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Performance and serum cortisol concentration in Santa Inês lambs under different suckling schemes

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ABSTRACT - The objective of this study was to examine the effects of suckling schemes (continued, controlled, and total separation) and the type of pregnancy on performance and serum cortisol concentration in lambs. A total of 29 Santa Inês ewes and 40 lambs were used, and the randomized block design was applied in a split-plot scheme with a 3 × 2 factorial arrangement in the plot and time in the subplot. For controlled suckling, the diet was supplied twice daily during one hour, starting on their 10th day of life. Total and average daily intakes of concentrate dry matter of lambs that underwent total separation was higher than those of lambs under continued suckling. Lambs subjected to total separation demonstrated higher concentrate dry matter intake/weight gain ratio, lower total weight gain, lower average daily weight gain, and lower weaning weight than those subjected to continued and controlled suckling. Lambs from single pregnancy demonstrated higher weight gain and obtained higher weight at weaning. Lambs subjected to total separation have a developmental delay. However, the lower performance of lambs subject to total separation cannot be attributed to stress because there is a decrease in the serum cortisol concentration over time.

Key Words: artificial suckling, concentrate intake, controlled suckling, weight gain

Introduction

Controlled suckling or total separation of lambs after birth represent strategies with the potential to improve herd production rates because they allow the rapid postpartum return of ovarian cyclicity in ewes (Morales-Terán et al., 2004; Hernández et al., 2009; Assis et al., 2011). However, the lamb performance until weaning may be compromised by these management practices. Previous studies have assessed how the suckling scheme influences lamb performance until weaning (Morales-Terán et al., 2004; Costa et al., 2007; Leal et al., 2010), although none of these studies evaluated the effects of total separation between lambs and ewe. Therefore, it is possible that controlled or artificial suckling, combined with supplementary feeding of Santa Inês lambs, may influence lamb performance prior to weaning.

From a nutritional standpoint, energetic deficiency is considered a major cause for reduced weight development among lambs (Umberger, 2009). This problem is even more evident in lambs from twin pregnancy, as these animals are subject to "natural" suckling restrictions because the increase in milk production due to twin pregnancy does not achieve double the amount of milk produced by a sheep with a single lamb (Ramsey et al., 1994). Thus, creep feeding or private feeding during the suckling phase of lambs may be required to obtain satisfactory performance.

Stress levels can be assessed through quantification of the serum cortisol concentration, which typically increases when an animal is subjected to a stressful condition (Roussel, 2006). Sevi et al. (2003) reported that after the maternal bond is formed, behavioral, endocrine, and immunological changes can be observed in lambs as a result of the stress induced by maternal deprivation, which can compromise their performance. Thus, the effect of suckling schemes on serum cortisol concentration in lambs should be investigated further.

The objective of this study was to examine the effects of suckling schemes (continued, controlled, and total separation) and the type of pregnancy (single and twin) on the performance of Santa Inês lambs at weaning as well as the serum concentration of cortisol.

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Material and Methods

These experiments were conducted between March 2010 and January 2011 in Lavras, Minas Gerais, Brazil (21°14'43"S, 44°59'59"W, 919 m altitude). This project was approved by the Ethics Committee for Animal Use of the University of Lavras and was registered under number CEUA/UFLA 042/10.

Twenty-nine Santa Inês pregnant ewes, at 1 to 3 years old, body weight (BW) of 52.60±1.76 kg (mean ± standard error), body condition score (BCS) of 2.5 to 3.5 (0 to 5 scale, with 0 = emaciated and 5 = very fat; Gordon, 1997) and demonstrating good health and clinical conditions were used. During the first four months of pregnancy, the ewes were subjected to routine management of the sheep husbandry facilities. Briefly, the ewes were released in a *Brachiaria decumbens* pasture during the day (7.00 h to 17.00 h) and housed in collective pens containing supplements of corn silage and concentrate consisting of soybean meal, corn meal, minerals, and vitamins at night (between 17.00 h and 7.00 h). Water and mineral salt were provided *ad libitum*.

