PRELIMINARY STUDIES ON THE CARCASS CHARACTERISTICS OF NATIVE BREEDS OF WOOLLESS SHEEP IN HOT TROPICAL SEMIARID NORTHEAST BRAZIL[1]

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ABSTRACT - This experiment was carried out to evaluate the potentiality of meat production in male lambs of three indigenous breeds of hairy (woolless) sheep maintained on native "caatinga" pastures up to six or seven months of age, and, if necessary, under stall-feeding subsequently, in the hot tropical Northeast Brazil. The results showed that the optimum slaughter weight of 25 kg was reached in Santa Inês and some of the Morada Nova lambs on native pastures by the time they were six to seven months of age. Some other twin-born lambs of Morada Nova and all lambs of Brazilian Somali breeds did not reach the weight till seven months of age and these animals had to be stall-fed for additional period. These reached the optimum slaughter weight at around nine to ten months of age. Thus, Santa Inês breed had the best growth, Morada Nova was intermediate and Brazilian Somali had the minimum growth. These breed differences, which reflect their adult body sizes, also influenced some of the carcass characteristics. The type of birth appeared to have a marked effect on size, growth and some of the carcass characteristics. Single-born lambs had a distinct advantage. There was virtually no difference in the carcass characteristics of older and younger lambs of comparable weights and it appeared that these traits were related more to the weight of lamb at slaughter.

Index terms: Santa Inês, Morada Nova, Brazilian Somali, meat productivity, native caatinga pastures, stall-feeding.

ESTUDOS PRELIMINARES SOBRE AS CARACTERÍSTICAS DE CARCAÇA DE OVINOS DESLANADOS DO NORDESTE SEMI-ÁRIDO DO BRASIL

RESUMO - Este experimento foi conduzido na região do Sertão no nordeste do Brasil, para avaliar a potencialidade de produção de carne, em ovinos de raças deslanadas, mantidos em pastagens nativas, de caatinga, até os seis ou sete meses de idade, e depois, se necessário, em confinamento. Os resultados demonstraram que o peso de abate (25 kg) foi alcançado em pastagem nativa com os animais da raça Santa Inês e alguns da raça Morada Nova, antes dos sete meses de idade. Alguns cordeiros gêmeos da raça Morada Nova e todos os da Somalis Brasileira não atingiram o peso de abate até os seis ou sete meses de idade e foi necessário o seu confinamento por um período adicional de dois a três meses. A raça Santa Inês apresentou a maior velocidade de crescimento, enquanto que a Somalis, a menor. A raça Morada Nova situou-se em posição intermediária. Essas diferenças entre raças refletem o tamanho corporal à idade adulta e também influenciaram algumas características de carcaça. O tipo de nascimento parece ter efeito signicativo no tamanho, no crescimento e em algumas características de carcaça. Cordeiros nascidos como únicos foram superiores aos gêmeos. Não foi observada nenhuma diferença nas características de carcaça entre os animais de idades diferentes e pesos semelhantes. Parece que essas características são mais relacionadas com o peso do cordeiro ao abate.

Termos para indexação: Santa Inês, Morada Nova, Somalis Brasileira, produtividade de carne, pastagem nativa de caatinga, alimentação em confinamento.

INTRODUCTION

The most part of Northeast Brazil is a hot semi-arid tropical region and, according to census figures of 1980, has 6.117 million sheep. Virtually, all these sheeps are primarily maintained for meat. Although most of the sheep population is known to consist of mixed non-descript (crioulo) type animals which produce smaller quantities of inferior, coarse and carpet type of wool, there are large numbers of hairy (woolless) sheep belonging to clearly defined breeds. In an earlier communication (Figueiredo et al. 1982), it was tried to present some information of the early growth of lambs of the three local hairy breeds of sheep. However, there are no reports on their growth in relation to optimum slaughter weight and carcass traits under traditional range conditions. The purpose of this study is to provide this type of information in a preliminary and systematic investigation.

