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Corn-based or high linoleic acid flushing increases productivity of Morada Nova and Brazilian Somalis ewes

Flushing à base de milho ou alto ácido linoleico aumenta a produtividade de ovelhas Morada Nova e Somalis Brasileira

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SUMMARY

The objective of this study was to compare the corn-based (FLU), high linoleic acid flushings(LAF), and a control treatment (un-supplemented, CON); two genetic groups: Morada Nova (MN) and Brazilian Somalis (BS), on the productive and reproductive performance of ewes and their lambs. A total of 156 non-pregnant ewes were supplemented three weeks before and after the breeding season. Supplementation with either FLU or LAF increased ewe body condition score (BCS) at the beginning of the breeding season and at lambing compared to CON. The BS ewes had greater body weights at the supplementation end, and BCS both at the supplementation start, and at lambing compared to MN. Similarly, ewes with three lambs per birth had greater BCS at the beginning of supplementation. They also had greater weights at the beginning of the breeding season and at lambing. Both FLU and LAF increased total lamb weight from 56 to 105 days of age compared to CON. The BS ewes had decreased prolificity and produced lower total weight of lambs at lambing, but greater 84 and 105 days after birth compared to MN. Total lamb weight at birth was greater for ewes that lambed three, followed by two and then one lamb per birth. In conclusion, the high linoleic acid and high corn supplementation increase body condition score of ewes form breeding season to lambing and enhance lamb performance after 56 days of age. Although Morada Nova ewes increased prolificacy, their lambs were lighter after they reached 84 days of age.
Keywords: fatty acid, fertility, prolificacy, reproductive performance, supplementation

RESUMO

O objetivo deste estudo foi comparar flushings à base de milho (FLU), ácido linoleico alto (FAL), e tratamento controle (não suplementado, CON);dois grupos genéticos: Morada Nova (MN) e Somalis Brasileiro (SB), sobre desempenho de ovelhas e cordeiros. Foram suplementadas 156 ovelhas não prenhes três semanas antes e após a estação de monta. Tanto FLU quanto FAL aumentaram o escore de condição corporal (ECC) de ovelhas no início da estação de monta e no parto, comparado ao CON. Ovelhas da raça SB tiveram maior peso no final da suplementação, e ECC, tanto no início da suplementação, quanto ao parto comparado ao MN. Da mesma forma, ovelhas com três cordeiros por nascimento tiveram ECC maior no início da suplementação. Elas também tiveram maiores pesos tanto no início da estação como no parto. Tanto FLU como FAL aumentaram o peso do cordeiro de 56 até 105 dias de idade comparado ao CON. Ovelhas SB diminuíram a prolificidade e produziram menor peso total

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de cordeiros ao parto, porém maior peso total após 84 e 105 dias comparado às ovelhas MN. O peso total de cordeiros ao nascimento foi maior para ovelhas com gestação tripla, seguido por dupla, e simples. Em conclusão, a suplementação com ácido linoleico e milho aumentam o escore da condição corporal de ovelhas desde a estação de monta até o parto e a performance do cordeiro após 56 dias de idade. Embora ovelhas Morada Nova tenham aumentado a prolificidade, seus cordeiros ficaram mais leves após os 84 dias de idade.
Palavras-chave: ácidos graxos, desempenho reprodutivo, fertilidade, prolificidade, suplementação