During the last month of pregnancy, the ewes were confined in collective pens for feeding and received a complete diet twice daily in an amount sufficient to allow at least 10% leftovers. The diet was composed of corn silage (73.5%), soybean meal (7.0%), corn meal (17.3%) and minerals (2.1%), with 43.1% dry matter (DM), 12.4% crude protein (CP), 35.3% neutral detergent fiber (NDF), 8.6% ash, 4.2% ether extract (EE), and 39.5% non-fibrous carbohydrate (NFC). The mineral salt used was composed of 155.0 g Ca, 85.0 g P, 5.0 g Mg, 15.0 mg S, 140.0 g Na, 3500.0 mg Zn, 5000.0 mg Mg, 42.0 mg I, 15.0 mg Se, 36.0 mg Co, 1000.0 mg F, and 1000.0 mg Mn. This diet was prepared according to the recommendations of the NRC (2007) to meet the nutritional requirements in late pregnancy. Water was provided *ad libitum*.

A randomized block design in a split-plot scheme, with a 3 × 2 factorial in the plot, was used. In total, three feeding schemes (continued, controlled, and total separation) and two types of pregnancy (single or twin) were evaluated. Six blocks were defined considering parity (primiparous and multiparous) and BW of the ewes at birth. The experiment was unbalanced, with three blocks containing the six treatments, one block containing five treatments, and two blocks containing only three treatments (for a total of 29 plots). Within each block, the ewes were randomly allocated to the treatments. The block with five plots did not contain the treatment related to continued suckling with twin pregnancy. The two blocks with three plots contained only the three suckling schemes for single-lamb pregnancies. The details of the three suckling schemes are listed as follows:

Continued suckling (n = 9 ewes and 12 lambs): The ewes remained in individual pens with their lambs, full-time, until weaning at 60 days; Controlled suckling (n = 10 ewes and 14 lambs): The lambs remained full-time with their mothers until the 9th day of life, but starting the afternoon on the 10th day of life they were separated and subjected to the controlled suckling scheme. The lambs were placed in the ewe pens twice a day at 7.00 h and 16.00 h for 1 h each session until weaning at 60 days. The ewes maintained auditory contact with the lambs, but without visual contact, at a distance of approximately 10 m. The lambs were housed in individual pens (1.0 × 1.0 m) and twin lambs were housed in the same pen. Total separation (n = 10 ewes and 14 lambs): The lambs remained full-time with their mothers until the 9th day of life but were separated from their mothers beginning in the afternoon of the 10th day of life. The lambs received milk in a bottle twice daily, at 07.00 h and 16.00 h. Sheep milk to cow milk transition was performed, to gradually replace the sheep milk for cow milk (Table 1). The ewes did not maintain visual or auditory contact with their lambs, which were placed at a distance of approximately 70 meters in individual pens (1.0 × 1.0 m). Twin lambs were housed in the same pen.

The ewes were confined in individual pens (2.7 × 1.0 m) after lambing and received a complete diet, calculated according to the NRC (2007) criteria to meet the nutritional requirements for early lactation. This diet was composed of corn silage (63.7%), soybean meal (22.2%), corn meal (12.1%), minerals (2.0%), and the chemical composition was DM (41.8%), CP (19.1%), NDF (29.4%), ash (6.8%), EE (5.1%), and NFC (39.6%). The mineral salt used was described previously. This diet was provided *ad libitum* twice a day (7.00 h to 16.00 h), with a sufficient amount to leave at least 10% as leftovers. The orts from each pen were removed and weighed daily before the feed supply, allowing an adjustment of the amount of feed. Water was provided *ad libitum*.

Table 1 - Sheep to cow milk transition and volume offered daily to lambs subjected to total separation

Age (days)	Sheep milk		Cow milk	
	% Sheep milk	kg/day	% Cow milk	kg/day
1-9	100	-	-	-
10-16	75	870	25	288
17-23	50	580	50	577
24-30	25	290	75	866
31-37	0	0	100	1155
38-60	0	0	100	577

Two daily milkings were performed in ewes that were totally separated from their lambs between 11 and 24 days postpartum. One daily milking was performed between days 25 and 31, and a single milking every other day was performed between days 32 and 36. Thus, the milking frequency decreased gradually, allowing the drying-off procedure of the ewes at day 36. Each ewe was milked again in cases of udder edema. Ewes were held in an appropriate trunk and received 5 IU of oxytocin (Oxytocin Forte UCB, Uzinas Chimicas Brasileiras, Jaboticabal, Brazil) via intramuscular injection to enable milking. The udder was disinfected with a pre-dipping solution at the concentration of 0.5% iodine and then dried with a paper towel.