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MATERIAL AND METHODS

Breeds and grazing management. Three breeds of local sheep, Brazilian Somali, Morada Nova and Santa Inês (Figueiredo et al. 1982), were used. These breeds originated from exotic sources (Domingues 1955; Shelton & Figueiredo 1981). But, due to many generations of breeding in the local environment, these have become modified and sufficiently adapted to be considered indigenous (Mason 1980). All experimental animals were being maintained as one flock and grazed on native "caatinga" pastures characterized by small bushy and thorny trees. The animals were grazed for about eight hours everyday, periodically changing the grazing area. At other times, these were kept in open corrals where water was available to them ad libitum.

Lambing management. All the ewes were naturally mated to rams and the lambing took place within a 60 day period in February-April in open lambing corrals. The ewes and lambs were kept together for the first two days and subsequently ewes went out for grazing as usual and returned to the lambing corral to be with the lambs for nursing. After ten days, the lambs were also let out to grazing areas with mother-ewes till weaning. At weaning. (about 112 days), the lambs were completely separated from ewes and sent to different grazing area till they were about six months of age. If lambs did not reach the optimum slaughter weight of 25 kg till they were seven months of age, they were kept under confinement.

Confinement. The lambs were weighed weekly and the optimum weight at slaughter was assumed to be 25 kg. As all the Brazilian Somali and some of the Morada Nova lambs did not reach the slaughter till six to seven months of age, these were put under stall-feeding where 300 g of concentrate ration, consisting of 40 parts of deoiled cottonseed cake and 60 parts of broken corn, was provided to each lamb per day. In addition, green cultivated fodder (elephant grass) was also available. These lambs reached the slaughter weight up to ten months of age.

Slaughter and carcass measurements. The lambs were being weighed once a month and all lambs that reached 25 kg in the monthly weighing schedule were slaughtered. The lambs that fell short of this weight were maintained for the next weighment after another month. The age in days on the day of slaughter is the:

1. **Age at slaughter** in this experiment. Thus, the lambs may have weighed 25 kg or more when they reached the slaughter weight. These animals were fasted for 18 to 24 hours before slaughter but were provided with adequate drinking water. Immediately before slaughter, weight was taken again and this is the:
2. **Weight at slaughter.**

For slaughter, each lamb was stunned by a blow on the head and bled by cutting the jugular veins and hanging the animal in a head down position. After the bleeding stopped and animal was dead, the carcass was skinned by trained personnel and the weight of whole skin was taken. This is the:

3. **Wet skin weight.**
   The skin was later spread and extended on wooden frames and allowed to dry for 48 hours. The skin was then weighed again and this represents the:
4. **Dry skin weight.**

After removal of skin, the head was removed at the atlas vertebra and legs at carpal and tarsal joints. Thereafter, the abdomen was opened and viscera, including liver, kidneys, heart and lung, were removed and the carcass was again weighed. This is the:

5. **Carcass weight** in this study and represents empty carcass weight. The proportion of (5) Carcass weight to the (2) weight at slaughter has been termed as the
6. **Dressing percentage.**

In the following carcass measurements, the distance means a straightline distance:

7. **Carcass length** is the distance between pubic joint and front border of the first rib.
8. **Length of hind leg** is the distance between pubic joint and distal end of febula.
9. **Depth of thorax** is the distance between the dorsal position of the 6th thoracic vertebra and the ventral position of the sternum.
10. **Circumference of thigh** in the circumference of the hind legs around thigh region where the measurement was maximum.

For the animals that were confined and stall-fed, there were also values on:

11. **Initial weight at confinement,**
12. **Duration of confinement, and**
13. **Average daily gain during confinement.**

Analysis of data. General Linear Models procedure of least square analysis was used for conducting analysis of variance and covariance and for obtaining least square means.

RESULTS

In the first analysis, data on Santa Inês and some Morada Nova lambs were included. These lambs were grazed on native caatinga pastures till they reached the slaughter weight and it was not necessary to keep them in confinement. The least square means and analysis of variance are presented in Table 1. Carcass length varied between breeds. Age at slaughter ($P = 0.0577$) and wet skin weight ($P = 0.0518$) appeared to be different among breeds. There was a significant difference between types of birth in circumference of thigh muscles of the carcass and dressing percentage had a significant positive association with live weight at slaughter.

TABLE 1. Analysis of variance and means of carcass characteristics of Morada Nova and Santa Inês sheep maintained on native pastures alone.

