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EVALUATION OF RECOMBINANT BOVINE SOMATOTROPIN (rbST) ON NON-CARCASS COMPONENTS OF GOAT KIDS OF THREE GENOTYPES

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ABSTRACT

This study was developed with the aim of evaluating recombinant bovine somatotropin (rbST) on non-carcass components of goat kids of three genotypes. It was used 23 male goat kids of three genotypes, being 8 Alpine, 4 ½ Boer + ½ Alpine (½ BA) and 11 ¾ Boer + ¼ Alpine (¾ BA), from which 12 received rbST and 11 control. The growth hormone used was the recombinant bovine somatotropin (rbST) and animals of treatment 1 received the hormone in the amount of 0.3 mg/kg live weight, from 45 days, adjusted in intervals of 14 days. Animals of treatment 2 (control) received saline solution in the same dosage and interval. The ½ BA goats presented a higher proportion of external non-carcass components (head, feet and skin) in relation to Alpine goats. Regarding the vital organs, such as lungs, kidneys and spleen, and the non-carcass components blood, internal fat and perinephric fat, Alpine goats presented higher values than ¾ BA goats. The administration of recombinant bovine somatotropin (rbST) did not produce effect on proportions and weight of non-carcass components. Proportions and weight of non-carcass components varied in function of genotypes, although animals were slaughtered at similar live weight.

KEYWORDS: carcass; goats; growth hormone; live weight components.

AVALIAÇÃO DA SOMATOTROPINA BOVINA RECOMBINANTE (rbST) NOS NÃO-COMPONENTES DA CARCAÇA DE CABRITOS DE TRÊS GENÓTIPOS

RESUMO

Desenvolveu-se o presente estudo com o objetivo de avaliar a somatotropina bovina recombinante (rbST) nos não-componentes da carcaça de cabritos de três genótipos. Foram utilizados 23 machos inteiros de três genótipos, sendo oito Alpino (A), quatro ½ Boer + ½ Alpino (½ BA) e 11 ¾ Boer + ¼ Alpino (¾ BA), dos quais 12 receberam rbST e 11 controle. O hormônio de crescimento utilizado foi a somatotropina recombinante bovina (rbST) e os animais do tratamento 1 receberam o hormônio na quantidade de 0,3 mg/kg de peso vivo, a partir dos 45 dias, ajustada em intervalos de 14 dias. Os animais do tratamento 2 (controle) receberam solução salina na mesma dosagem e intervalo. Os animais ½ BA apresentaram uma maior proporção dos não-componentes externos (cabeça, patas e pele) em relação aos da raça Alpina. Em relação aos órgãos vitais, como pulmão, rins e baço, e aos não-componentes sangue, gordura interna e gordura perirrenal, os animais da raça Alpina apresentaram maiores valores em relação aos ¾ BA. A administração da somatotropina bovina recombinante (rbST) não produziu efeito nos não-componentes da carcaça. As proporções e os pesos dos não-componentes da carcaça variaram em função dos genótipos, embora abatidos a pesos vivos semelhantes.

PALAVRAS-CHAVE: caprinos; componentes do peso vivo; hormônio de crescimento; rendimento de carcaça.

INTRODUCTION

The animal must be considered as a whole, in order to achieve the greatest economic yield within an intensive meat production system. Accordingly, OSÓRIO et al. (1996) argue that, by slaughtering an animal, we obtain other components of the body weight besides the carcass, which can also be used. According to DELFA et al. (1991), they are called non-carcass components, "fifth quarter", "viscera" or "outputs", i.e. all the components of live weight, except the carcass.

In the Northeast Region of Brazil, it is common to use organs and viscera in regional cuisine in traditional dishes like "sarapatel" and "buchada". The importance of non-carcass components is not only related to economic yield, but it could also be an alternative source of food for disadvantaged populations, which require animal origin protein (MATTOS et al., 2006).

External components of the carcass represent low income for the producer, but they are important because they influence carcass yield. CARVALHO et al. (2003) argue that lower participation of these components can increase carcass yield. Among the most important external components, the head stands up. It is deboned and the meat is primarily intended for production and marketing in the form of ground beef, sausage and processed foods, and its skin is sold *in natura* to tanneries to be prepared to clothing and footwear industry. Vital organs such as liver, kidney, spleen and heart did not constitute income to the farmer in trades based on carcass yield, but account for the abbatoir (MISSIO et al., 2009).

