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Ewe maternal behavior score to estimate lamb survival and performance during lactation

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ABSTRACT. Mortality of perinatal lambs and low weight at weaning cause huge liabilities to farmers. Current study describes maternal-filial behavior and evaluates the use of maternal behavior score (MBS) to estimate the behavior of ewes and lambs soon after birth, and correlate it with lamb mortality and performance during lactation. Thirty-seven Corriedale ewes were used in a completely randomized design. MBS was assessed up to 24 hours after birth, taking into consideration the distance of the ewe from the lamb at the approach of a person. Maternal behavior, placental weight, weight gain of the lambs until weaning and their survival rate were also evaluated until two hours after lambing. More than 90% of the ewes had adequate maternal behavior, with parental care, even though ewes were very sensitive to the presence of people. There was no significant correlation between MBS and maternal behavior, lamb mortality rate and live weight gain. Under these conditions, MBS was not a useful tool to estimate maternal behavior and performance of lambs.

Keywords: lambing, reactivity, survival, weaning.

Escore de comportamento materno de ovelhas para estimar a sobrevivência e o desempenho de cordeiros durante a lactação

RESUMO. A mortalidade de cordeiros perinatal e o baixo peso ao desmame trazem enormes perdas para os ovinocultores. Este trabalho objetivou descrever o comportamento materno-filial e avaliar o uso do Escore do Comportamento Materno-Filial (ECM) como ferramenta para estimar o comportamento de ovelhas e cordeiros logo após o parto, e correlacionar com a sobrevivência e o desempenho dos cordeiros durante a lactação. Avaliaram-se 37 ovelhas da raça Corriedale em um delineamento completamente casualizado. Até 24h após o parto, avaliou-se o ECM, que considera a distância da ovelha em relação ao cordeiro no momento da aproximação de um avaliador, o comportamento materno até 2h após o parto, o peso de placenta, e o ganho de peso e sobrevivência dos cordeiros até o desmame. Mais de 90% das ovelhas apresentaram comportamento materno adequado, cuidando de suas crias, mas essas ovelhas foram muito reativas na presença do observador. Não houve correlação significativa entre o ECM e o comportamento materno ao parto, a taxa de mortalidade dos cordeiros após o parto e ao desmame, e seu ganho de peso até o desmame. Nessas condições, o ECM não mostrou ser uma ferramenta útil para estimar o comportamento materno e o desempenho de cordeiros.

Palavras-chave: parição, reatividade, sobrevivência, desmame.

Introduction

Since the maternal behavior of pregnant and lactating ewes may be linked to mortality of lambs, experience and temperament should be taken into consideration in the management of sheep flocks (Rech et al., 2008; Corner et al., 2013). In fact, ewe behavior before, during and after lambing has great influence on lamb survival (Grandinson, 2005; Ceyhan, Sezenler, Yüksel, & Yıldırır, 2012; Hinch & O'Brien, 2014) due to the fact that the ability of a lamb to survive until weaning is largely determined by the establishment of maternal-filial bonds and the care and protection given by the ewe (Dwyer, 2008; Bickell, Nowak, Poindron, Ferguson, & Blache, 2010). Evaluation of maternal-filial relationship may be very important, with direct impact on productivity and on sheep production chain.

Ewes express maternal behavior soon after lambing through lamb body cleaning, low intensity bleating and acceptance of the lamb´s approach near the inguinal region (Rech et al., 2011). The selection of sheep by maternal ability through the Maternal

Behavior Score (MBS), described is capable of improving the productive and economic efficiency of sheep production business traditionally assessed by the weaned lamb weights per ewe. Rech et al. (2008) reported that ewes with higher MBS protected their lambs more soon after birth and weaned heavier lambs.

Several factors may influence maternal behavior (Hernandez, Matthews, Oliver, Bloomfield, & Harding, 2009; Corner et al., 2010), such as previous experience, breed, ewe body condition score, nutritional state, production system and other factors. Since young females may show little or no ability (Mariz et al., 2007; Dwyer, 2008; Dwyer, 2014), they reduce lamb viability without human interference. Fear-caused reaction by female sheep was greater in young animals than in older ones (Silveira, Fischer, & Mendonça, 2010). Pickup and Dwyer (2011) reported difference in maternal behavior soon after lambing and during lactation between different ewe breeds, Suffolk and Blackface, in which the former showed poorer maternal ability. According to Grandinson (2005), under extensive production system and with little human supervision, sheep maternal care is more important, and, therefore, the female environment and nutrition are essential for the survival and growth of progeny (Hernandez, Matthews, Oliver, Bloomfield, & Harding, 2010; Hild, Andersen, and Zanella, 2010).