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INTRODUCTION

In certain regions, sheep meat consumption is common and there is a growing interest in increasing productivity to meet the ever-increasing demand (LIGNANI et al., 2010). Among the characteristics of sheep meat production, prolificacy is a major determinant of sheep productivity (McMANUS et al., 2010). In Northeast Brazil, two sheep breeds are commonly raised for meat production: the Morada Nova, characterized by its high prolificacy (BOMFIM et al., 2014; MACHADO et al., 1999), and Brazilian Somalis, of lower prolificacy (SILVA et al., 1998). These animals have unique producers for its recognized impact on reproduction. Flushing consists of energy supplementation provided at levels above the animal requirements in the pre- and post-breeding season(SCARAMUZZI et al., 2006). The most recent version of the NRC (2007) established nutritional requirements of essential fatty acids, such as linoleic acid, focusing on the positive impact on the productive and reproductive response of small ruminants. Essential fatty acids have a key role in ovarian follicular development (WATHES et al., 2007), luteal function (RAES et al., 2004), and embryo quality (CERRI et al., 2009).
Although the above evidence indicates the possibility of improving reproductive efficiency in sheep through strategic use of lipids in their diet, few studies have evaluated the use of flushing with these nutrients. Furthermore, there is a possibility that subsequent results are dependent on genotype because of the importance of genetics on prolificacy. Thus, the present study evaluated the effects of corn-based and high linoleic acid flushing, on the productive and reproductive performance of both adaptive characteristics specific to the local climatic conditions throughout the year (MARIANTE et al., 2011), that can influence the food supply, impairing reproductive and productive performance of sheep herds raised in that region (COSTA et al., 2008).
The mechanism of action for nutritional factors on productive and reproductive performance is a complex process. Many interactions exist between the availability of nutrients, weight, and body condition score of animals depending on their physiological state of the animal(PETROVIC et al., 2012; ROBINSON et al., 2006). Flushing is a nutritional management strategy widely practiced among researchers and Morada Nova and Brazilian Somalis ewes grazing native pasture.

MATERIAL AND METHODS

The protocol of animal treatment was approved by the Animal Welfare Commissioner of the Embrapa Goats and Sheep. The experiment was conducted at the Center of Morada Nova and Brazilian Somalis sheep breeds at Embrapa Goats and Sheep Preservation, located in Sobral - CE, Brazil (03°40'55" S latitude and 40°20'51" W longitude, 69 m altitude),where the average annual temperature is 30° Cand annual precipitation is 800 mm^3.
A total of 156 non-lactating, non-pregnant ewes, from second to fifth parturitions,76 Morada Nova and 80 Brazilian Somalis, with 24.2±3.9 kg of live weight, and body condition score (BCS) of 2.03±0.5. Ewes were distributed in a completely randomized design in a 2×3 factorial arrangement of treatments (two genetic groups and three diets).Ewes were divided into three groups(Table 1): CON - control diet (without flushing), in which ewes

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were fed exclusively native pasture; FLU - corn-based flushing, in which each ewe received 360 g/day of ground corn; and LAF - high linoleic acid flushing, with ewes fed 200 g/day of supplement, composed of 470.1 g/kg babassu cake and 529.9 g/kg corn germ meal on a dry matter basis (DM).

Table 1. Distribution of ewes according to diet, and genetic group

Genetic group	DIET[1]			Total
	CON	FLU	LAF	
Brazilian Somalis	27	27	26	80
Morada Nova	26	25	25	76
Total	53	52	51	156

[1]Diets:CON = control group; FLU = corn-based flushing; LAF = high linoleic acid flushing.

The chemical composition of the supplement ingredients is described in Table 2.

Table 2.Chemical composition of the supplement ingredients.

Ingredient	Composition[1]							
	DM	OM	MM	CP	EE	NDF	ADF	C18:2
Ground Corn	89.00	97.30	2.70	10.00	3.70	13.98	3.7	1.59
Babassu cake	96.42	94.05	5.95	18.31	8.87	69.29	47.71	0.89
Corn germ meal	92.02	94.01	5.99	12.10	13.81	32.61	7.30	4.67

[1]DM: dry matter, OM: organic matter, MM: mineral matter, EE: ether extract, NDF: neutral detergent fiber, ADF: acid detergent fiber, C18:2: linoleic acid.

Different amounts of the supplement were provided so that energy and supplemental protein supplies were similar (Table 3). The nutritional requirements of the animals were calculated according to the (NRC, 2007) and both supplements were offered to provide a nutritional input of 60% above maintenance requirements (NRC, 1985). The linoleic fatty acid content of LAF was calculated to meet 100% of the requirements of that nutrient (NRC, 2007). Supplementation was given for 42 days, from −21 to +21 days in relation to the beginning of the breeding season.