Although few studies non-carcass components have been conducted, probably because these variables are not part of the commercial carcass, they should be carried out, because the internal organs, when properly processed, can become valuable by-products of the meat industry and contribute to biological, nutritional and medicinal studies (KIRTON et al., 1995).

In goats, the relative weight of non-carcass components can vary from 40 to 60% of live weight, according to live weight at slaughter (AMIN et al., 2000; PEÑA et al., 2007), genotype (CAMERON et al . 2001; KOSUM et al. 2,003), gender (GALLO et al. 1,996; PEÑA et al. 2,007), and nutrition (PEREZ et al. 2001; MATTOS et al. 2006).

Some studies demonstrated an increase in weight of the non-carcass components in animals treated with increasing doses of rbST (ZAINUR et al. 1989; EARLY et al. 1990). SKARDA (1998) showed a significant increase in the relative weight of the liver and kidney of 16 and 19%, respectively, in goats treated with the growth hormone, besides an increase in absolute heart weight.

This study was carried out to evaluate the effect of recombinant bovine somatotropin (rbST) and genotype on non-carcass components of growing goats.

MATERIAL AND METHODS

The Board of Ethics in Animal Experimentation of the Faculty of Veterinary Medicine and Animal Science (FMVZ) approved this research project on August 10, 2004.

We used 23 intact males of three genotypes, eight Alpine (A), four ½ Boer + ½ Alpine (½ BA) and eleven ¾ Boer + ¼ Alpine (¾ BA), of which 12 received rbST and 11 the placebo. In a shed with cement floor, we placed 12 collective pens equipped with slatted floor, feeders and drinkers, where we distributed the animals according to genotype, treatment, and age at the beginning of the experiment, in order to avoid heterogeneous animals within the same pen.

During lactation, feeding management consisted in providing heat-treated goat colostrum, followed by the provision of a maximum of 1.5 liters of pasteurized goat milk, divided into two meals a day, the animals were weaned on the 45th day of life and solid diet was provided ad libitum from the seventh day of life.

The goat-specific mineral supplement (quantity/kg product) comprised 200 g of sulfur, 150 g of magnesium, 47,210 mg of zinc, 27,000 mg of iron 20,000 mg of copper, 1200 mg of manganese, 1,400 mg of cobalt, 1250 mg of iodine, 315 mg of selenium.

Chemical analysis of the total diet was performed according to SILVA & QUEIROZ (2002), in the Laboratory of Food Science, Faculty of Veterinary Medicine and Animal Science (FMVZ) - UNESP / Botucatu - SP (Table 1).

Table 1. Chemical composition of the total diet

Chemical composition	Complete diet
Dry matter (%)	94.59
Mineral matter (%)	9.27
Crude protein (% DM)	16.47
Ether extract (% DM)	3.10
Total Carbohydrate (% DM)[1]	70.82
Neutral detergent fiber (% DM)	25.14
Acid detergent fiber (% DM)	15.17
Non-fibrous carbohydrates (% DM)[2]	38.14
Total digestible nutrients (% DM)[2]	73.77
Metabolizable energy (Mcal / kg DM)[3]	2.66
Calcium (% DM)	1.72
Phosphorus (% DM)	0.45

[1]Obtained from the equation proposed by SNIFFEN et al. (1992). [2]Obtained from the equation proposed by NRC (2001). [3]Obtained from the estimated TDN and by the relations: 1 kg TDN = 4,409 Mcal of DE and ME = 81.7% DE (NRC, 2001).

We supplied the ration at 7 a.m. and 7 p.m., weighed the leftovers and adjusted the quantity supplied. We monitored the development of the animals by weighing them weekly until they reach the age previously determined for the slaughter of about 120 days.

The growth hormone used was the recombinant bovine somatotropin (rbST) of slow release, with vitamin E. Animals in Treatment 1 received the hormone subcutaneously, by means of 1 ml disposable syringes, in the region of the ischioanal fossa. The amount of rbST administered was 0.3 mg/kg body weight adjusted at intervals of 14 days. Animals in Treatment 2 received saline solution at the same dose and interval. We began hormone administration after weaning of the animals (at approximately 45 days of age).

The animals were slaughtered after a fasting period of 16h. They were weighed before and after fasting, to obtain the live weight (LW) and live weight at slaughter (LWS), respectively. The average age at slaughter was 129.13 ± 6.71 days.