Research papers on maternal-filial behavior of wooly ewe in subtropical conditions and the use of MBS as a tool to estimate their behavior are still scarce. Current study correlated MBS with the performance of lambs until weaning and provided a better understanding of the maternal-filial behavior among ewes and lambs, and their reactions. Evaluation of the maternal ability may be an important tool to improve the sheep production system.

Material and methods

The experiment was conducted at the State Agricultural Research Foundation (Fepagro), Viamão RS Brazil, 30º 04' 51" S and 51° 01' 22" W, between May 2009 and January 2010. Research followed rules and legal requirements on ethical procedures and welfare of animals in scientific experimentation (Process N. 19221 Research Committee of UFRGS/ Faculty of Agronomy).

The study was carried out in a 4.8 hours area with *Brachiaria arrecta* Napper sward. A continuous grazing method was used, and the average herbage allowance was 11.5 kg of dry matter x (100 kg body weight)$^{-1}$. Thirty-seven multiparous Corriedale ewes were used. During the breeding period and before their first lambing, the ewes´ body condition score (BCS) was assessed. The BCS was based on a palpation of the lumbar region of the spine, checking the amount of fat and muscle found between the spinous and transverse process of the vertebras (Russel, Doney, & Gunn, 1969). Lambing occurred between September 21, 2009 and November 9, 2009. Twenty-six among the 37 births were monitored throughout the whole day, from birth till first lamb feeding. During this period, ewe identification, lambing time (morning or afternoon), type of lambing (single or multiple, normal or dystocic), positioning of the ewe in relation to flock (if she was isolated from the herd or not), placenta weight and behavior to lamb were recorded: whether the ewe licked and smelled the lamb(s); whether it facilitated the ingestion of colostrum and vocalized in the direction of the lamb. With regard to the lamb: lamb´s vigor, vocalization, lag of time between birth and standing up, and lag of time from birth till the animal could support itself on all four legs) were registered.

The lambs were weighed and identified between 12 and 24 hours after lambing, using a manual scale, at 10 g precision. Placentas were weighed with a digital scale, at 0.5 g precision. Total placenta weight was calculated by totaling the weight of the placentas of all lambs born per ewe.

At the time of lamb weighing and identification, ewe behavior was assessed by a six-point scale (maternal behavior score, MBS) which assessed the escaping distance of the ewe, adapted from Rech et al. (2008):

1. The ewe runs away when a person approaches; she shows no interest in the lamb(s); she does not emit any vocalization and she does not return to the lamb(s) during the observation period;

2. The ewe flees and remains more than 10 m from the lamb(s), and returns during the period of observation;

3. The ewe flees and remains 5 to 10 m from the lamb(s);

4. The ewe flees and remains between 1 and 5 m of the lamb(s);

5. The ewe remains up to 1 m of the lamb(s);

6. The ewe keeps physical contact with the lamb(s).

MBSs may be grouped into two classes: worse ($\leq$ 2) and better ($>$ 2). The survival rate was calculated by the ratio between the number of lambs per ewe, and the number of those that remained alive in the first 72 hours after birth and at weaning.

Weaning occurred January 10, 2010, when 33 lambs were weaned, with average age of 84 days. Animal performance was evaluated on this day. Body weight was assessed after a previous fasting of solid and liquid of at least 12 hours, using a 0.5 kg precision scale. BCS of lambs and the ewes was evaluated on that day.

The experiment was set up in a completely randomized design, where the ewe was the experimental unit. The continuous variables and normal distribution were submitted to analysis of variance to describe the maternal behavior of the ewe, and were related to lamb performance. The mathematical model used was $Yij = \mu + ti + eij$ where: $Y\,ij$ = value of the variable tested under the i^{th} score level, μ = overall mean for the variable, ti = effect of the i^{th} level of MBS and eij = random error. The Wilcoxon Signed-Rank test, a non-parametric analysis, was performed, using the observed frequencies in the case of qualitative or discrete variables. Correlation analyses were done between variables (Spearman coefficient). Statistical analyses were performed with SAS 9.1 (SAS Institute Inc., Cary - NC, USA).

Results and discussion

Maternal behavior is influenced by the environment and animal handling techniques (Everett-Hincks, Lopez-Villalobos, Blair, & Stafford, 2005) are probably affected by factors such as strain (Dwyer & Smith, 2008), previous maternal experience (Dwyer, 2014) and maternal nutritional status (Dwyer, Lawrence, Bishop, & Lewis, 2003), described in several papers. In current assay, ewes received the same previous management, with uniform nutritional status during the experiment, resulting in similar behavior among the ewes.

Approximately 83% of the ewes kept a distance from the herd to lamb. At lambing, the ewe transforms itself from a highly gregarious animal to an isolated animal because, according to Nowak, Porter, Lévy, Orgeur, and Schaal (2000), isolation is an important step towards the formation of the maternal-filial bond. Besides isolation, most ewes (95.5%) licked and smelled the offspring(s), as described by several authors in other regions of the world (Pickup & Dwyer, 2011). The set of attention behavior, including sniffing, licking and protecting the neonate, serves as an instrument for the formation of a selective maternal-filial bond (Lévy & Keller, 2008). The establishment of the mother-infant bond is essential for the offspring´s survival. Due to this behavior, the lambs receive proper nutrition, protection from predators, suitable environment for their development and social life (Gómez et al., 2010).