Table 3.Characteristics of native pasture (control group), supply, and composition of supplements

Item	CON[1]	Supplements	
		FLU[2]	LAF[3]
Supply of supplement (g/day)			
Fresh matter	-	360	200
Ingredient inclusion in the flushing supplements (g/kg dry matter, DM)			
Ground corn	-	1,000.0	-
Corn germ meal	-	-	529.9
Babassu cake	-	-	470.1
Analyzed composition (g/kg dry matter, DM)			

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Dry matter[4]	273.7	890.0	940.3
Neutral detergent fiber	617.0	139.8	509.5
Crude protein	103.8	100.0	152.0
Metabolizable energy[5]	2.10	3.15	5.37
Fatty acids	9.8	27.0	123.4
Linoleic acid	0.92	15.90	29.66

[1]CON: Control group, with no supplementation, fed native pasture *ad libitum*.
[2]FLU: corn-based flushing.
[3]LAF: High linoleic acid flushing.
[4]g DM/kg fresh matter.
[5]Mcal/kg DM.
* Composition of the mineral supplement fed *ad libitum*to all treatments. Each kg contains: 132 g sodium; 82 g calcium; 60 g phosphorus; 11.7 g sulfur; 2600 mg zinc; 1200 mg manganese; 600 mg fluorine; 350 mg copper; 180 mg molybdenum; 100 mg iron; 50 mg iodine; 30 mg cobalt; 15 mg selenium; 11.7 mg chromium.

Flushing supplementationin addition to a commercial mineral supplement (provided *ad libtium*) was provided in individual stalls, equipped with water, feed and salt troughs. Ewes were housed in 12 paddocks consisting of 60 hectares of caatinga. This area was subjected to selective thinning at the beginning of the rainy season according to the recommendations of ARAÚJO FILHO & CRISPIM (2002), to maintaining 15% of the soil coverage by the woody plants, with partial removal of the undesirable species, especially weeds such as *Mimosa hostilis* and *Croton sonderianus*. Furthermore, arboreal and shrub species of high wood value, or, considered in the process of extinction, or those that remain green during the dry season, such as *Ziziphus joazeiro*, were preserved. After selective thinning this area was hand planted with *Panicum maximum* cv. Massai, by evenly distributing seeds by hand. Individual forage evaluation determined the period of time grazed for each paddock.

Weights and body condition scores (scale of 1-5 with intervals of 0.5) of ewes were assessed on days −21, day 0, and day 21 in relation to the beginning of breeding season and lambing. Body condition score was evaluated according to CALDEIRA &VAZ PORTUGAL (1998). Every 14 days, the number of eggs per gram of feces (EPG) of each animal was counted. When the average EPG was greater than 800 eggs g^{-1}, all animals were dewormed.

The controlled breeding season lasted 45 days, without the use of drugs for the induction of estrus. Ewes were mated with 17 rams, where nine were Morada Nova(2.5 ± 1.01 years of age and mean weight of 41.06 ± 2.92 kg) and eight were Brazilian Somalis(4.11 ± 3.41 years of age and mean weight of 43.97 ± 10.05 kg) breed. All rams were submitted to andrological exams and semen analysis. The controlled-mating technique was utilized, in which mating was directed based on the inbreeding coefficient of individuals to promote genetic variability. Two castrated sheep were used to assist in the identification of females in estrus, marked with a mixture of powdered pigment and soybean oil in the sternal region. The ewes in estrus were taken to the stalls of their respective rams .During the breeding season, rams received elephant-grass(*Pennisetum purpureum*

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spp) *adlibitum* provided in the trough with 200 g concentrate twice daily.

The parturition season lasted 28 days, with 48.3%, 70.8% and 61.9% of deliveries in the first 15 days, for CON, FLU and LAF, respectively. After 42 days of supplementation, when the first-born lamb completed 105 days of age, all ewes were submitted to the same nutritional management until weaning. In the final third of gestation and during lactation, all ewes were supplemented with 400 g/day of concentrate(800 g/kg ground corn,200 g/kg soybean meal) containing 196.8 g/kg crude protein and 3.37 Mcal/kg metabolizable energy, according to CANNAS et al., (2004).