The slaughter occurred in accordance with the normal flow of the commercial abattoir. The gastrointestinal tract was emptied for obtaining the empty body weight (EBW), which was calculated by subtracting the weights for the gastrointestinal tract and the liquid contained in the gall bladder off the LWS. Organs, viscera and other byproducts from the slaughter of animals were weighed separately to obtain the non-carcass components (NCC). The proportion of each NCC was calculated as a function of LWS and EBW.

The carcass was obtained after separation of the hands and feet in the carpal-metacarpal and tarsal-metatarsal joints, respectively, obtaining the hot carcass weight. The carcasses were kept in a chill chamber with forced air for 24 hours at a temperature of 5 ºC, obtaining the cold carcass weight (CCW). From these data we calculated the commercial yield, CY (%) = CCW / LWS x 100.

The quantitative characteristics and the non-carcass components were submitted to analysis of variance using the following model. We processed the analyses using SAEG (UFV, 2000).

$$Y\_ijk = \mu + T\_i + G\_j + (T * G)\_ij + b(X\_ijk - \bar{X}) + e\_ijk$$

In which,

Y_{ijk} = characteristic evaluated in the animal k, genotype j and treatment i;

μ = constant inherent to the observations Y_{ijk};

T_i = effect of treatment i, where i = 1 - treated with rbST and i = 2 - control;

G_j = effect of genotype j (j = 3), where j = 1 - Alpine, j = 2 - ½ Boer + ½ Alpine, and j = 3 - ¾ Boer + ¼ Alpine;

$T*G$ = interaction effect of treatment i and genotype j;

b = coefficient of linear regression of the characteristic Y_{ijk} according to the age of the animal at evaluation;

X_{ijk} = age at evaluation of the characteristic Y_{ijk};

$\bar{X}$ = Mean age at evaluation of the characteristic Y_{ijk};

e_{ijk} = error regarding the observation Y_{ijk} $(0; \sigma^2_e)$.

RESULTS AND DISCUSSION

Table 2 displays the average values of live weight, live weight at slaughter, empty body weight, fasting loss and commercial yield of three genotypes, assessed in the two treatments. We did not observe interaction effect of treatment and genotype for any of the variables studied. There were no effects of genotype and treatment for any of the characteristics analyzed. FATURI et al. (2002) evaluated bovines and concluded that, when these parameters show genetic similarity among the groups, there is a tendency of having no differences for the other quantitative carcass traits.

Table 2. Mean of live weight (LW), live weight at slaughter (LWS), empty body weight (EBW), fasting loss (FL) and commercial yield (CY) of goats, according to the genotype and treatment

Variable	Mean	Treatment		Genotype[1]			Level of significance[2]		CV[3]
		control	rbST	ALP	½ BA	¾ BA	T	G	
LW (kg)	27.93	27.12	28.68	29.33	28.58	26.68	NS	NS	14.32
LWS (kg)	25.89	25.19	26.53	27.18	26.43	24.76	NS	NS	15.12
EBW (kg)	23.27	22.65	23.84	24.41	23.89	22.22	NS	NS	16.11
FL (%)	7.36	7.25	7.46	7.31	7.61	7.30	NS	NS	20.64
CY (%)	45.50	45.53	45.47	45.85	48.74	44.07	NS	NS	8.25

[1]ALP: Alpine; ½ BA: ½ Boer + ½ Alpine; ¾ BA: ¾ Boer + ¼ Alpine. [2]T: treatment; G: genotype. [3]Coefficient of variation. NS: non-significant (P>0.05).

MENEZES et al. (2009) studied the effects of genotype on carcass traits, and observed carcass yield values of 49.16; 45.57 and 47.82% for Alpine, ½ Boer + ½ Alpine and + ¾ Boer + ¼ Alpine animals, respectively.

Variations in fasting loss can be attributed to variations in higher live weight at slaughter. COSTA et al. (1990) analyzed the carcass yield of crossbred Anglo-Nubians goats and found lower value, 2.63% slaughtered with 23.72 kg.

Table 3 presents the mean values of the external non-carcass components of goats. Treatment and genotype interaction, as well as the treatment did not affect any of the variables studied.

