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Short communication

Reproductive performance of ewes mated in the spring when given nutritional supplements to enhance energy levels

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Abstract

The objective of this study was to evaluate the reproductive performance of ewes mated in the spring when given nutritional supplements to enhance energy levels. Ewes were assessed for weight and body condition at the beginning and end of flushing periods. Lambing rates and rates of proliferation were also evaluated. Crossbred woolly ewes (n = 46), 36 ± 2 months of age and rated 3.0 ± 0.1 on a body condition scale that spanned from 1 to 5 were divided into four treatment groups. One group received no feed supplements (NFS), while the others were supplemented for 64 days: 21 days before and 43 days during the mating season. The latter groups were fed soybean hulls at 0.6% (S06), 0.9% (S09) and 1.2% (S12) of their body weight (BW), calculated using dry mass. Ewes were mated for 50 days with four rams by means of natural breeding in October and November, which is spring in Brazil. There was no significant difference among the treatments based on mean BW of the ewes before and after the supplementation period ($P > 0.05$). Similarly, no differences were found in the rates of proliferation ($P > 0.05$). The S09 treatment presented the highest lambing rate (82%, 9/11), while the NFS treatment correlated with the lowest rate (42%, 5/12; $P < 0.05$). There was a positive linear effect for body condition score as the supplementation level increased ($P < 0.05$). We conclude that a supplementation level of 0.9% BW seems to improve lambing rates for ewes that undergo springtime mating.

Keywords: ewes, fertility, flushing, lambing rate, soybean hulls.

Introduction

One limitation associated with the sheep breeding industry is the seasonality of ovine reproductive behavior. This seasonality is regulated by the daylight period, such that decreasing daylight triggers estrus (Hafez *et al*., 2004). Because of this, the typical breeding season for ewes is the autumn. However, some breeds, such as Santa Ines for example, are not sensitive to seasonality in temperate climates (Aboul Naga *et al.,* 1991). There is minimal information on reproductive seasonality in tropical latitudes, but researchers believe that other factors may contribute to the observed behavior, including lactation, presence of males (Traldi, 1990) and nutrition (Mori *et al*., 2006).

Recently, some approaches have been used to minimize the effects of seasonality. These include hormonal treatments, artificial suckling, luminosity manipulation (Nugent III *et al*., 1988), and the male effect (Cushwa *et al*., 1992).

Energy intake can serve as a significant limitation to sheep production rates among animals raised on pasture. Insufficient energy results in decreased growth, delays in reaching puberty and a decrease in reproductive performance (Silva Sobrinho, 1996). The adoption of flushing before and during the mating period results in a significant increase in ovulation rates (Molle *et al*., 1997), decrease of follicular atresia (Silva Sobrinho, 1996), better body condition at mating (Jardim, 1983), and higher incidences of twin births (Mukasa-Mugerwa and Lahlou-Kassi, 1995).

Our objective in this study was to evaluate the reproductive performance of ewes mated in the spring when given nutritional supplements to enhance energy levels. Ewes were assessed for weight and body condition score before and after the flushing period. We also evaluated lambing rates and rates of proliferation.

Materials and Methods

Location and management

The experiment was carried out on a farm located in Parana State, in the south of Brazil, at 22º51' S 51º33' W. This location features a subtropical climate with most rainfall occurring during the summer months.

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The mating period was chosen to be during October and November (spring season), when average temperatures were 28.7 ± 1.1ºC (range 27.3 to 30ºC) and humidity was recorded as 64.4 ± 7.8% (range 53.1 to 70.6%). Spring starts in September and ends in December in the Southern Hemisphere. The average daily sunshine for São Jerônimo da Serra city in the year 2004 during September, October and November was 11:58, 12:39 and 13:16 hours, respectively. Animals were kept on an 11.4 hectare pasture (*Cynodon plectostachyrus Pilger*, *Brachiaria decumbens* and *Paspalum notatum*).