Source of variation	d.f.	Mean squares									
		Age at slaughter (days)	Weight at slaughter (kg)	Carcass weight (kg)	Wet skin weight (kg)	Dry skin weight (kg)	Carcass length (cm)	Length of hind leg (cm)	Depth of thorax (cm)	Cirfumference of thigh (cm)	Dressing percentage
Breeds	1	4113.37[a]	8.530	1.123	0.2228[b]	0.00267	6.598*	0.301	0.588	2.8376	16.32
Sires within breeds	2	345.91	3.753	0.617	0.0075	0.00721	0.837	0.820	2.486[c]	1.8128	10.62
Types of birth	1	250.38	0.032	1.076	0.0160	0.00032	0.188	1.961	0.510	7.1754*	18.90
Breed x types	1	101.84	0.285	0.001	0.0022	0.00012	0.934	1.321	0.682	0.0055	0.23
Regression on weight at slaughter	1	129.05	0.334	0.075	0.0198	0.00936	1.873	0.548	2.474	0.0033	69.26**
Error	12	916.99	2.370	0.466	0.0478	0.00928	1.116	1.108	0.655	1.2104	7.34
LEAST SQUARES MEANS (figures within parentheses indicate one standard error)											
(A) Breeds											
(1) Morada Nova		213.52 (20.99)	22.85 (0.99)	10.980 (0.473)	1.583 (0.152)	0.737 (0.067)	57.86 (0.73)	38.61 (0.73)	17.897 (0.561)	32.89 (0.76)	44.07 (1.88)
(2) Santa Inês		163.67 (10.48)	25.18 (0.57)	11.804 (0.236)	1.950 (0.076)	0.777 (0.033)	59.85 (0.37)	39.04 (0.36)	17.301 (0.280)	31.59 (0.38)	47.21 (0.94)
(B) Types of birth											
(3) Single		182.53 (19.18)	24.08 (0,93)	11.790 (0.432)	1.815 (0139)	0.764 (0.061)	59.02 (0.67)	38.29 (0.67)	17.873 (0.513)	33.27 (0.70)	47.31 (1.72)
(4) Multiple		194.67 (13.23)	23.94 (0.63)	10.994 (0.298)	1.718 (0.096)	0.750 (0.042)	58.69 (0.46)	39.37 (0.46)	17.325 (0.354)	31.21 (0.48)	43.98 (1.18)

Note: In case of analysis of variance of weight at slaughter, the regression is on the age of animals at slaughter.
a, P= 0.0577; b, P= 0,0518; c, P= 0.0529; *, 0.025<P<0.050; **, 0.005<P<0.010.

Brazilian Somali, being a smaller sized breed (Figueiredo et al. 1982), did not reach the slaughter weight till six months of age in the native caatinga pastures. Thereafter, these lambs were kept under confinement and maintained on concentrate ration and green fodder. These animals then reached the slaughter weight at about nine to ten months of age and the results of analysis and means of carcass traits are presented in Table 2. Significant differences between the progenies of the two sires used for breeding were observed in wet and dry skin weights, and depth of thorax was nearly significantly different (P = 0.0534). There was a clear difference between single-born and twin-born lambs in the age at which these reached the slaughter weight. The twins took nearly 34 more days to reach the same weight as the singles, but there was no difference in any of the carcass traits. The weight of lambs at slaughter significantly influenced the carcass weight, dry skin weight and depth of thorax.

An attempt was also made to analyse the growth of these lambs during confinement and the results are presented in Table 2A. Initial weight at confinement was significantly different among single-born and twin-born lambs, the difference being nearly 5 kg. The total duration of confinement was nine days more in twin lambs and nearly ten days more for the progeny of sire number 68, but these differences were only minor and not significant. However, the duration of confinement was significantly correlated to the initial weight of lambs at the time of confinement and was more for lighter lambs. The per day gain of lambs during confinement appeared (P = 0.0595) to be more in twin lambs than in single lambs, but per day gain was not dependent on either the initial weight or the duration of confinement.