Table 3. Mean of weights expressed in absolute values and in percentage of live weight at slaughter (LWS) and of empty body (EBW) of the external components of goats, according to the genotype and treatment

Variable	Mean	Treatment		Genotype[1]			Level of significance[2]		CV[3]
		control	rbST	ALP	½ BA	¾ BA	T	G	
Head, kg	1.59	1.54	1.65	1.57	1.65	1.60	NS	NS	12.57
Head, % LWS	6.16	6.14	6.18	5.75b	6.05ab	6.50a	NS	*	9.23
Head, % EBW	6.92	6.88	6.96	6.43b	7.01ab	7.24a	NS	*	8.81
Feet, kg	0.82	0.79	0.85	0.85	0.85	0.79	NS	NS	14.22
Feet, % LWS	3.15	3.16	3.16	3.11	3.12	3.20	NS	NS	6.20
Feet, % EBW	3.54	3.53	3.56	3.48	3.62	3.56	NS	NS	6.98
Skin, kg	1.91	1.86	1.95	1.90	2.05	1.86	NS	NS	19.16
Skin, % LWS	7.31	7.32	7.30	6.95	7.48	7.51	NS	NS	12.67
Skin, % EBW	8.21	8.20	8.22	7.78	8.63	8.37	NS	NS	12.31
Total, kg	4.32	4.19	4.44	4.31	4.55	4.25	NS	NS	14.11
Total, % LWS	16.62	16.61	16.64	15.81	16.64	17.21	NS	NS	7.23
Total, % EBW	18.69	18.61	18.73	17.68b	19.26a	19.18ab	NS	*	6.90

[1]ALP: Alpine; ½ BA: ½ Boer + ½ Alpine; ¾ BA: ¾ Boer + ¼ Alpine. [2]T: treatment; G: genotype. [3]Coefficient of variation. NS: non-significant (P>0.05).

The proportion of the head in relation to LWS and EBW was influenced by genotype (Table 3). The ¾ BA showed higher values compared to Alpine and ½ BA presented similar values to the other genotypes. This result can be explained by the fact that ¾ BA had higher proportion of Boer breed blood, which presents heavy heads as a characteristic feature (SKINNER, 1972). CAMERON et al. (2001) found similar results: a greater proportion of the head in Boer x Spanish and Boer x Angora animals compared to the Spanish breed.

Of the external non-carcass components, the skin presented the highest proportion (8.21%) (Table 3). This can mean a financial return to the producer, since the skin has significant commercial value. DHANDA et al. (1999) observed a ratio of 7.3% of skin in relation to EBW of Boer x Angora animals.

The weights of head, feet and skin, called hard discard, represent 15-17% of the live weight of the animal. In this study, they accounted for about 17% (Table 3). According to CARVALHO et al. (2003), the smaller the weight of these components, the greater is the carcass yield.

The total proportion of external non-carcass components in relation to the EBW was affected by genotype (Table 3). Goats of the ½ BA breed showed higher values compared to Alpine animals, while ¾ BA presented similar results to the other breeds. This result is due to higher proportions of feet and skin of ½ BA animals.

Table 4 presents the mean values for vital organs of goats. We did not observe any interaction effect of treatment and genotype for any of the variables studied.

Table 4. Mean of weights expressed in absolute values and in percentage of live weight at slaughter (LWS) and of empty body (EBW) of the vital organs of goats, according to the genotype and treatment

Variable	Mean	Treatment		Genotype[1]			Level of significance[2]		CV[3]
		control	rbST	ALP	½ BA	¾ BA	T	G	
Heart, kg	0.14	0.14	0.15	0.14	0.16	0.14	NS	NS	19.97
Heart, % LWS	0.54	0.53	0.56	0.52	0.57	0.55	NS	NS	9.78
Heart, % EBW	0.61	0.60	0.63	0.58	0.67	0.62	NS	NS	9.73
Lung, kg	0.41	0.42	0.41	0.47a	0.44ab	0.36b	NS	*	19.77
Lung, % LWS	1.59	1.65	1.53	1.72	1.62	1.48	NS	NS	17.39
Lung, % EBW	1.78	1.84	1.73	1.92	1.87	1.65	NS	NS	17.41
Kidneys, kg	0.11	0.10	0.11	0.13a	0.11ab	0.10b	NS	**	14.18
Kidneys, % LWS	0.42	0.41	0.43	0.47	0.40	0.40	NS	NS	16.71
Kidneys, % EBW	0.47	0.46	0.48	0.52a	0.46ab	0.44b	NS	*	13.07
Liver, kg	0.54	0.55	0.53	0.60	0.55	0.49	NS	NS	22.32
Liver, % LWS	2.05	2.13	1.99	2.20	2.00	1.97	NS	NS	12.65
Liver, % EBW	2.31	2.38	2.24	2.47	2.30	2.19	NS	NS	12.01
Spleen, kg	0.04	0.04	0.04	0.05	0.04	0.04	NS	NS	16.30
Spleen, % LWS	0.16	0.16	0.15	0.18a	0.16ab	0.14b	NS	*	19.88
Spleen, % EBW	0.18	0.18	0.17	0.20a	0.18ab	0.16b	NS	*	18.64
Total, kg	1.25	1.25	1.25	1.39a	1.30ab	1.13b	NS	*	16.93
Total, % LWS	4.76	4.88	4.66	5.09a	4.74ab	4.54b	NS	*	9.39
Total, % EBW	5.35	5.47	5.24	5.69a	5.47ab	5.06b	NS	*	8.55