Animals

Our experiment was consistent with the principles of biomedical research involving animals (International, 1985). We selected 46 crossbred (1/2 Santa Ines 1/2 Suffolk) woolly ewes 36 ± 2 months of age and with a body condition score of 3.0 ± 0.1 on a scale of 1 to 5. Animals were sheared and confirmed as nonpregnant by ultrasonography (Aloka SSD 500, 5 MHz linear transducer) 70 days before mating. Reproduction was subsequently performed using four rams with proven fertility.

Treatments

Ewes were divided into one of four treatment groups. One group received no nutritional supplements (NFS, n = 12), while the others were fed soybean hulls at levels of 0.6% (215 g/day – S06, n = 12), 0.9% (326 g/day – S09, n = 11) and 1.2% (425 g/day – S12, n = 11) of the animal's body weight, calculated according to dry mass. All the animals were kept together in the same pasture, except for a one-hour period every morning, when each group was separated to receive the appropriate feed treatment. The flushing period lasted 64 days from September 18th to November 20th. This included 21 days before and 43 days during the mating season, which was chosen to last from October 9th to November 27th (50 days). Ewes were assessed for weight and body condition score before and after the flushing period. Ewes were also evaluated for lambing rate (number of ewes lambing per number of ewes in each treatment group) and rate of proliferation (number of lambs born per number of ewes lambing in each treatment group).

Feed measurements

The soybean hulls were sampled shortly after delivery. The sample was representative because hulls were taken from multiple zones of the shipment containers.

Chemical analyses of the soybean hulls were carried out to measure the content of dry matter, crude protein and ash, according to methodologies recommended by AOAC (Official, 1990). Neutral detergent fiber and acid detergent fiber content was determined according to Van Soest *et al*. (1991). The *in vitro* dry matter digestibility (IVDMD) was determined using the methodology recommended by Tilley and Terry (1963). The total digestible nutrient (TDN) content was estimated from the IVDMD (Moore *et al*., 1999; Table 1).

Table 1. Average chemical composition (g/kg of dry matter) of the soybean hulls.

Sample	Soybean hulls	S06	S09	S12
	g/kg of dry matter	g	g	g
CP	229.6	49.4	74.8	97.6
NDF	545.0	117.2	177.7	231.6
ADF	320.7	68.9	104.5	136.3
ash	70.7	15.2	23.0	30.0
TDN	836.3	179.8	272.6	355.4
IVDMD	816.8	175.6	266.2	347.1

CP, crude protein; NDF, neutral detergent fiber; ADF, acid detergent fiber; TDN, total digestible nutrients; IVDMD, *in vitro* dry matter digestibility.

Statistical analyses

A randomized design was used with 46 animals and four treatment groups. Each animal was considered a single experimental unit. The weight and body condition score data were submitted to regression analysis, and the independent variable was the flushing level. Linear and quadratic effects were checked. The initial body weight was used as a covariate for measurements of final body condition. The effect of the covariate was significant for the metrics of final weight and final body condition. Reproductive performance was analyzed using the Chi-square test. The SAEG system of statistical and genetic analysis was used (SAEG, 1997).

Results

There was no difference ($P > 0.05$) in the mean body weight (BW) and in body condition score of the ewes at the beginning of the experiment. This confirms that the animals were appropriately distributed within groups. The mean BW of the ewes showed no significant difference at the end of the experiment ($P > 0.05$). Flushing treatments were positively and linearly correlated with body condition ($P < 0.05$; Fig. 1), providing improvements of up to 0.77 in the best case. However, we did not observe significant changes in BW ($P > 0.05$; Fig. 2), despite group S12 presenting an average weight gain of 5.69 kg by the end of treatment. The P-values for the quadratic effect were not significant for either final BW or body condition.

