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Influence of low pasture allowance during pregnancy on the attachment between ewes and their lambs at birth and during lactation

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ABSTRACT

Nutrient restriction during pregnancy may negatively affect ewe-lamb attachment at birth. We hypothesised that the difference in the attachment at birth could persist during lactation and, consequently, the emotional response of lambs to a short-term maternal separation test during late postpartum would be affected. The aim of this study was to compare the ewe-lamb attachment behaviours at birth and the behavioural response to a short-term maternal separation test of 3-month-old lambs born from dams that grazed on high or low natural pasture allowance from day 30 to day 143 of gestation. A complementary aim was to determine if milk yield and lambs' BW would be affected by the dams' pasture allowance during pregnancy. Forty-one multiparous single-lambing Corriedale ewes were randomly assigned to two natural pasture allowances: a) high (group HPA: n = 22): the ewes grazed on 14–20 kg of dry matter (DM)/100 kg of body weight (BW)/day; and b) low (group LPA; n = 19): ewes grazed on 6–10 kg of DM/100 kg of BW/day. From day 100 of gestation until lambing, the ewes were collectively provided with 300 g/animal/day of rice bran. From day 143 of gestation until lambs were 3 months old, all animals grazed on natural pasture with unlimited forage availability. Body condition score (BCS) of ewes and BW of ewes and lambs were recorded during the experiment, and udder size was recorded at lambing. Mother-lamb attachment behaviours were recorded at birth and ewes' milk yield was determined at 3 months of age, when lambs were subjected to a short-term maternal separation test. During the treatments, the HPA ewes had greater BCS and BW than the LPA ewes ($p < 0.0001$ for both). Birth weight was greater ($p = 0.0001$) in the HPA than the LPA lambs. At 45 and 91 days postpartum, lambs and ewes from the HPA group tended to be heavier than those from the LPA group ($p < 0.08$ and $P < 0.06$ respectively). The HPA ewes had greater udder volume ($p = 0.002$) at birth and produced more milk ($p = 0.04$) than the LPA ewes. The HPA ewes tended to have a greater frequency of high-pitched bleats ($p = 0.07$) and aggressive behaviours towards an alien lamb ($p = 0.1$) than the LPA ewes. All the other behaviours recorded at birth and variables recorded during the short-term maternal separation test were not affected by the treatment. Low pasture allowance from early gestation until lambing, in association with supplementation in advanced pregnancy, affected ewes' BW, BCS and milk production, lambs' birth weight, and slightly modified ewes' rejection towards an alien lamb. However, it did not modify the main ewe-lamb behaviours at birth and the lambs' emotional response to a short-term separation from their mother at 3 months of age.

1. Introduction

Ewes and lambs establish a mutual and selective emotional bond immediately after parturition (Poindron et al., 2007). They maintain a close relationship during the first weeks after lambing, when ewes allow lambs to suckle every time they require (Ewbank, 1967; Fletcher, 1971). Suckling events decrease gradually with the advancement of lactation (Gordon and Siegmann, 1991; Hernández et al., 2001; Freitas-

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de-Melo et al., 2017a), as the lambs gain nutritional and social independence from their mother (Weary et al., 2008). In wild sheep, the complete independence of the lamb from its dam is observed between 6 and 12 months of age (Geist, 1971; Grubb, 1974). However, in extensive sheep productive systems lambs are abruptly and definitively separated from their dams between 2 and 5 months after lambing (Freitas-de-Melo and Ungerfeld, 2016). Artificial weaning involves different stressors, including the end of the mother-lamb relationship, changes in the physical and social environment (i.e., lambs are housed in a new environment, often with other animals with which they had no previous contact), the end of suckling and an acute nutritional change (the replacement of milk by solid foods) (Freitas-de-Melo and Ungerfeld, 2016). The separation triggers behavioural changes in the lamb, including an increase in the frequency of vocalizations (Orgeur et al., 1999) and the time spent standing, walking and pacing (Freitas-de-Melo et al., 2017b); the latter has been associated with the loss of the mother (Damián et al., 2013). The intensity of the response to separation may be used to determine the strength of the attachment between the ewe and their lamb, which involves the emotional response of both of them (Nowak and Boivin, 2015). Moreover, many factors may affect the response of ewes and lambs to separation during artificial weaning, such as age and sex of the lamb and its nutritional independence from the dam, milk production and feeding of the mother during gestation (Freitas-de-Melo and Ungerfeld, 2016).