[1]ALP: Alpine; ½ BA: ½ Boer + ½ Alpine; ¾ BA: ¾ Boer + ¼ Alpine. [2]T: treatment; G: genotype. [3]Coefficient of variation. NS: non-significant (P>0.05). *: P<0.05; **: P<0.01.

The treatment did not affect any of the variables studied. These results are contrary to those reported by SKARDA (1998) and EARLY et al. (1990), who observed heavier liver in treated goats and bovines, respectively, which may reflect an increase in the metabolism of this organ due to the application of this hormone. In the present study, however, the dosage used did not seem to be sufficient to cause this effect.

The genotype did not affect the weight and the proportions of the heart and liver in relation to the LWS and EBW (Table 4). The results can be explained by the fact that the animals presented similar age, initial weight and weight at slaughter; therefore, we can infer that organ development is also related to the size of the animal. According to TONETTO et al. (2004), the similarity of the weights and percentages of early growth organs, including heart and liver, is due to the physiological need of the animal to develop these organs for survival. These results are similar to those found by GIBB et al. (1993) and DHANDA et al. (1999), who assessed liver and heart proportions and did not observe the influence of different genotypes.

Lungs and kidneys weights were affected by genotype (Table 4). Alpine breed animals showed higher values compared to ¾ BA. This result suggests that dairy breed ancestry produces a higher relative lung weight in relation to beef breeds. These results similar to FERREL's et al. (1976), who observed that the intestines, liver, heart and kidneys of dairy heifers (Jersey) are proportionately larger than those of beef heifers (Hereford). CARVALHO et al. (2003) found greater relative weight of lungs, rumen-reticulum, liver, heart, lungs and spleen in dairy bovines than in beef bovines.

The proportions of the kidneys (in relation to EBW) and spleen (in relation to LWS and EBW) were affected by genotype (Table 4). Alpine animals showed higher values compared to ¾ BA animals. According to SILVA SOBRINHO et al. (2003), the spleen is economically unrepresentative and most retailers sell it along with the liver. MATTOS et al. (2006) observed average of 0.06 kg, and 0.30%

EBW to the kidneys in Moxotó and Canindé animals.

There are differences among genotypes for the model of development or formation rate of organs and tissues that make up the mass of the body. This speed of development may be affected by the size of the adult body and hormones (JORGE & FONTES, 2001), by age and environmental factors (COLEMAN et al., 1993).

Table 5 shows the mean values for blood, empty gastrointestinal tract and internal and perinephric fat in goats. There was no interaction effect of treatment and genotype for any of the variables studied.

The treatment did not affect any of the variables studied. These results are contrary to those found by EARLY et al. (1990), who evaluated bovines, and verified no effect of rbST on the proportion of perinephric fat.

Table 5. Mean of weights expressed in absolute values and in percentage of live weight at slaughter (LWS) and of empty body (EBW) of blood, empty gastrointestinal tract (EGT), internal fat (IF) and perinephric fat (PF) of goats according to the genotype and treatment