After birth, the newborns were confined with the ewes for a period of five days. During confinement, only the ewes had access to chopped elephant grass (*Pennisetum purpureum* spp), water, and salt (*ad libitum)*, and 400 g of the concentrate described above. After that confinement period, ewes were taken to the pasture without their lambs in the morning. In the evening, they returned to the management facilities to be supplemented and spend the night with their offspring. During this period, in addition to the concentrate, ewes had access to 1.5 kg (fresh matter) chopped elephant grass (*Pennisetum purpureum* spp),water, and a commercial mineral salt (*ad libitum).*

Lambs were identified, weighed at birth, and every 14 days until weaning. They had *ad libitum* access to water and a commercial mineral supplement with monensin. After the fifth day of age, lambs had access to creep feeding, which consisted of a concentrate containing 264.4 g/kg crude protein and 3.11 Mcal/kg metabolizable energy. The concentrate was composed of 670 g/kg ground corn, 300 g/kg soybean meal, 20 g/kg calcitic limestone, and 10 g/kg commercial mineral mixture. The concentrate was fed at 100 g/lamb/day, which was later adjusted to 1.5% of live weight. When the first-born lamb reached 45 days of age, all lambs received chopped elephant grass (*Pennisetum purpureum* spp) in addition to the creep feeding until weaning.

The chemical composition analysis of supplements and native pasture were performed in the Animal Nutrition Laboratory of Embrapa Goats and Sheep. Samples were analyzed for dry matter (method 930.15; AOAC, 2010), crude protein (N × 6.25; method 984.13; AOAC, 2010), acid-detergent fiber (method 973.18; AOAC, 2010), and neutral-detergent fiber, using α-amylase without addition of sodium sulfite (Van Soest et al. 1991).

Analyses of the fatty acid profile of supplements used in this study were performed in the Animal Nutrition Laboratory of Embrapa Goats and Sheep following the methodology described by Bligh and Dyer (1959) and the transmethylation performed according to Molkentin and Precht (2000). Methyl esters of fatty acids were analyzed with a Shimadzu GC 2010 gas chromatograph equipped with a flame ionization detector (FID) and fused silica capillary column (Supelco SP-2560). Samples were injected in the split at a ratio of 1:10. The temperature of the injector and detector was 250 ºC. The column temperature program was180 to 190 ºC at 5 ºC/min;190º C for 12 min; 190 ºC to 215 ºC at 3 ºC/min; 215 ºC to 240 ºC at 5 ºC/min; and 240 ºC for 10 min. The carrier gas was nitrogen, at a flow rate of 1 mL/min. The peak of each fatty acid was identified by comparing it with the retention time of peaks present in the lipid standard, which is composed of a mixture of fatty acids (FAME-Supelco

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37-Component FAME Mix-10,000 μg in CH_2Cl_2 / SUPELCO cat. 47885-U, PUFA2–Supelco cat. 47015-U and Conjugated Linoleic Acid Methyl Ester / SIGMA cat. O5632).

Reproductive indices were calculated according to the following equations:

$$Fertility\ (\%) = \frac{Lambed\ ewes}{Ewes\ exposed\ to\ service} x100 \quad (1)$$

$$Prolificacy = \frac{Lambs\ born}{Ewes\ exposed\ to\ service} \quad (2)$$

Ewe productivity (Px) was calculated according to the following equation:

$$Px\ (\frac{kg}{ewe}) = \frac{Wax\ (kg)}{Lambed\ ewes} \quad (3)$$

Where,
P_x is the production at the lambs day of age x; WAx is the adjusted weight of the lambs.
An average of adjusted weighs was used to adjust the lamb weights to the ages of 28, 56, 84, and 105 days, by weighing the animals on two occasions 14 days apart. The weight of the animals was adjusted according to the following equation:

$$WAx = \frac{(Wy - Wb)}{Ay} xAx + Wb \quad (4)$$

Where,
$WA_x$is the weight adjusted to x days (x = 28, 56, 84, and 105); W_y is the weight measured at y days of age; W_b is the weight at birth; A_y is the age at weighing; and A_x is the age to which the weight was adjusted.