Morada Nova breed is intermediate in size to the larger breed Santa Inês and smaller Brazilian Somali. Some of the Morada Nova lambs, other than those included in the analysis in Table 1, did not reach the slaughter weight up to seven months on"caatinga" pastures and were therefore kept in confinement for additional period to grow up to weight. All these were twin-born lambs. A comparison was made between these lambs and the twin lambs which reached the slaughter weight at seven months and which are included in the analysis in Table 1. Results of this comparative analysis are presented in Table 3. The analysis showed that there was a big difference in the number of days that it took lambs to reach the slaughter weight in the two groups. The smaller sized twin lambs of Morada Nova breed took nearly 75 more days to reach the same size as their larger sized counterparts. Significant differences in the progenies of the two sires were observed only in case of weight at slaughter, but the wet and dry skin weights were significantly different in the confined and non-confined lambs, being greater in the lambs that were slaughtered at a later age after confinement. The weight of dry skin depended greatly on the weight of lamb at slaughter. There was no difference in other carcass characteristics between older and younger lambs and it seems that carcass characteristics are more closely related to weight at slaughter than to age of lambs.

Utilizing the data of Table 1, another analysis was carried out on only Santa Inês lambs which is presented in Table 4. In this analysis, effects of two sires and of the two types of birth were analysed. The sires influenced the weight at slaughter of lambs and the types of birth significantly influenced the circumference of thighs. The weight at slaughter had significant regression on the depth of thorax and dressing percentage.

In Table 5 are presented least square means of carcass characteristics and certain growth parameters of Brazilian Somali and Morada Nova lambs that were confined between six and ten months of age as they had poor growth. This comparison showed that for attaining same weight as the poorly growing Morada Nova, Brazilian Somali still needed almost ten more days. There were significant breed differences in the weight of dry skin, carcass length, length of hind leg and depth of thorax. In all these characteristics, Morada Nova had better averages.

Although the total number of observations was rather small, attempt was made to correlate all the characteristics studied. The weight at slaughter was correlated to the carcass weight without exception and tended to be positively related to weights of wet skins and carcass length. In lambs that grew

TABLE 2. Analysis of variance and means of carcass traits of Brazilian Somali lambs maintained on stall-feeding after six months of age.

Source of variation	d.f.	Mean squares									
		Age at slaughter (days)	Weight at slaughter (kg)	Carcass weight (kg)	Wet skin weight (kg)	Dry skin weight (kg)	Carcass length (cm)	Length of hind leg (cm)	Depth of thorax (cm)	Cirfumference of thigh (cm)	Dressing percentage
Sires	1	399.4	3.353	0.026	0.1608***	0.05708***	0.261	0.4445	1.576[a]	0.516	0.608
Types of birth	1	3027.9**	0,851	0.335	0.0039	0.00045	1.495	0.0458	0.303	0.375	5.662
Sire x types	1	498.7	0.179	0.450	0.0049	0.00726	0.284	3.6243*	0.404	0.250	8.675
Regression on weight at slaughter	1	301.6	3.291	4.547***	0.2602	0.11814***	31.177**	0.3377	2.241*	5.302	2.736
Erros	8	278.9	3.044	0.119	0.0099	0.00271	3.472	0.6703	0.307	4.221	2.518
LEAST SQUARES MEANS (figures within parentheses indicate one standard error)											
(A) Sires											
(1) Number 1		285.5 (7.1)	22.17 (0.79)	10.77 (0.15)	1.772 (0.042)	0.794 (0.022)	52.28 (0.79)	35.11 (0.35)	17.639 (0.234)	30.71 (0.87)	47.31 (0.67)
(2) Number 68		297.9 (7.4)	23.33 (0.76)	10.67 (0.15)	2.021 (0.044)	0.942 (0.023)	52.59 (0.83)	34.69 (0.36)	16.859 (0.246)	31.16 (0.91)	46.83 (0.70)
(B) Types of birth											
(3) Single		274.9 (7.3)	22.33 (1.05)	10.90 (0.15)	1.915 (0.044)	0.862 (0.023)	52.81 (0.81)	34.97 (0.36)	17.416 (0.242)	31.12 (0.90)	47.79 (0.69)
(4) Multiple		308.4 (6.9)	23.17 (0.87)	10.55 (0.14)	1.877 (0.042)	0.875 (0.022)	52.07 (0.78)	34.84 (0.34)	17.082 (0.232)	30.75 (0.86)	46.35 (0.66)

Note: In case of analysis of weight at slaughter, the regression is on the age of animal at slaughter.
a, P= 0.0534; *, 0.025<P<0.050; **, 0.010<P<0.025; ***, P<0.005.