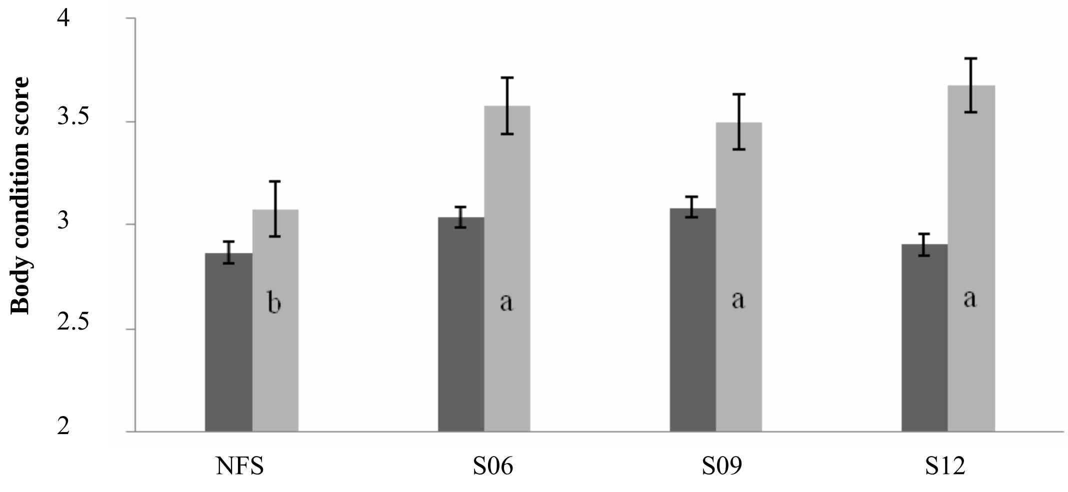

Figure 1. Means for body condition score ± S.E.M. at the beginning of the supplementation (BCSBS ■) and end of the supplementation (BCSES ■) for no supplemented ewes (NFS) or ewes supplemented with soybean hulls at the level of 0.6% (S06), 0.9% (S09), and 1.2% (S12) of BW. Body condition of treated groups (S06, S09 and S12) were different from control group at the end of the experiment ($P < 0.05$), according to the regression equation: $\hat{Y}=1.23+0.05\text{Ln}X$ ($R2 = 0.67$).

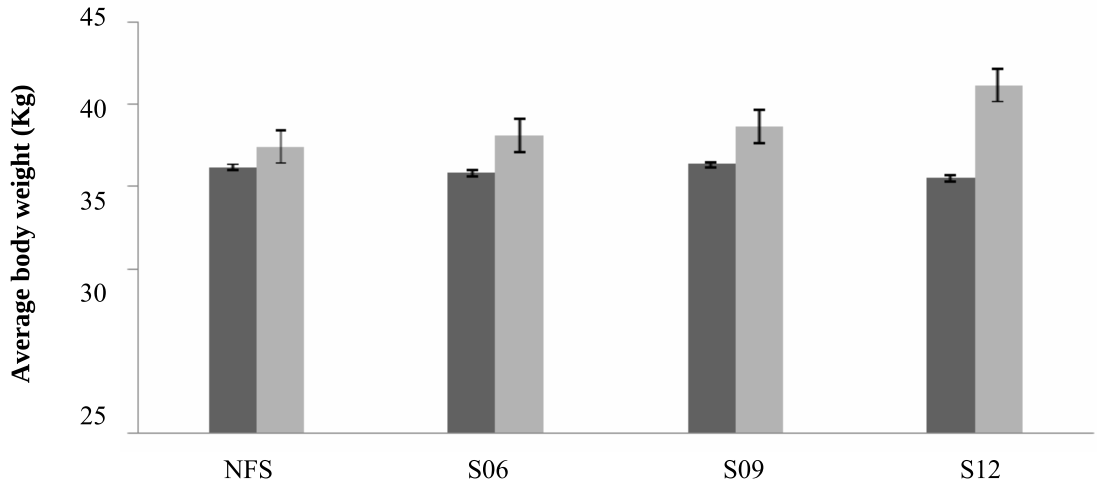

Figure 2. Means for body weight ± S.E.M. at the beginning of the supplementation (BWBS ■) and end of the supplementation (BWES ■) for no supplemented ewes (NFS) or ewes supplemented with soybean hulls at the level of 0.6% (S06), 0.9% (S09), and 1.2% (S12) of BW. There were no differences between treated (S06, S09 and S12) and control group on body weight at the end of the experiment ($P > 0.05$).

Flushing enhanced reproductive rates, as did supplementation. All the treatment groups showed improved pregnancy and lambing rates as compared with the control. The S09 treatment group showed the best results, with a lambing rate that was 40% higher than the control group (P < 0.05; Fig. 3).