Variable	Mean	Treatment		Genotype[1]			Level of significance[2]		CV[3]
		control	rbST	ALP	½ BA	¾ BA	T	G	
Blood, kg	1.16	1.16	1.16	1.31a	1.17ab	1.05b	NS	**	14.33
Blood, % LWS	4.46	4.59	4.33	4.79a	4.30ab	4.27b	NS	*	7.57
Blood, EBW	5.01	5.14	4.88	5.36a	4.99ab	4.76b	NS	**	6.23
EGT, kg	2.34	2.31	2.36	2.59a	2.25ab	2.18b	NS	*	15.12
EGT, % LWS	8.97	9.09	8.87	9.50	8.23	8.86	NS	NS	10.73
EGT, % EBW	10.07	10.18	9.97	10.62	9.50	9.88	NS	NS	10.29
IF, kg	0.42	0.41	0.43	0.60a	0.45ab	0.29b	NS	**	39.86
IF, % LWS	1.55	1.55	1.55	2.17a	1.55ab	1.10b	NS	**	29.77
IF, % EBW	1.75	1.74	1.76	2.43a	1.78ab	1.25b	NS	**	31.07
PF, kg	0.15	0.16	0.15	0.20a	0.18ab	0.11b	NS	*	52.48
PF, % LWS	0.56	0.60	0.53	0.73a	0.62ab	0.43b	NS	*	43.41
PF, % EBW	0.63	0.67	0.60	0.81a	0.71ab	0.48b	NS	*	42.82

[1]ALP: Alpine; ½ BA: ½ Boer + ½ Alpine; ¾ BA: ¾ Boer + ¼ Alpine. [2]T: treatment; G: genotype. [3]Coefficient of variation. NS: non-significant (P>0.05). *: P<0.05; **: P<0.01.

We observed influence of the genotype on the weight and proportions of blood (in relation to LWS and EBW). Alpine animals showed higher values compared to ¾ Boer animals. The ½ BA goats were similar to both genotypes. The results of the present study were higher than those of MATTOS et al. (2006), who observed average of 0.80 kg, and 4.29% EBW of blood in Moxotó and Canindé animals.

The weight of the empty gastrointestinal tract (EGT) was affected by genotype. Alpine animals showed higher EGT weight compared with ¾ Boer, probably because Alpine animals selection has been directed mainly to milk production, which requires greater food consumption. PERON et al. (1993) observed that Holstein animals had heavier empty gastrointestinal tract (stomach and intestines) than beef breeds. However, DHANDA et al. (1999) and CAMERON et al. (2001) evaluated goats of different genotypes and observed no influence on the weight of EGT.

The fat distribution on goat carcass is quite different from other ruminant species such as sheep, because most of it is extracted in the evisceration process. About 45% of body fat is stored in the viscera, while only 25% is stored in bovines and sheep (POTCHOIBA et al., 1990).

We observed that the genotype affected the weight and proportions of internal and perinephric fat (in relation to LWS and EBW). Alpine animals showed higher values compared to ¾ Boer animals. This result demonstrates that Alpine animals showed greater physiological ability at depositing intra-abdominal fat than ¾ BA animals. The greater amount of visceral fat in dairy animals might result, in practical terms, in higher energy requirements for maintenance, because of the higher metabolic activity of internal adipose tissue in relation to the peripheral adipose tissue (THOMPSON et al., 1983; SOLIS et al., 1988). KOSUM et al. (2003) observed a higher proportion of internal fat (% EBW) in Saanen animals compared to Bornova animals.

CONCLUSIONS

The use of recombinant bovine somatotropin (rbST) at a dosage of 0.3 mg/kg of live weight in Alpine, ½ Boer and ¾ Boer goats did not alter the weight and the proportion of non-carcass components. The proportions and weights of non-carcass components varied with the genotypes, although the animals were slaughtered at similar body weights. Alpine animals showed greater physiological ability at depositing internal fat than crossbred Boer.

REFERENCES

AMIN, M.R.; HUSAIN, S.S.; ISLAM, A.B.M.M. Evaluation of Black Bengal goats and their cross with the Jamunapari breed for carcass characteristics. **Small Ruminant Research**, v.38, p.211-215, 2000.

CAMERON, M.R.; LUO, J.; SAHLU, T.; HART, S.P.; COLEMAN, S.W.; GOETSCH, A.L. Growth and slaughter traits of Boer x Spanish, Boer x Angora, and Spanish goats consuming a concentrate-based diet. **Journal of Animal Science**, v.79, p.1423-1430, 2001.

CARVALHO, P.A.; SANCHEZ, L.M.B.; VIÉGAS, J.; VELHO, J.P.; JAURIS, G.C.; RODRIGUES, M.B. Componentes do peso vivo e órgãos viscerais de bezerros machos de origem leiteira ao nascimento, 50 e 110 dias de vida. **Revista Brasileira de Zootecnia**, v.32, n.6, p.1469-1475, 2003.

COLEMAN, S.W.; EVANS, B.C.; GUENTHER, J.J. Body and carcass composition of Angus and Charolais steers as affected by age and nutrition. **Journal of Animal Science**, v.71, n.1, p.86-95, 1993.