TABLE 2A. Analysis of variance and means of body weights and gain in Brazilian Somali sheep during confinement.

Source of variation	d.f.	Mean squares		
		Initial weight at confinement in kg (A)	Duration of confinement in days (B)	Per day gain in g (C)
Sires	1	0.128	278.24	75.93
Types of birth	1	69.380**	51.47	596.55[a]
Sire x Types	1	10.116	26.45	335.23
Regression on A	1	–	887.96*	9.64
Regression on B	1	–	–	44.76
Error (d.f.)	–	2.956 (9)	72.25 (8)	118.25 (7)
LEAST SQUARES MEANS (figures within parentheses indicate one standard error)				
(A) Sires				
(1) Number 1		16.385 (0.719)	111.97 (3.64)	50.76 (5.04)
(2) Number 68		16.600 (0.745)	122.04 (3.85)	57.15 (5.58)
(B) Types of birth				
(3) Single		19.000 (0.745)	112.90 (6.27)	39.38 (8.16)
(4) Multiple		13.985 (0.719)	121.10 (4.78)	68.53 (6.50)

Note: a, P= 0.0595; *, 0.005<P<0.010; **, P<0.005.

faster, carcass weight was positively correlated with dressing percentage, but not in animals that were small and were therefore confined. Wet skin weight was closely related to dry skin weight. There were some other irregular correlations which are not important and hence not presented here.

DISCUSSION

The hairy sheep are primarily maintained for meat and therefore a study on carcass characteristics of such sheep may be useful. The profitable management of these animals requires several informations concerning rates of growth in varieties and breeds of these animals, especially on the sparse pasture ranges where these animals are normally located. Meagre nutrition creates an adverse stress environment and therefore leaves much less scope to improve meat productivity by drastically improving feeding management.

In Northeast Brazil, comparable populations of sheep (5.3 million) and goats (6.1 million) exist and their future numbers may depend on their relative economic profitability to the producers. As a first step, therefore, it was tried to find out as to how much time these animals take in reaching a particular slaughter weight and the nature of variation in weights and measurements of some carcass parts. In this type of preliminary investigation, it was unavoidable to use small numbers of animals and the results obtained are intended to provide some basic information. As there are no reports on performance of sheep breeds on native "caatinga" pastures, this information may be valuable. In this experiment, weight at slaughter was controlled, which is expected to bring more uniformity in carcass characteristics. At the same time, total number of lambs was rather small. Hence, the probability levels in the tests of significance had to be looked at more carefully, especially when these were close to 5%. The smallness of the body of data seems to have influenced formal significance of effects in the analysis, but it has been quite easy to obtain useful conclusions.

The main observation has been concerning the relative size of the three breeds, and this study con-

TABLE 3. Analysis of variance and means of carcass traits of Morada Nova sheep kept under confinement around 6 to 9 months of age versus those maintained only on native "caatinga" pastures up to 7 months (effect of treatment confounded with effect of age).