The lambs in all treatment groups had access to starter concentrate pellets from the 7th day of life, provided in the proportion of 10% of their BW until weaning at 60 days. Tifton 85 hay with 6% CP was provided *ad libitum* to lambs in all treatment groups from the 5th week of life. The starter concentrate was composed of corn meal (7.2%), soybean meal (21.3%), sodium monensin (Rumensin®, Elanco, Itapira, Brazil) (0.035%), sugar (2.3%), minerals (4.0%), and the chemical composition was DM (86.5%), CP (18.5%), NDF (13.3%), ash (6.6%), EE (3.9%), NFC (50.6%), and sodium monensin (35.0 mg/kg). The mineral salt used was described previously. Lambs subjected to continued suckling received the concentrate pellets in a private trough inside of the ewe pen. The concentrate leftover from each pen was removed and weighed prior to the daily supply of DM and nutrient intake determination. In case of twin lambs, which were confined to the same pen, the average and estimated BW and the individual average intake were also considered. The hay intake was not measured.

Concentrate ingredient samples were collected once weekly and stored at –20 °C prior to the chemical analysis. The composite samples for each ingredient were pre-dried in an air oven for 72 h at 55 °C and ground through a 1-mm sieve in a Thomas-Wiley grinder, and a subsample from each pre-dried sample was dried at 100 ºC for 24 h to determine the DM content. The CP and EE analyses were performed according to the AOAC (2004). Ash was evaluated following sample incineration at 550 °C for 6 h. The NDF content was determined with an Ankon® Fiber Analyser (Ankon Technology Corporation Fairport, NY) according to Van Soest et al. (1991), using heat-stable α-amylase. Non-fibrous carbohydrates were calculated with the following equation: NFC = 100 – (CP + EE + NDF + Ash).

All lambs were weighed at birth and thereafter every seven days until weaning at 60 days. The weight measurements were always performed at the same time for evaluation of the average daily weight gain. Weighing was performed before the morning suckling of lambs subjected to controlled suckling and before the artificial feeding of those subjected to total separation.

Blood samples of approximately 8 mL were collected on the 10th (first day of the treatments) and 20th days after birth (10 days after the beginning of the treatments) to assess the serum cortisol concentration of the lambs. These days were chosen to evaluate the cortisol concentration on the first day of physical separation of lambs and ewes and on the 10th day after separation, when the lambs should be adapted to treatments. Samples were collected through jugular vein puncture using 25 × 7 mm needles and Vacutainer tubes without anticoagulant. Approximately 40 min after collection, the blood was centrifuged at 1.509 x g for 10 min to obtain the serum, which was frozen at –20 °C. The serum cortisol concentration was measured by solid-phase radioimmunoassay using a commercial kit (Cortisol Coat-A-Count®, Siemens Health Care Diagnostics, Los Angeles, USA). The intra- and inter-assay coefficients of variation were 0.04% and 1.08%, respectively.

Sibling lambs from twin pregnancies were kept in a single pen, which was considered the experimental unit for all variables. The effects of feeding scheme and type of pregnancy on the total concentrate intake, average daily concentrate intake, total weight gain, average daily weight gain, and total concentrate intake/total weight gain rate were analyzed using the SAS GLM procedure (Statistical Analysis System, version 9.1) with variance and F test analysis. In this analysis, the time factor was not considered. The following statistical model was used:

$$Y_{ijk} = \mu + \alpha_i + \beta_j + \alpha_i\beta_j + \omega_k + e_{ijk},$$

in which Y_{ijk} = observation in treatments i and j in blocks k; μ = constant inherent to the entire observation; α_i = effect of type of gestation (i = 1, 2); β_j = feeding scheme effect (j = 1, 2, 3); $\alpha\beta_{ij}$ = type of pregnancy vs. feeding scheme interaction effect (i = 1, 2, and j = 1, 2, 3); ω_k = block effect (k = 1, 2..6); and e_{ij} = experimental error associated with observation Y_{ijk}, random with normal distribution, mean zero and variance σ^2.