Although there was no difference in the rates of proliferation among the treatment groups (P > 0.05), it is interesting to note that twin births only occurred among the nutritionally supplemented ewes (Fig. 4).

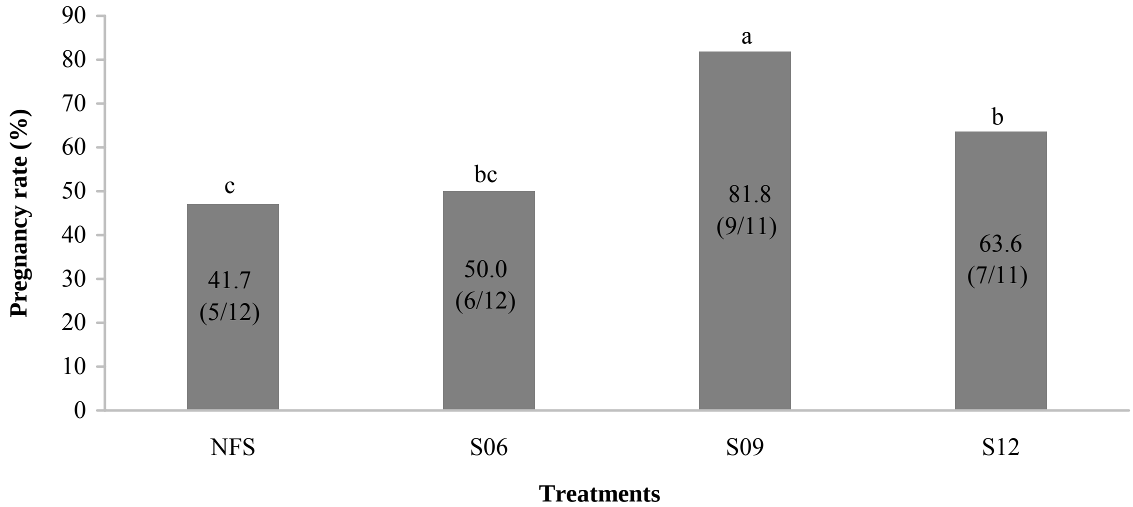

Figure 3. Pregnancy rates for no supplemented ewes (NFS) or ewes supplemented with soybean hulls at the level of 0.6% (S06), 0.9% (S09), and 1.2% (S12) of BW. Means followed by different letters (a, b, c) differ statistically (P < 0.05).

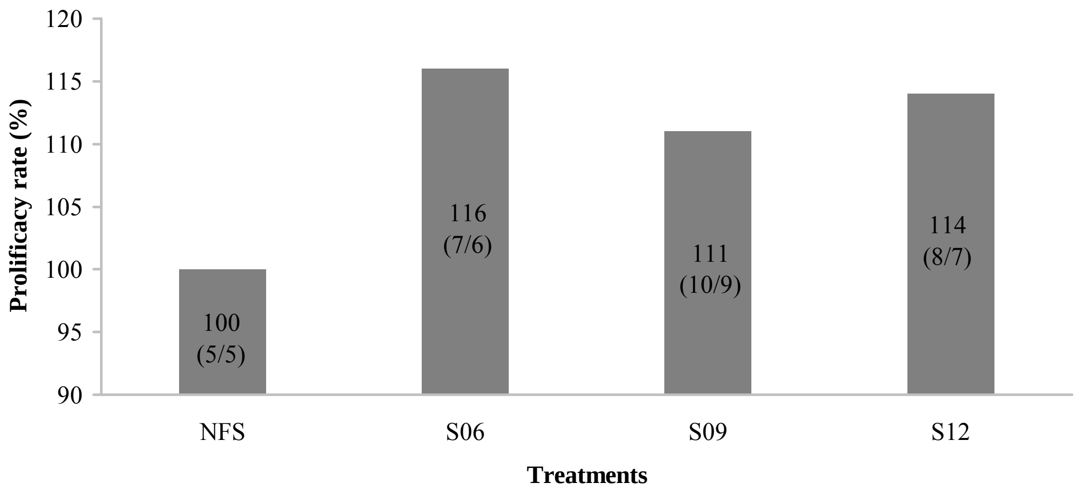

Figure 4. Prolificacy rate for no supplemented ewes (NFS) or ewes supplemented with soybean hulls at the level of 0.6% (S06), 0.9% (S09), and 1.2% (S12) of BW. Means do not differ statistically (P > 0.05).