COSTA, R.G.; PIMENTA FILHO, E.C.; MOREIRA, R.T.; RODRIGUES, A. Rendimento de carcaça e vísceras em caprinos mestiços Anglo-Nubianos. **Agropecuária Técnica**, v.11, n.1/2, p.1-8, 1990.

DELFA, R.; GONZALES, C.; TEIXEIRA, A. El "quinto quarto". **Revista Ovis**. n.17, p.49-66, 1991.

DHANDA, J.S.; TAYLOR, D.G.; McCOSKER, J.E.; MURRAY, P.J. The influence of goat genotype on the production of Capretto and Chevon carcasses. 1. Growth and carcass characteristics. **Meat Science**, v.52, p.355-361, 1999.

EARLY, R.J.; McBRIDE, B.W.; BALL, R.O. Growth and metabolism in somatotropin-treated steers: II. Carcass and noncarcass tissue components and chemical composition. **Journal of Animal Science**, v.68, p.4144-4152, 1990.

FATURI, C.; RESTLE, J.; BRONDANI, I.L.; SILVA, J.H.S.; ARBOITTE, M.Z.; CARRILHO, C.O.; PEIXOTO, L.A.O. Características da carcaça e da carne de novilhos de diferentes grupos genéticos alimentados em confinamento com diferentes proporções de grão de aveia e grão de sorgo no concentrado. **Revista Brasileira de Zootecnia**, v.31, n.5, p.2024-2035, 2002.

FERREL, C.L.; GARRET, W.N.; HINMAN, N. Estimation of body in pregnant and non pregnant heifers.**Journal of Animal Science**, v.42, p.1158-1166, 1976.

GALLO, C.; LE BRETON, Y.; WAINNRIGHT, I.; BERKHOFF, M. Body and carcass composition of male and female Criollo goats in the South of Chile. **Small Ruminant Research**, v.23, p.163-169, 1996.

GIBB, M.J.; COOK, J.E.; TREACHER, T.T. Performance of British Saanen, Boer x British Saanen and Anglo-Nubian castrated male kids from 8 weeks to slaughter at 28, 33 or 38 kg live weight. **Animal Production**, v.57, p.263-271, 1993.

JORGE, A.M.; FONTES, C.A.A. Desenvolvimento relativo das partes do corpo de zebuínos de quatro raças. **Ciência Rural**, v.31, n.5, p.857-881, 2000.

KIRTON, A.H.; CARTER, A.H.; CLARCKE, J.N.; SINCLAIR, D.P.; MERCER, G.J.K.; DUGANZICH, D.M. A comparison between 15 ram breeds for export lamb production. 1. Live weights, body components, carcass measurements and compositions. **New Zealand Journal of Agricultural Research**, v.38, p.347-360, 1995.

KOSUM, N.; ALCICEK, A.; TASKIN, T.; ÖNENÇ, A. Fattening performance and carcass characteristics of Saanen and Bornova male kids under an intensive management system. **Czech Journal of Animal Science**, v.48, n.9, p.379-386, 2003.

MATTOS, C.W.; CARVALHO, F.F.R.; DUTRA JÚNIOR, W.M.; VÉRAS, A.S.C.; BATISTA, A.M.V.; ALVES, K.S.; RIBEIRO, V.L.; SILVA, M.J.M.S.; MEDEIROS, G.R.; VASCONCELOS, R.M.J.; ARAÚJO, A.O.; MIRANDA, S.B. Características de carcaça e dos componentes não-carcaça de cabritos Moxotó e Canindé submetidos a dois níveis de alimentação. **Revista Brasileira de Zootecnia**, v.35, n.5, p.2125-2134, 2006.

MENEZES, J.J.L.; GONÇALVES, H.C.; RIBEIRO, M.S.; RODRIGUES, L.; CAÑIZARES, G.I.L.; MEDEIROS, B.B.L. Efeitos do sexo, do grupo racial e da idade ao abate nas características de carcaça e maciez da carne de caprinos. **Revista Brasileira de Zootecnia**, v.38, n.9, p.1769-1778, 2009.

MISSIO, R.L.; BRONDANI, I.L.; RESTLE, J.; SILVA, J.H.S.; SILVEIRA, M.F.; SILVA, V.S. Partes não-integrantes da carcaça de tourinhos alimentados com diferentes níveis de concentrado na dieta. **Revista Brasileira de Zootecnia**, v.38, n.5, p.906-915, 2009.