Eight periods of seven days from the 7th to the 55th day and a five-day period from the 56th to the 60th day were organized to analyze the concentrate DM intake. The weight from the 14th day was considered, and the birth weight was used as a covariate in the lamb BW analysis. Serum cortisol concentration was analyzed on the 10th day (start of feeding scheme) and on the 20th day of the experimental period. Concentrate DM intake and serum cortisol concentration were analyzed over time using the SAS MIXED procedure according to the statistical model

defined below. For lamb BW analysis, the same model was used, but the term $b(X_{ijl} - \bar{X})$ referring to covariate birth weight was included.

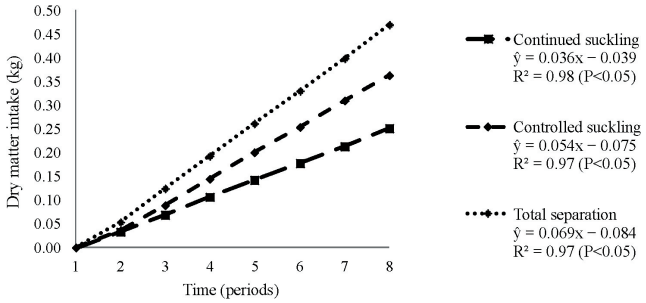
$Y_{ijk,l} = \mu + \alpha_i + \beta_j + \alpha_i\beta_j + \omega_l + \varepsilon_{ijk} + \tau_k + \alpha_i\tau_k + \beta_j\tau_k + \alpha_i\beta_j\tau_k + e_{ijkl}$, in which $Y_{ijk,l}$ = subplots i, j, k, l observed value (i = 1, 2; j = 1, 2, 3; k = 1,...6; and l = 1,...8); μ = constant inherent to every observation; α_i = type of gestation effect (i = 1, 2); β_j = feeding scheme effect (j = 1, 2, 3); $\alpha_i\beta_j$ = type of pregnancy vs. feeding scheme interaction effect; ω_l = block effect; l = 1,...6); ε_{ijk} = random error associated with observation $Y_{ijk,l}$, in plot level; τ_k = time effect (k = 1, 2...8 (concentrate intake and lambs weight), or k = 1, 2 (cortisol)); $\alpha_i\tau_k$ = type of pregnancy vs. time interaction effect; $\beta_j\tau_k$ = feeding scheme vs. time interaction effect; $\alpha_i\beta_j\tau_k$ = type of pregnancy vs. feeding scheme vs. time interaction effect; and e_{ijkl} = experimental error associated with the observation $Y_{ijk,l}$, subplot level.

Results

The daily milk production of ewes subjected to total separation from the 10th to the 24th day postpartum was 651.2±30.6 kg. Between days 25 and 31, the ewes produced 436.6±13.5 kg/day of milk, and this production was 411.0±16.4 kg between days 32 and 36.

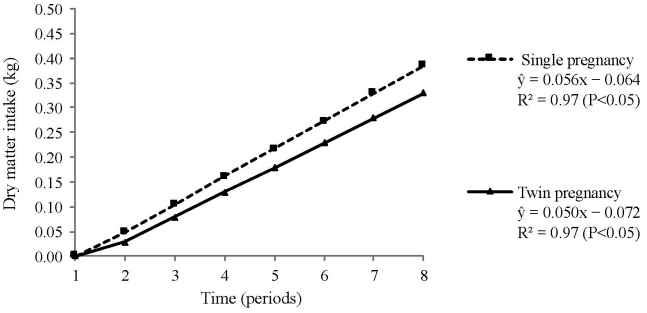
The average daily concentrate intake of lambs in each of the three feeding schemes (Figure 1) and lambs from single- and twin-pregnancies (Figure 2) increased linearly (P<0.05) until weaning.