Source of variation	d.f.	Mean squares									
		Age at slaughter (days)	Weight at slaughter (kg)	Carcass weight (kg)	Wet skin weight (kg)	Dry skin weight (kg)	Carcass length (cm)	Length of hind leg (cm)	Depth of thorax (cm)	Circumference of thigh (cm)	Dressing percentage
Sires	1	12.19	3.4804*	0.20917	0.00244	0.001769	0.0393	1.6834	0.20887	0.7722	3.855
Treatments	1	11089.58****	0.7663	0.60643	0.15237*	0.004106**	0.0537	1.3018	0.55709	1.1556	11.226
Sires x treatments	1	292.43	0.0038	0.05971	0.00215	0.003040*	0.2609	0.1227	0.08861	0.2352	1.339
Regression on weight at slaughter	1	298.67	0.3514	0.18688	0.01520	0.005996***	1.9576	1.0860	0.20568	0.1076	2.687
Error	5	447.43	0.5264	0.15996	0.01536	0.000363	2.3751	0.8495	0.49220	1.5118	3.104
LEAST SQUARES MEANS (figures within parentheses indicate one standard error)											
(A) Sires											
(1) Number 209		247.19 (12.92)	23.97 (0.34)	11.249 (0.244)	1.629 (0.076)	0.7123 (0.116)	57.26 (0.94)	37.91 (0.56)	19.066 (0.429)	32.533 (0.751)	48.187 (1.076)
(2) Number 1316		243.60 (12.76)	22.70 (0.34)	10.779 (0.241)	1.680 (0.075)	0.7556 (0.0115)	54.47 (0.93)	39.24 (0.56)	18.596 (0.423)	31.629 (0.742)	46.167 (1.063)
(B) Treatments											
(3) Native pastures		207.93 (12.76)	22.67 (0.62)	10.737 (0.191)	1.516 (0.059)	0.7111 (0.0091)	57.28 (0.74)	38.98 (0.44)	18.565 (0.336)	32.464 (0.588)	45.985 (0.843)
(4) Confinement		282.85 (10.20)	24.00 (0.59)	11.291 (0.193)	1.793 (0.060)	0.7567 (0.0092)	57.45 (0.74)	38.17 (0.44)	19.096 (0.338)	31.699 (0.593)	48.369 (0.849)

Note: In case of weight at slaughter in the analysis, regression is on the age at slaughter.
*, 0.025<P<0.050; **, 0.010<P<0.025; ***, 0.005<P<0.010; ****, P<0.005.

TABLE 4. Analysis of variance and means of carcass characteristics of Santa Inês sheep maintained on nativa "caatinga" pastures.

Source of variation	d.f.	Mean squares									
		Age at slaughter (days)	Weight at slaughter (kg)	Carcass weight (kg)	Wet skin weight (kg)	Dry skin weight (kg)	Carcass length (cm)	Length of hind leg (cm)	Depth of thorax (cm)	Circumference of thigh (cm)	Dressing percentage
Sires	1	19.02	12.753*	0.150	0.0045	0.0119	1.371	1.1868	2.827	0.4848	1.66
Types of birth	1	4770.54	0.847	2.209	0.0137	0.0019	0.000	0.1715	2.131	10.0570**	32.38
Regression on weight at slaughter	1	59.70	0.071	0.084	0.0187	0.0079	4.581	0.9818	5.651*	0.0091	65.53**
Error	11	2150.29	2.546	0.519	0.0501	0.0100	1.672	1.6445	0.870	1.4352	8.20
LEAST SQUARES MEANS (figures within parentheses indicate one standard error)											
(A) Sires											
(1) Number 170		180.89 (15.72)	26.01 (0.52)	11.90 (0.24)	1.93 (0.08)	0.743 (0.034)	60.02 (0.44)	38.88 (0.43)	18.08 (0.32)	32.10 (0.41)	46.69 (0.97)
(2) Number 306		184.05 (27.47)	23.87 (0.81)	11.62 (0.43)	1.98 (0.13)	0.822 (0.059)	59.18 (0.77)	38.56 (0.76)	16.87 (0.55)	31.59 (0.71)	45.76 (1.70)
B) Types of birth											
(3) Single		162.66 (17.04)	25.22 (0.59)	12.18 (0.26)	1.99 (0.08)	0.795 (0.037)	59.60 (0.48)	38.84 (0.47)	17.90 (0.34)	32.76 (0.44)	47.86 (1.05)
(4) Multiple		202.27 (22.44)	24.65 (0.78)	11.33 (0.35)	1.92 (0.11)	0.770 (0.048)	59.60 (0.63)	38.60 (0.62)	17.06 (0.45)	30.94 (0.59)	44.59 (1.39)

Note: In case of weight at slaughter in the analysis, regression is on the age at slaughter.

*, $0.025<P<0.050$; **, $0.010<P<0.025$.