The nutrition of sheep in extensive systems is highly dependent on natural pasture availability and quality. During winter, in subtropical areas such as Uruguay, pasture growth is insufficient to provide the nutritional requirements of pregnant ewes (Freitas-de-Melo et al., 2015, 2017a). Thus, during this period, pregnant ewes undergo food restriction, which may affect their body condition during pregnancy and postpartum (Freitas-de-Melo et al., 2015, 2017b), as well as lambs' birth weight, ewes' milk production, and lambs' postnatal growth (Louca et al., 1974; Kenyon, 2013, 2008). Additionally, ewes that are undernourished during pregnancy may develop a weaker attachment to their lambs at birth (Dwyer et al., 2003). For instance, ewes bearing triplets and grazing on low pasture availability during pregnancy are less likely to make contact with their offspring after tagging (Everett-Hincks et al., 2005). Lambs delivered from ewes that graze on low pasture availability during pregnancy display behaviours that indicate a greater need of their mother than those born from mothers that graze on high pasture availability (Corner et al., 2010). In contrast, low natural pasture allowance from before conception until late gestation in ewes does not affect the ewe-lamb behaviours that lead to the establishment of the ewe-lamb bond (Freitas-de-Melo et al., 2015). However, ewes that graze on lower pasture allowance during gestation produce less milk, and their lambs start to graze earlier than those reared by mothers that graze on greater pasture allowance (Freitas-de-Melo et al., 2017b). Thus, at 65 days of age, lambs reared by the former respond less intensively – considering behavioural and physiological changes – to artificial weaning than those reared by mothers that grazed on high pasture allowance during pregnancy (Freitas-de-Melo et al., 2017b). A possible interpretation for this is that lambs reared by ewes that graze on low pasture allowance during their pregnancy are at a more advanced stage of the natural weaning process and therefore have a weaker attachment with their dam.

As nutrient restriction during pregnancy may negatively affect ewe-lamb attachment at birth, we hypothesised that the difference in the attachment at birth could persist during lactation and, consequently, the emotional response of lambs to a short-term maternal separation test during late postpartum would be affected. We predicted that ewes that grazed on low pasture allowance during gestation would present a weaker ewe-lamb attachment at birth, and thus, their lambs would display a lower behavioural response to a short-term maternal separation test during late postpartum. The aim of this study was to compare the ewe-lamb attachment behaviours at birth and the behavioural response to a short-term maternal separation test of 3-month-old lambs born from dams that grazed on high or low natural pasture allowance from day 30 to day 143 of gestation. A complementary aim was to determine if milk yield and lambs' BW would be affected by the dams' pasture allowance during pregnancy.

2. Materials and methods

All the procedures were approved by the Comisión de Ética en el Uso de Animales (CEUA), Facultad de Agronomía (UdelaR, Uruguay).

2.1. Location, animal management and treatments

The experiment was performed at the Estación Experimental Bernardo Rosengurtt, Facultad de Agronomía, Universidad de la República (Cerro Largo, Uruguay; 32° S), using multiparous single-lambing Corriedale ewes and their lambs. At the beginning of the study, the ewes weighed 48.0 ± 1.1 kg (mean ± sem) and had a body condition score (BCS) of 3.52 ± 0.05 (scale 1–5, where 1 = emaciated and 5 = obese; Russel et al., 1969). The ewes remained grazing on natural pastures under extensive conditions and had free access to water. Oestrus were synchronized with an intravaginal sponge impregnated with medroxyprogesterone acetate (60 mg, Syntex, Buenos Aires, Argentina) during 6 days plus a dose of a PGF2alpha analogue (10 mg, Dinoprost tromethamine, Lutalyse, Pfizer, Kalamazoo, MI, USA) and 200 IU of eCG (Novormon, Syntex, Buenos Aires, Argentina) at sponge withdrawal. Thereafter, ewes were joined with marking vasectomized rams painted on the chest (1 male: 10 ewes ratio). The ewes were checked twice a day and marked ewes were inseminated with fresh semen 12 h after oestrus detection (day 0). Pregnancy and foetal number were determined 30 days later with transrectal ultrasound.

Single-bearing ewes were randomly assigned to two different natural pasture allowances from day 30 to day 143 of gestation. Pasture allowance offered to each group along the gestation is presented in Table 1. Twenty-two ewes grazed on high pasture allowance (HPA treatment; nine ewes carrying a male and 13 a female foetus), which consisted of 14–20 kg of dry matter (DM)/100 kg of BW/day. Another 19 ewes grazed on low pasture allowance (LPA treatment; 12 ewes carrying a male and seven a female foetus), which consisted of 6–10 kg of DM/100 kg of BW/day. Pasture availability was determined monthly and adjusted by including or removing "put-and-take" ewes from each paddock according to the BW of all the ewes (Freitas-de-Melo et al., 2015). Each nutritional treatment had three replications in one of three independent paddocks (~3 ha each) separated by electric fences. The HPA treatment had seven ewes in each replication, and the LPA treatment had two replications with six ewes and one replication with eight ewes. From day 100 of gestation until lambing, ewes were daily supplemented with 300 g/animal of rice bran (88% DM, 14% crude protein, 9% acid detergent fiber and 24% neutral detergent fiber) offered in common feeders. From day 143 of gestation until parturition, during daylight all ewes were kept in a paddock of approximately 2.5 ha, grazing on natural pastures. During the night, they were moved to a 40 × 20 m^2 pen with artificial dim light, close to the paddock. From approximately 10 days after parturition until the short-term maternal separation test, all ewes and their lambs grazed in a paddock of

Table 1
Pasture availability during gestation of ewes that grazed on high (HPA) or low pasture allowance (LPA).

Days of gestation	Pasture allowance[a]	
	HPA	LPA
30–60	14	6
61–110	15	5
111–143	20	10

[a] kg of dry matter/100 kg of body weight/day.