.405[a]	-	-	-	-
Error	(d.f. under individual columns within parentheses)	17.664 (161)	824.07 (162)	1.7989 (163)	2337.119 (163)	1287.412 (161)

Note: No superscript= (P > 0.05); [a] = (P = 0.0566); * = (0.025 < P < 0.050); ** = (0.010 < P < 0.025); *** = (0.005 < P < 0.010); **** = (P < 0.005).

animal would be one that has ability to grow faster, which may eventually mean better feed conversion ratio.

In small flocks of goat, it is often not possible to effectively compare the pre- and post-weaning growth of different catagories of animals. This is due to the difficulty which is invariably encountered in accomodating various variables (types of birth, breed, sex, etc) in small samples. Moreover, because of mortality, which is usually high in tropical areas (Minett 1950, Devendra & Burns 1970, Gill & Dev 1972, Empresa Brasileira de Pesquisa Agropecuária. Centro Nacional de Pesquisa de Caprinos 1980, Sarmah et al. 1981), some of the sub-samples may completely disappear at later stages, say at weaning, or, may sometimes make some of the factors confounded (like age of mother and genotype of the kid). Considering all these difficulties and the fact that the maximum data would be available at birth, it was thought desirable to explore if pre-natal pattern of growth could be used as a useful means to predict future growth and economic value of the kids.

Birth weight has been an object of study in sheep and goat for many years and plenty of information on this character is now available. It has been observed that the birth weight of goat (Datta et al. 1963) and sheep (Thomson 1954, Harrington et al. 1958, Ćeranić et al. 1976) is an important factor affecting later growth. Greater birth weight in sheep also improves survivability (Shelton 1964, Kaushik & Singh 1968, Labban et al. 1969, Labban 1971, Malik & Acharya 1972, Shin et al. 1975). Birth weight in itself depends on such factors as maternal environment and age and weight of dam (Asker et al. 1954, Hunter 1956, Kaushik & Singh 1968, Labban 1971, Shin et al. 1975) and it is difficult to disentangle the maternal effects from the effects due to genotype of the offspring (Willham 1980). There is evidence to show that the pre-natal growth of lambs up to 140 days of gestation is under marked genetic control (Foote et al. 1959) and the birth weight is influenced by such factors as inbreeding (Hazel & Terril 1945, Glembocki & Nahimison 1954, Terril et al. 1948) and non-additive gene interactions (Asker et al. 1954). The critical studies of Dickinson et al. (1962) also showed that the size of lamb

at birth was markedly under the control of lamb's genotype and maternal influence was much less. The lamb's genotype accounted for 72 percent of total variation in birth weight as compared to 20 percent contributed by mother's environment. The genotypic effects become more pronounced with age of kid (Hunter 1956). In this study, the growth traits are derived from birth weight. The birth weight is assumed to depend on its own genotype, its mother's size and the duration of pregnancy. So to calculate per day growth of foetus, the birth weight has been divided by the gestation length. The growth of foetus is not linear and so the calculated per day growth is an arbitrary figure. Subsequently, the per day growth has been calculated for per kg of mother's body weight. Starke et al. (1958) have reported that in expressing birth weights as a percentage of the average weight of parents, a very nearly constant figure of 7.5 was obtained irrespective of breeding. From a cursory look at the data, it appeared that the exotic breeds, Anglo-Nubian and Bhuj, probably have the potential for larger birth weight because their adult size is distinctly larger to the indigenous breeds and also their gestation periods are distinctly lower to indigenous breeds, breeds with shorter gestation lengths indicating larger size at birth (Narayanswami et al. 1975, Sahani & Pant 1978). However, although the Anglo-Nubian dropped the heaviest kid, Bhuj did not and produced a kid that was not different from the kids produced by the indigenous breeds. This is surprising, especially since the adult Bhuj was the heaviest among the breeds studied. In earlier reports of this Center (Empresa Brasileira de Pesquisa Agropecuária 1979, 1980), Bhuj appears to be slightly smaller to Anglo-Nubian and their gestation periods appear to be significantly different to what we have found in this investigation. Still, the heavier weight of Bhuj was confirmed by its shorter gestation period, and as we have used a different type of statistical analysis for unequal sample size, we are inclined to believe that such differences are expected to occur. Consequent to above results, except Anglo-Nubian, all other breeds had identical per day pre-natal gain in foetal weight. The daily gain of Anglo-Nubian was distinctly superior to other breeds. When the pre-natal daily gain was calculated per kg of mother-doe's weight, the superiority of Anglo-Nubian vanished and the net gain of Bhuj was actually the lowest. This may mean that most of the breed differences were due to mother's size and Bhuj appeared to have lowest foetal gain per unit body weight of the dam, as even with larger body size it only produced kids almost similar in size to much smaller indigenous breeds. If Bhuj males are used in a crossbreeding programme with indigenous does, the resultant halfbred progeny may not be much different from the indigenous breeds. In the crosses of Merino rams and Blackhead Persian ewes, similar trend has been observed by Starke et al. (1958). However, this appears too simple a generalization which pre-supposes a complete absence of an interaction between maternal environment and the genotype of the kid, which is not the case. The genotype of the kid is known to influence the maternal environment (Hunter 1956). Starke et al. (1958) have reported significant differences in genetic groups in the ratio of birth weight to dam's weight. Thus, these results show that the interbreed influence of mother's body size on birth weight may not be as simple and linear as reported by Hamada (1954), Bhasin & Desai (1967) and several other workers. Obviously, the foetus grows according to its own genotype and not merely as a reflection of mother's body size (Dickinson et al. 1962). Type of birth had a consistent effect, single born kids being superior to twins in all the growth traits including the net gain (Bogart et al. 1957, Juma & Faraj, 1966, Singh 1973, Shin et al. 1975). Sexes, on the other hand, did not show any difference, although the mean values of the male kids were marginally more than of the female kids and within two of the breeds, Marota and Anglo-Nubian, male kids were significantly heavier at birth and had significantly better average daily gain. There is much information on the sex effects and male kids and lambs are known to grow faster (Bogart et al. 1957, Juma & Faraj 1966, Kaushik & Singh 1968, Singh 1973, Shin et al. 1975).

This study also provided information on the adult body weight of the five breeds and their gestation periods. The Bhuj was heaviest and had shortest gestation period and the Anglo-Nubian was next in order. The body size of the indigenous

breeds was almost identical and lower to exotic breeds and similarly had almost identical and longer gestation periods. The breed means of gestation periods and adult body weights showed a near perfect negative correlation which is similar to that observed by Sahani & Pant (1978) in sheep, although within breeds such correlations may not be significant (Terril & Hazel 1947, Forbes 1967, Glimp 1971).

The present study is an attempt to provide the readers some information on the local breeds. Obviously, the data used is rather small. But, in view of the fact that the breeding programmes are just starting and information on local goats is generally lacking, we hope, results presented here will be of interest.

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