The data were subjected to analysis of variance by the PROC MIXED procedure of SAS (v. 9.2, SAS Institute Inc, Cary, NC, USA), according to the following model:

$$Y_{ijk} = \mu + D_i + G_j + e_{ijk}, \quad (5)$$

Where,
Y_{ijk} is animal k belonging to genetic group j, which received diet i; μ is the overall mean; D_i the fixed effect of diet i; G_j is the fixed effect of genetic group j and $e_{ijk}$is the random error. For the productive variables, the effect of the number of lambs per birth (NLB) was included in the model. The diet effect was studied by Fischer Means Test (PDIFF). Differences were considered at 5% probability.

RESULTS AND DISCUSSION

In this study, we investigated the production and reproduction of Morada Nova and Brazilian Somalis ewes fed supplements with corn or linoleic acid. No interaction effect between diet and genetic group was observed on live weight and BCS of ewes in the different evaluated periods (P>0.05; Table 4). However, ewes supplemented with either FLU or LAF increased the BCS both at the beginning of the breeding

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season (*P*=0.014) and at lambing (*P*=0.001) compared to the CON group. However, at the end of supplementation, BCS increased in ewes supplemented with FLU compared to the other two treatments (*P*<0.001). The Brazilian Somalis ewes had greater live weights at the end of supplementation (*P*=0.030), and greater BCS during the beginning of supplementation (*P*<0.001), and at lambing (*P*<0.001) compared to MN genetic group ewes. The number of lambs per birth had the greatest effect on the general condition of the ewes. Ewes that had three lambs per birth increased their live weights, at the beginning and end of supplementation start (*P*<0.001, Table 4) compared to those that had two, followed by ewes with only one lamb per birth. Similarly, ewes with three lambs per birth had greater BCS at the beginning of supplementation (*P*=0.043), and greater weights at the beginning of the breeding season (*P*=0.02), and at lambing (*P*=0.048), compared to those with only one lamb per birth, with no differences for those that had two lambs. Conversely, females with three lambs per birth had decreased BCS at lambing (*P*=0.007) compared to one lamb, with no differences to ewes that had two lambs at birth.

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Table 4.Weight and body condition score of ewes at the start of supplementation, start of the breeding season, end of supplementation and atlambing according to diet, genetic group, and number of lambs per birth

Item	DIET[1]			GG[2]		NLB[3]			*SEM*[4]	*P*-values[5]			
	CON	FLU	LAF	BS	MN	One	Two	Three		DIET	GG	NLB	DIET*GG
Supplementation start													
Weight (kg)	26.60	26.64	26.63	27.06	26.18	23.61[c]	25.82[b]	30.44[a]	0.316	0.227	0.920	0.001	0.999
BCS[6]	2.29	2.20	2.18	2.39[a]	2.06[b]	1.99[b]	2.17[ab]	2.51[a]	0.038	0.406	<0.001	0.043	0.870
Breeding season start													
Weight (kg)	26.73	28.18	27.71	28.26	26.82	24.44[b]	26.88[ab]	31.30[a]	0.338	0.208	0.065	0.002	0.791
BCS	1.95[b]	2.20[a]	2.04[ab]	2.14	1.99	1.99	2.03	2.17	0.034	0.014	0.057	0.729	0.559
Supplementation end													
Weight (kg)	29.22	30.08	30.35	30.75[a]	29.02[b]	26.33[c]	28.98[b]	34.33[a]	0.346	0.399	0.030	<0.001	0.824
BCS	2.41[b]	2.80[a]	2.47[b]	2.64	2.48	2.43	2.49	2.76	0.044	<0.001	0.102	0.472	0.646
Lambing													
Weight (kg)	27.81	27.80	28.87	28.72	28.47	26.82[b]	28.34[ab]	30.62[a]	0.362	0.125	0.499	0.048	0.860
BCS	2.06[b]	2.42[a]	2.19[a]	2.33[a]	1.92[b]	2.33[a]	2.09[ab]	1.90[b]	0.053	0.001	<0.001	0.007	0.916

Within a row, means without a common superscript differ($P<0.05$).
[1]Diets:CON = control; FLU = corn-based flushing; LAF = high linoleic acid flushing
[2]Genetic group (GG): BS = Brazilian Somalis; MN = Morada Nova.
[3]Number of lambs per birth
[4]SEM: standard error of means.
[5]*P*-values: Effects of Diet; genetic group; number of lambs per birth, and diet and genetic group interaction.
[6]Body condition score according CALDEIRA & VAZ PORTUGAL (1998).