The total and average daily concentrate DM intake by lambs subjected to total separation were higher (P<0.05) than those of lambs under continued suckling, but did not differ (P>0.05) between lambs subjected to continued and controlled suckling or between lambs subjected to controlled suckling and total separation (Table 2). Lambs subjected to total separation demonstrated lower (P<0.05) total weight gain and average daily weight gain but increased (P<0.05) concentrate DM intake/weight gain ratio compared with those from other management groups. The BW of lambs in each of the three suckling schemes increased linearly over the experimental period (P<0.05; Figure 3). The weaning weight of lambs subjected to continued suckling



Average daily intake differed over time (P<0.05).
Data represent periods of seven days from the 14th to 55th day and five days from the 56th to 60th day of age.

Figure 1 - Average daily concentrate intake of Santa Inês lambs subjected to continued suckling, controlled suckling, and total separation.



Average daily intake differed over time (P<0.05).
Data represent periods of seven days from the 14th to 55th day and five days from the 56th to 60th day of age.

Figure 2 - Average daily concentrate intake of Santa Inês lambs from single and twin pregnancies.

Table 2 - Performance data from the 14th to 60th day after birth in lambs subjected to continued, controlled, or total separation feeding schemes and lambs from single and twin pregnancies (mean ± standard error)

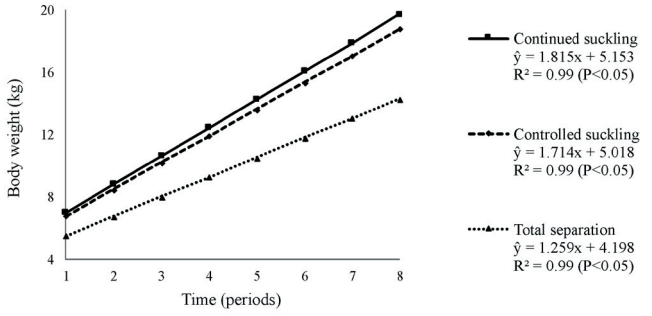
	Performance measurement				
	Intake (kg DM)[1]	ADI (kg DM)	WG (kg)	ADWG (kg)	Intake/weight[2]
Suckling scheme					
Continued	6.58a±1.12	0.14a±0.02	12.00a±0.67	0.26a±0.01	0.55a±0.10
Controlled	8.18ab±1.46	0.17ab±0.03	11.23a±1.00	0.24a±0.02	0.72a±0.13
Total separation	11.26b±0.89	0.24b±0.02	8.31b±0.37	0.18b±0.04	1.33b±0.11
Pregnancy					
Single	9.83±1.14	0.21±0.02	11.21a±0.53	0.24a±0.01	0.94±0.12
Twin	7.87±0.78	0.17±0.01	9.92b±0.73	0.21b±0.01	0.85±0.10

For comparisons between feeding schemes, means followed by different letters in the column differed according to Tukey-Kramer's test (P<0.05). For comparisons between types of pregnancy, means followed by different letters in the column differed according to the F test (P<0.05).
DM - dry matter; ADI - average daily intake of concentrate; WG - total weight gain; ADWG - average daily weight gain.
[1] Intake - total concentrate intake.
[2] Intake/weight - total concentrate intake (kg DM) and total weight gain ratio.

was 19.07±1.04 kg (mean ± standard error of the mean), and that of lambs subjected to controlled suckling was 18.59±1.09 kg; there was no significant difference between these groups (P>0.05), but these results were higher (P<0.05) than that observed in lambs subjected to complete separation (14.21±0.40 kg).

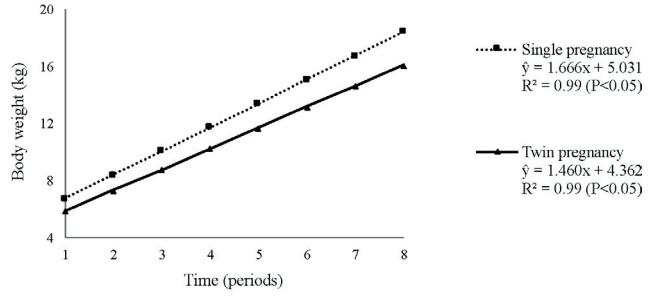
The total and average daily concentrate DM intakes and the concentrate intake/weight gain ratio did not differ (P>0.05) between lambs from single and twin pregnancies (Table 2). The total weight gain and the average daily weight gain were higher (P = 0.05) in lambs from single pregnancy (Table 2), and these animals also had higher (P<0.05) weaning weight in relation to animals from twin pregnancy (18.36 and 16.04 kg, respectively, Figure 4).