Discussion

Our results demonstrate the potential of flushing for improving lambing rates. The highest lambing rate was obtained from treatment S09, and this can be ascribed to the increase in feed, energy and crude protein intake before and during the mating season. Similar benefits on lambing rates after flushing were described by El-Hag *et al*. (1998). Abecia *et al*. (1999) registered a 100% pregnancy rate for ewes submitted to flushing after 15 days at the beginning of the breeding season. By contrast, those animals that received no supplements had a pregnancy rate of 40%. In ewes that were fed two maintenance diets for 6 days before and during the emergence of the ovulatory wave, the increased concentrations of glucose, insulin and leptin were associated with increased numbers of follicles that grew to between 2 and 3 mm in diameter (Viñoles *et al*., 2005).

Clear improvements were shown by groups S09 and S12, with the best results being obtained from S09. It is possible that S12 (23% crude protein diet, Table 1) provided excessive protein, considering that soybean hulls are rich in protein that is degraded in the rumen (Zambom *et al*., 2001). Excessive protein, irrespective of protein source or degradability, is correlated with multiple disorders of reproductive function. Problems in the uterus, corpus luteum and sperm migration were reported by Kaur and Arora (1995). Insufficient activity of ovarian steroids and contractility of the oviduct were noted by Bernardelli *et al*. (2001).

We expected a higher incidence of twin births after flushing. Although our study offered no significant data in this regard, it is interesting to note that only ewes from the treated groups experienced twin births. Mukasa-Mugerwa and Lahlou-Kassi (1995) demonstrated a higher incidence of twin births with flushing. Our results agree with data from Ribeiro *et al*. (2002) for ewes supplemented with 0.5 kg per animal of ground corn. Their study did not report any incidences of twin births with flushing, recording proliferation rates of 108% and 103% for treatment groups without or with supplementation, respectively. Mori *et al*. (2006) also did not observe any differences in proliferation rates between ewes in the control group (132%, 37/28) and those receiving supplements (139%, 46/33). Another aspect to be considered in explaining the lack of evidence for multiple births may be the good body condition at the beginning of the experiment. The initial BCS was around 3, and further improvements after supplementation are commonplace when animals begin their treatment with a lower BCS.

Flushing with soybean hulls increased body condition score for all of the ewes and contributed to a higher lambing rate, without influencing the rate of proliferation. Under these conditions, the treatment that seemed to most improve the lambing rate was flushing at 0.9% of live weight. Food flushing was a viable technique, and we conclude that it can be used as part of a feeding regimen for ewes with spring mating schedules.

References

Abecia JA, Forcada F, Lozano JM. 1999. A preliminary report on the effect of dietary energy on prostaglandin F2a production *in vitro*, interferon-tau synthesis by the conceptus, endometrial progesterone concentration on day 9 and 15 of pregnancy and associated rates of embryo wastage in ewes. *Theriogenology*, 52:1203-1213.

Aboul Naga AM, Mansour H, Aboul Eia MB, Mousa MT, Hassan F, El-Hommosi F. 1991. Oestrous activity in three subtropical sheep breeds in Upper Egypt and response to long-day light treatment. *J Agric Sci*, 116: 139-143.

Bernardelli JG, Weng J, Burfening PJ, Adair R. 2001. Effect of excess degradable intake protein on early embryonic development, ovarian steroids, and blood urea nitrogen on days 2, 3, 4, and 5 of estrus cycle in mature ewes. *J Anim Sci*, 79:193-199.

Cushwa WT, Bradford GE, Stabenfeldt GH, Berger YM, Dally MR. 1992. Ram influence on ovarian and sexual activity in anestrous ewes: effects of isolation of ewes from rams before joining and date of ram introduction. *J Anim Sci*, 70:1195-1200.