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The supplementation increased ewe productivity, except for the first period evaluated, where supplementation increased the body condition score of ewes without changing their live weights, regardless the type of supplementation. Differences in body condition score, not demonstrated in live weight, reinforced the need for animal weight to be associated with other variables to define its adequacy to the sheep nutritional management. At the supplementation end, the ewes that received FLU treatment had greater BCS compared to the other two treatments. This result may be associated with the greater starch content of corn (72.07) compared to corn germ meal (19.67) which may have contributed with an energy source of a faster digestion(NRC, 2016). However, this difference was later minimized at lambing by the FLU treatment.

The effect of genetic group on body condition score at lambing seems to reflect differences in predisposition to carcass fat deposition, which occurs to a greater extent in Brazilian Somalis animals in relation to the Morada Nova (LÔBO et al., 2014). The greater live weight and body condition score of ewes that lambed two and three lambs per birth in the pre-breeding season and the live weight in later events may have been an effect of their improved nutritional status influencing the number of viable lambs leading up to lambing.Incontrast, the decreased body condition score at lambing with the greater number of lambs per birth is likely due to the greater nutritional requirements of ewes with twin or triplet-births.In this regard, fetal count by ultrasound at early stages of gestation (30-40 days), associated with a more refined nutritional management in the final third of gestation, can reduce the loss of body condition score due to twin pregnancies. The nutritional refinement in the final third of gestation could improve the offspring weight and reduce the deleterious effect of the metabolic transition period that happens gradually in the final stage of gestation (DRACKLEY, 1999).

Prolificacy was not affected by supplementation (*P*=0.196, Table 5).However, prolificacy was greater for Morada Nova than Brazilian Somalis group (*P*<0.001). There was no effect of treatments on fertility (*P*>0.05; Table 5), and no interaction was observed between diet and genetic group on prolificacy or fertility (*P*>0.05; Table 5).

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Table 5.The effects of diet and genetic group onprolificacy and fertility according to diet and genetic group

Item	DIET[1]			GG[2]		*P*-values[3]		
	CON	FLU	LAF	BS	MN	DIET	GG	DIET*GG
Prolificacy	1.23±0.04	1.29±0.03	1.33±0.05	1.04[b] ±0.30	1.51[a] ±0.33	0.196	<0.001	0.651
Fertility (%)	86.54	96.08	91.49	90.67	92.00	0.132	0.575	0.312

Within a row, means without a common superscript differ(P<0.05).
[1]Diets:CON = control; FLU = corn-based flushing; LAF = high linoleic acid flushing.
[2]Genetic group (GG): BS = Brazilian Somalis; MN = Morada Nova.
[3]*P*-values: Effects of Diet; genetic group; and diet and genetic group interaction.

The greater prolificacy of Morada Nova ewes can also be responsible for their lower body condition score, because of their greater demand for nutrients to meet the gestation requirements(NRC, 1985). SILVA et al., (1998) found an average prolificacy of 1.19, ranging from 1.06 to 1.36, in the Brazilian Somalis, which are values similar to those obtained in this study. The fertility of Brazilian Somalis ewes found in this study (90.67%) was higher than that found by SILVA et al., (1998) who observed a fertility rate at lambing of 76.13% in a herd raised on native pasture.

The weight of lambs per lambed ewe, at birth and at 28 days of age, was not influenced by the diets (*P*>0.05; Table 6). However, both FLU and LAF, although not different form each other,provided greater lamb weight at 56 (*P*=0.032), 84 (*P*=0.048), and 105 days (*P*=0.036; Table 6) of age compared to the control group, with no differences between them.Brazilian Somalis ewes had lambs with lower weights at lambing (*P*=0.047), but heavier after 84 (*P*=0.026) and 105 days (*P*=0.025) compared to Morada Nova. Lamb weight at birth was greater for ewes that lambed three, followed by two and then one lamb per birth(*P*<0.001; Table 6).