The serum cortisol concentrations did not differ (P>0.05) between lambs subjected to continued, controlled, and total separation or between lambs from single or twin pregnancies (Table 3). There was no interaction between suckling scheme or type of pregnancy and time (P>0.05). However, there were differences between the two time periods studied (P<0.05), as the serum cortisol concentration in lambs on the 10th day of life was 26.81±2.91 ng/mL, whereas that on the 20th day of life was 18.36±3.23 ng/mL.



Body weights differed over time (P<0.05).
Data represent the weights at 14, 21, 28, 35, 42, 49, 56, and 60 days.

Figure 3 - Body weight of Santa Inês lambs subjected to continued suckling, controlled suckling, and total separation from the 14th day until the 60th day of age.



Body weights differed over time (P<0.05).
Data represent the weights at 14, 21, 28, 35, 42, 49, 56, and 60 days.

Figure 4 - Body weights of Santa Inês lambs from single and twin pregnancies from the 14th day until the 60th day of age.

Table 3 - Serum cortisol concentration in lambs subjected to continued, controlled, or total separation feeding schemes and lambs from single and twin pregnancies (mean ± standard error)

	Serum cortisol concentration	
	10th day (ng/mL)	20th day (ng/mL)
Suckling scheme		
Continued	21.32±3.66	22.54±7.66
Controlled	26.25±5.88	6.84±2.40
Total separation	32.31±5.00	16.89±5.58
Pregnancy		
Single	26.45±3.55	18.05±4.82
Twin	27.39±5.27	10.47±3.37

Discussion

The Santa Inês milk production reported by other authors (Susin et al., 2005; Ribeiro et al., 2007; Araújo et al., 2008; Ferreira et al., 2011) was generally less than 1.06 to 1.47 kg/day. However, the current experiment performed total lamb separation, whereas in other studies, the ewes and lambs were separated daily (Ribeiro et al., 2007) or once a week (Susin et al., 2005; Araújo et al., 2008; Ferreira et al., 2011), which may have stimulated greater milk production by ewes. The different doses of oxytocin used (Araújo et al., 2008) may have also contributed to the differences observed between studies. The decrease in production observed during lactation course was similar to that reported by Araújo et al. (2008).

The lower intake of concentrate DM by lambs subjected to continuous suckling compared with total separation was expected, since those lambs had continuous access to breast milk. Thus, most of the nutritional requirements of lambs subjected to continuous suckling were supplied by milk, which resulted in a lower intake of the starter concentrate. The average daily intake of concentrate by lambs subjected to total separation was similar to that reported by Silva et al. (2012) in Santa Inês × Dorper lambs that received creep-feeding with unpelleted feed from the 14th day of life (250 g).

Lambs subjected to continuous and controlled suckling had higher weight gain than those subjected to total separation; consequently, the concentrate intake/weight gain ratio of artificially fed lambs was higher. These results suggest that total separation on the 10th day of life compromised the performance of lambs. Morales-Terán et al. (2004) also reported no difference in average daily

weight gain between Pelibuey lambs subjected to continued or controlled suckling schemes until weaning at 63 days (186 and 174 g, respectively). However, Assis et al. (2011) observed that Santa Inês and Bergamácia lambs, which remained full-time with parental sheep, demonstrated a reduced mean weight gain (160 g) compared with those subjected to controlled suckling (195 g). These authors also provided the starter concentrate *ad libitum* and in private troughs for lambs that remained full-time with parental sheep but used a concentrate with a higher CP content (20%) than that used in the current study.

Regarding weaning weight, the results of the current study are similar to those reported by Sousa (2009), who observed an average weight at 60 days of 18.2 and 18.8 kg when comparing Santa Inês lambs under continued or controlled feeding schemes, respectively, with supplementation of 200 g of commercial diets containing 18% CP in the dry season. However, the results of the current study differ from those reported by Leal et al. (2010), who observed weights at 56 days of 13.26 kg in Santa Inês lambs subjected to continued suckling and 14.42 kg in lambs under controlled suckling. Leal et al. (2010) evaluated lambs kept on native pastures with access to elephant grass and Leucaena supplementation and commercial feed containing a lower CP content (15%) than that of the starter concentrate (18.5%) offered in this study. Lower weaning weights compared with those observed in this study were also reported by Costa (2003) in Santa Inês lambs provided access to corn silage and concentrate creep-feeding containing 18% CP; these animals were subjected to continued (15.58 kg) or controlled suckling twice a day for 1 h each session (14.3 kg).