TABLE 5. Least square means (s.e.) of carcass characteristics of Brasilian Somali and Morada Nova breeds of sheep maintained on "caatinga" pastures up to 6 months of age and confined thereafter till slaughter at around 10 months.-

Carcass characteristics	Breeds				
	Brazilian Somali			Morada Nova	
Age at slaughter (days)	294.05	(6.57)		285.40	(10.72)
Weight at slaughter (kg)	22.86	(0.40)		23.25	(0.65)
Carcass weight (kg)	10.862	(0.105)		11.084	(0.171)
Wet skin weight (kg)	1.897	(0.043)		1.752	(0.070)
Dry skin weight (kg)	0.885	(0.024)	*	0.735	(0.039)
Carcass length (cm)	52.66	(0.44)	**	57.03	(0.72)
Length of hind leg (cm)	34.70	(0.25)	**	38.37	(0.41)
Depth of thorax (cm)	17.23	(0.17)	**	18.99	(0.28)
Circumference of thigh (cm)	31.06	(0.44)		31.31	(0.76)
Dressing percentage	47.33	(0.47)		48.27	(0.76)
Initial weight at confinement (kg)	15.92	(0.82)		18.84	(1.31)
Average per day gain during confinement (g)	54.32	(3.31)		54.64	(5.47)

Note: *, $P < 0.01$; **, $P < 0.005$.

firms our previous report (Figueiredo et al. 1982) that Santa Inês is the largest and Brazilian Somali the smallest among the three breeds studied. However, Morada Nova has much better prolificacy than Santa Inês (175 versus 125) (Figueiredo et al. 1979) and for calculating overall economy this will have to be considered.

In this study, the pre-fasting body weight of 25 kg at slaughter has been considered optimum. However, in Santa Inês and larger lambs of Morada Nova breeds, dressing percentage has a significant association to the weight at slaughter and larger animals have more dressing percentage. This shows that there is still more scope for improving overall meat production by allowing the lambs to grow further. Botkin et al. (1969) have also shown that faster growing lambs have advantage in overall meat productivity. But, Lambuth et al. (1970) showed that the percent retail cut are not different between slow growing and fast growing lambs. The slow growing lambs tend to accumulate too much fat and fast growing lambs have too large a proportion of bones. However, in the "caatinga" range conditions, the pattern may be different and genetic progress through selecting for increased weight may be desirable (Jacobs 1974). In slow growing lambs in this study, no association between dressing percentage and weight of the animal was found.

The type of birth did not have any effect on carcass characteristics of fast growing lambs of Morada Nova and Santa Inês breeds, although twin-born lambs took a little longer to reach the same weight as singles and circumference of thigh muscles was slightly larger in single born lambs. But, in case of Brazilian Somali, the type of birth had a marked effect on the final weights in native "caatinga" pastures which were also the initial weights of confinement and on the age when lambs reached the slaughter weight after confinement. The single-born lambs were superior in all these characteristics. Still, as the weight of lamb at slaughter was controlled, the carcass characteristics did not differ. Botkin et al. (1969) also found that the type of birth had little value on carcass traits, and in fact, in their study twins grew faster than singles. But, in spite of controlling the slaughter weight of lambs, they obtained marked variation in all the carcass characteristics.

The duration of confinement of these animals depended on the initial weight at confinement and was greater for smaller lambs. The per day gain was

more in twin lambs than singles during the period of confinement and this shows that smaller twin-born lambs have the capacity for compensatory growth.

In the Brazilian Somali lambs, marked sire effects were observed in the weights of wet and dry skins. On an overall basis, the carcass weight and depth of thorax were the other characteristics that appeared to be different between sires. However, with only two sires, these differences can only be taken as indications, although high estimates of heritability have been reported for several carcass characteristics (Botkin et al. 1969, Bowman & Hendy 1972, Wolf et al. 1981).

The results of this experiment show that it would be advantageous to have a larger sized lamb in Santa Inês breed and the optimum slaughter weight may be determined separately for this breed. The most economic weight of lamb at slaughter may be different and higher in Santa Inês in comparison to smaller Morada Nova and Brazilian Somali lambs. In Morada Nova, more attention may be given to prolificacy as the twin-born lambs have done well and have tried to compensate for their initial small size, especially under confinement. Bichard & Yalçin (1964) have reported that birth weight has no correlation with weights at later stages of growth in crossbred lambs, but later weights are closely interrelated. This further supports the view that the small sized twins at birth may outgrow the singles, if suitable management is devised for them. It may also be necessary to study the growth of Morada Nova and Brazilian Somali on native "caatinga" pastures for longer duration of time. Brazilian Somali appears to be the least suitable for efficient meat production under the local conditions.

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