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Table 6. Total lamb weight at lambing (TWL), Total lamb weight at 28 days (TW28), Total lamb weight at 56 days (TW56), Total lamb weight at 84 days (TW84), and Total lamb weight at 105 days (TW105) after birth whose progenitorswere submitted to different treatments: diet, genetic group, and number of lambs per birth

Item*	DIET[1]			GG[2]		NLB[3]			*SEM*[4]	*P*-values[5]			
	CON	FLU	LAF	BS	MN	One	Two	Three		DIET	GG	NLB	DIET*GG
TWL(kg)	2.64	2.76	2.81	2.47[b]	3.00[a]	2.40[c]	3.65[b]	4.53[a]	0.145	0.871	0.047	<0.001	0.253
TW28(kg)	6.55	8.33	7.64	7.87	7.22	7.09	8.78	9.38	0.163	0.288	0.327	0.156	0.317
TW56(kg)	7.30[b]	9.07[a]	9.05[a]	8.94	8.06	8.01	9.84	10.28	0.291	0.032	0.471	0.246	0.184
TW84(kg)	10.43[b]	12.84[a]	12.89[a]	13.13[a]	11.05[b]	11.43	13.93	14.25	0.374	0.048	0.026	0.318	0.421
TW105(kg)	11.27[b]	14.14[a]	14.20[a]	14.02[a]	12.47[b]	12.43	15.50	16.01	0.325	0.036	0.025	0.084	0.159

*It corresponds to the sum of all lamb weights produced per ewe
Within a row, means without a common superscript differ(P<0.05).
[1]Diets:CON = control; FLU = corn-based flushing; LAF = high linoleic acid flushing
[2]Genetic group (GG): BS = Brazilian Somalis; MN = Morada Nova.

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[3]Number of lambs per birth
[4]SEM: standard error of means.
[5]*P*-values: Effects of Diet; genetic group; number of lambs per birth, and diet and genetic group interaction.

Ewes subjected to corn-based or high linoleic acid flushing produced heavier lambs atlambing, at 56, 84, and 105 days after birth, and among other factors, seems to have been a result of differences in BCS of ewes from the breeding season until lambing. MORI et al., (2006) evaluating the reproductive performance of Hampshire Down, Ile de France, Sulffolk and Corrideale ewes submitted to different supplementation types before and during the breeding season, verified that the ground corn supplementation before and after the breeding season positively influenced the production of lambs. In a study evaluating the effects of pre and postnatal nutritional restrictions on the growth and performance of Santa Inês lambs from weaning to slaughter, GERASEEV et al., (2006) observed that prenatal restriction affects the performance of the animals even after weaning. Thus, resulting in lower weight gain, greater total feed intake and slaughter age, indicating that these animals did not compensate for the restriction imposed during the prenatal phase, even at a later stage. The greater productivity of Brazilian Somalis ewes in relation to Morada Nova at 84 and 105 days may be related to differences in prolificacy and availability of milk to the offspring between the studied breeds which lead to different growth rates and weight gains. According to LÔBO et al., (2012) the proliferative activity of satellite cells, which are sources of new muscle cells, is greater in Brazilian Somalis lambs than in Morada Nova lambs. The data found in this study were similar to those found by LÔBO et al., (2012) who observed that Brazilian Somalis lambs have more efficient post-natal growth. In addition, the lower productivity of Morada Nova ewes in relation to the Brazilian Somalis may have been a result of body condition score differences at lambing. Although Morada Nova ewes were more prolific, total lamb production at 105 days was lower than that found in the Brazilian Somalis. This indicates that this assessment should be carefully interpreted, and also include the maternal ability aspect and the characteristics of the production system. The greater birth weight of lambs from triple and twin births agrees with the findings of MEXIA et al., (2004)who found heavier weights of lambs born per lambed ewe in twin births, when ewes were supplemented in different stages of gestation.

From the results obtained in the present study, it can be concluded that high linoleic acid supplement and the traditional high-corn supplement increase the body condition score of ewes form the breeding season to lambing and, therefore, enhance production of lambs after 56 days of age. Although Morada Nova ewes increased prolificacy, their lambs were lighter after they reached 84 days of age.

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