Lambs subjected to total separation did not demonstrate a weight gain proportional to their concentrate DM intake, possibly due to differences in the chemical composition of sheep and cow milk. Maestá et al. (2010) also observed that Bergamácia lambs subjected to artificial suckling with cow milk from 48 h of life had lower weaning weights at 60 days than those subjected to controlled suckling (16.55 and 18.98 kg, respectively), and these authors attributed the lower weaning weights of lambs artificially breastfed to the use of cow milk as a substitute.

The sheep milk is richer in nutrients than cow milk. In Santa Inês ewes, Alves et al. (2015) reported 16.97% total solids, 5.77% fat, and 5.39% protein at the 10th day postpartum. Moreover, in contrast to cow milk, sheep milk is composed of fat globules that have a higher surface to enzymatic activity due to the reduced size and higher triglyceride percentage, which allows easier digestion. Furthermore, the fat-to-protein ratio in sheep milk is greater than that in cow milk (Campos, 2012). Sevi et al. (1999) suggested that the gradual transition from sheep milk to a commercial substitute (47.8 g/kg CP, 44.9 g/kg fat) is important to minimize stress in artificially suckled Comisana lambs. These authors observed similar intake and lamb weight gain increases, except in lambs gradually separated from ewes, which demonstrated a compromised weight gain.

The average daily weight gain of lambs from single (240 g) and twin (220 g) pregnancies in this study was higher than that observed by Assis et al. (2011) in Santa Inês lambs from birth to weaning at 60 days (203 g and 144 g in single and twin pregnancies, respectively). The lower weight gain of lambs from twin pregnancies may be attributed to the probable shortage of mother milk, because although ewes can increase their milk production due to twin pregnancy, this production is not twice the quantity produced by a ewe with single pregnancy (Ramsey et al., 1994). Snowder and Glimp (1991) observed that ewe milk production and the BW of lambs from single pregnancies were higher during all lactation stages when correlating the BW of lambs of single and twin pregnancies to the milk production of Rambouillet, Columbia, Suffolk, and Polypay sheep. According to these authors, ewes with a twin pregnancy produced 40-64% more milk than those with single pregnancies. Susin et al. (2000) reported 28 and 33% higher productions in the second and third weeks of lactation, respectively, in twin pregnancies of Santa Inês sheep compared with animals with single pregnancies.

The increased serum cortisol concentration observed on the first day of the suckling schemes compared with day 20 may suggest that the lambs adapted over time to different management practices to which they were subjected. Therefore, the lower performance of lambs subjected to total separation cannot be attributed to stress caused by this form of management. The serum cortisol concentrations of lambs in this study on the 20th day were similar to those reported by Hargreaves and Hutson (1990) and Minton et al. (1995), who found that the plasma concentration of this hormone in Merino sheep, without imposing any kind of stress, was 20 ng/mL. In lambs gradually separated from their dams from day 12 of age, Sevi et al. (2003) reported 45.3 ng/mL, whereas in lambs that remained with their dams, the serum cortisol concentration was 18.2 ng/mL. Similarly, the authors did not observe differences between groups at 32 days of age. It is important to note that cortisol is a glucocorticoid hormone, which normally rises when the animal is subjected to a stressful condition and takes a few days to return to normal, although the pattern of discharge may vary between individuals (Roussel, 2006).

Conclusions

Lambs subjected to total separation show reduced performance compared with lambs subjected to continued and controlled suckling, which demonstrates that this management practice is not efficient for sheep reared in intensive systems. Additionally, lambs from single pregnancies display increased performance and are heavier at weaning than those from twin pregnancies. The serum cortisol concentration reduced on the 20th day compared with the 10th day of experiment, suggesting adaptation to management.

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