NATIONAL RESEARCH COUNCIL – NRC 2001**. Nutrient Requirements of Dairy Cattle**. 7.ed. Washington: National Academic Press, 2001. 387p.

OSÓRIO J.C.; JARDIM, P.O.; PIMENTEL, M.; POUEY, J.; LÜDER, W.E.; ÁVILA, C.J. Componentes do peso vivo em cordeiros da raça Corriedale. **Ciência Rural**, v.26, n.3, p.483-487, 1996.

PEÑA, F.; PEREA, J.; GARCÍA, A.; ACERO, R. Effects of weight at slaughter and sex on the carcass characteristics of Florida suckling kids. **Meat Science**, v.75, p.543-550, 2007.

PEREZ, P.; MAINO, M.; MORALES, M.S.; SOTO, A. Effect of goat and milk substitutes and sex on productive parameters and carcass composition of Creole kids. **Small Ruminant Research**, v.42, p.87-93, 2001.

PERON, A.J.; FONTES, C.A.A; LANA, R.P.; SILVA, D.J.; QUEIROZ, A.C.; PAULINO, M.F. Tamanho dos órgãos internos e distribuição da gordura corporal em novilhos de cinco grupos genéticos, submetidos à alimentação restrita e "ad libitum". **Revista Brasileira de Zootecnia**, v.22, n.5, p.813-819, 1993.

POTCHOIBA, M.J.; LU, C.D.; PINKERTON, F.; SAHLU, T. Effects of all-milk diet on weight gain, organ development, carcass characteristics and tissue composition, including fatty acids and cholesterol contents, of growing male goats. **Small Ruminant Research**, v.3, p.583-592, 1990.

SILVA SOBRINHO, A.G.; GASTALDI, K.A.; GARCIA, C.A.; MACHADO, M.R.F. Diferentes dietas e pesos ao abate na produção de órgãos de cordeiros. **Revista Brasileira de Zootecnia**, v.32, n.6, p.1792-1799, 2003 (supl.1).

SILVA, D.J., QUEIROZ, A.C. **Análise de alimentos –** Métodos químicos e biológicos. Viçosa: Universidade Federal de Viçosa, 2002. 235p.

SKARDA, J. Effects of bovine growth hormone on growth, organ weights, tissue composition and adipose tissue metabolism in young castrated male goats. **Livestock Production Science**, v.55, p.215-225, 1998.

SKINNER, J.D. Utilization of the Boer goat for intensive animal production. **Tropical Animal Health and Production**, v.4, p.120-128, 1972.

SNIFFEN, C.J.; O'CONNOR, D.G.; VAN SOEST, P.J.; FOX, D.G.; RUSSELL, J.B. A net carbohydrate and protein system for evaluating cattle diets: II Carbohydrate and protein avaibility. **Journal of Animal Science**, v.70, p.3562-3577, 1992.

SOLIS, J.C.; BYERS, F.M.; SCHELLING, G.T.; LONG, C.R.; GREENE, L.W. Maintenance requirements and energetic efficiency of cows of different breed types. **Journal of Animal Science**, v.66, p.764-773, 1988.

THOMPSON, W.R.; MEISKE, J.C.; GOODRICH, R.D.; RUST, J.R.; BYERS, F.M. Influence of body composition on energy requirements of beef cows during winter. **Journal of Animal Science**, v.56, n.5, p.1241-1252, 1983.

TONETTO, C.J.; PIRES, C.C.; MÜLLER, L.; ROCHA, C.G.; SILVA, J.H.S.; FRESCURA, R.B.M.; KIPPERT, C.J. Rendimentos de cortes da carcaça, características da cerne e componentes do peso vivo em cordeiros terminados em três sistemas de alimentação. **Revista Brasileira de Zootecnia**, v.33, n.1, p.234-241, 2004.

UNIVERSIDADE FEDERAL DE VIÇOSA – UFV. **Sistema de análises estatísticas e genéticas** - SAEG. Versão 8.0. Viçosa, 2000. 142 p.

ZAINUIR, A.S.; TASSELL, R.; KELLAWAY, R.C.; DODEMAIDE, W.R. Recombinant growth hormone in growing lambs: effects on growth, feed utilization, body and carcass characteristics on wool growth. **Australian Journal of Agricultural Research**, v.40, p.195-206, 1989.

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