El-Hag FM, Fadlalla B, Elmadih MA. 1998. Effect of strategic supplementary feeding on ewe productivity under range conditions in North Kordofan, Sudan. *Small Rumin Res*, 30:67-71.

Hafez ESE, Jainudeen MR, Wahid H. 2004. Ovinos e caprinos. *In*: Hafez ESE, Hafez B (Eds.). *Reprodução Animal*. 7th ed. São Paulo: Manole. pp.173-192.

International guiding principles for biomedical research involving animals. 1985. Geneva: Council For International Organizations of Medical Sciences (CIOMS). Available on: http://www.cioms.ch/frame_1985_texts_of_guidelines.htm. Accessed in: May 30, 2005.

Jardim VR. 1983. *Os Ovinos*. Rio de Janeiro, RJ: Nobel. 196 pp.

Kaur H, Arora SP. 1995. Dietary effects on ruminant livestock reproduction with particular reference to protein. *Nutr Res Rev*, 8:121-136.

Molle G, Landau S, Branca A, Sitzia M, Fois SN, Ligios S, Casu S. 1997. Flushing with soybean meal can improve reproductive performances in lactating Sarda ewes on a mature pasture. *Small Rumin Res*, 24:157-165.

Moore JE, Brant MH, Kunkle WE. 1999. Effects of supplementation on voluntary forage intake, diet digestibility, and animal performance. *J Anim Sci*, 77:122-135.

Mori RM, Ribeiro ELA, Mizubuti IY, Rocha MR, Silva LDF. 2006. Desempenho reprodutivo de ovelhas submetidas a diferentes formas de suplementação alimentar antes e durante a estação de monta. *Rev Bras Zootec*, 35:1122-1128.

Mukasa-Mugerwa E, Lahlou-Kassi A. 1995. Reproductive performance and productivity of Menz sheep in the Ethiopian highlands. *Small Rumin Res*, 17:167-177.

Nugent III RA, Nottler DR, Beal WE. 1988. Effect of ewe breed and ram exposure on estrous behavior in May and June. *J Anim Sci*, 66:1363-1370.

Official methods of analysis of the Association Official

Analytical Chemists. 1990. 15th ed. Arlington, VA: Kenneth Helrich. 1684 pp.

Ribeiro ELA, Silva LDF, Mizubuti IY, Rocha MA, Silva AP, Mori RM, Ferreira DOL, Casimiro TR. 2002. Desempenho produtivo de ovelhas acasaladas no verão e no outono recebendo ou não suplementação alimentar durante o acasalamento. *Semina Ciênc Agrar*, 23:35-44.

SAEG. Sistema para Análises Estatísticas e Genéticas. 1997. versão 7.1, Viçosa, MG: Universiade Federal de Viçosa. 150 pp.

Silva Sobrinho AG. 1996. *Nutrição de Ovinos***.** Jaboticabal; FUNEP. pp. 119-137.

Tilley JMA, Terry RA. 1963. A two-stage technique for the *in vitro* digestion of forage crops. *J Br Grassl Soc*, 18:104-111.

Traldi AS. 1990. Aspectos reprodutivos dos ovinos. Performance reprodutiva dos ovinos deslanados no Brasil. *In*: Américo Garcia Silva Sobrinho AG (Org.). *Produção de Ovinos*. Jaboticabal: FUNEP. pp. 81-124.

Van Soest P, Robertson JB, Lewis BA. 1991. Methods of dietary fiber, neutral detergent fiber, and nonstarch polysaccharides in relation to animal nutrition. *J Dairy Sci*, 74:3583-3597.

Viñoles C, Forsberg M, Martin GB, Cajarville C, Repetto J, Meikle A. 2005. Short-term nutritional supplementation of ewes in low body condition affects follicle development due to an increase in glucose and metabolic hormones. *Reproduction*, 129:299-309.

Zambom MA, Santos GT, Modesto EC, Alcalde CR, Gonçalves GD, Silva DC, Silva KT, Faustino JO. 2001. Nutritional value of soybean hulls, soybean meal, ground corn and wheat meal for cattle. *Acta Sci*, 23:937-943.