Similar to what was reported in relation to insolation attitude and offspring care, the attitude to facilitate the intake of colostrum was observed in 79% of the ewes; the mother's interest in the lamb immediately after lambing was observed in 90% of the ewes; and the vocalization of ewes and lambs after birth was observed in 100% of cases. These observations coincided with those reported in other studies (Everett-Hincks et al., 2005; Rech et al., 2008; Aita et al., 2012). Smell, visual and auditory (vocalizations) stimuli played an important role in the recognition of the lamb by the ewe (Poindron, 2005).

Ewes in current study averaged 2.25 ± 0.84 MBS, indicating high reaction to the presence of a person approaching the lamb. The frequencies of animals in MBS 1, 2, 3, 4 and 5 were respectively 9.1, 69.7, 12.1, 6 and 3%. MBS was not related to the several behavior traits at lambing, such as ewe isolation from the herd, feed facilitation, lick, smell and showing interest in the lamb, possibly because most ewes showed these behaviors almost regardless of their reaction to the person´s approach. This result partly disagree with that in other studies (Everett-Hincks et al., 2005; Dwyer, 2008; Rech et al., 2008), in which most ewes with higher MBS cared and protected more their lambs than those with a lower MBS.

MBS was positively correlated to BCS during breeding ($r = 0.37$, $p < 0.05$), but not related to BCS at lambing. Moreover, results revealing that MBS was not correlated with the weight of the lamb at birth and the weight of the placenta show that there was apparently no close relationship between the ewe´s nutrition at the end of pregnancy (Clarke, Heasman, Juniper, & Symonds, 1998) and maternal-filial behavior. Mariz et al. (2007) found that ewes receiving increased energy intake vocalized and licked more their offspring, but failed to change the lamb´s behavior. This result adds to what was already reported in a recent publication by Asmad et al. (2014) that nutrition during pregnancy of sheep has a limited effect on performance of lambs from birth to weaning. It may be concluded that managements to increase the birth weight of lambs will not have a major effect on improving the maternal behavior to promote the ewe's care for the lamb just after delivery. Arnold and Morgan (1975) reported that in Australia only 16% of lamb deaths were related to inefficient maternal behavior and 23% resulted in the lamb's inability to suckle after standing upright.

Approximately 95% of the lambs were vigorous after birth; they took on average 26 (± 17.8) min to stand up and 40 (± 12.8) min to first feeding (Table 1). Latency time to stand up and have the first feeding were positively correlated (r = 0.88, p < 0.0001), while the lamb vigor tended to be negatively related to latency to stand up (r = -0 45, p < 0.10). It is important for lambs to be able to stand up and show proper search behavior for the udder since they are born with limited energy reserves and require colostrum immediately after birth to survive. Most lambs take less than 30 min to stand up after birth, and 60% ingest colostrum within the first two hours of life (Nowak, Keller, Val-Laillet, & Lévy, 2007). A short time to first feeding is desirable because the survival rate is enhanced for the lambs that stand out and quickly ingest milk (Dwyer et al., 2003). This is due to the fact that lambs with low birth weight have little tissue of body reserves; they are less vigorous at lambing; they have a lower body temperature and they take longer time to stand up and ingest the colostrum (Dwyer & Morgan, 2006). Darwish and El-Bahr (2007) also observed that the increase in lamb´s birth weight was associated with the speed to stand up and ingest colostrum. Assessing the amount of time lambs spend to stand up and suckle, Aita et al. (2012) observed that lambs spent between 5 and 58 min (mean 21 min) and between 9 and 120 min (mean 60 min), respectively, after birth, whereas Rech et al. (2008) reported an average of 23 min (9-62 min) to lift up and 10 min (3-30 min) to suckle.

Table 1. Estimates of correlation (Spearman´s Coefficient) between measures of behavior and performance of Corriedale ewes and their lambs, Viamão, Brazil, 2010.

Correlated Variables	Correlation Coefficient*
SURV72 x TWLAMB	0.57
LAMBBW x PLACWEIG	0.44
MBS x LAMBWW	0.13
MBS x PLACWEIG	0.21
MBS x NLAMBBB	-0.10
MBS x LAMBBW	0.36

*All correlation coefficients were not significant (p > 0.05). LAMBBW– lamb birth weight; PLACWEIG - placental weight; MBS - maternal behavior score; LAMBWW – lamb weaning weight; NLAMBBB - number of lambs born per birth, TWLAMB - total weight of lambs born per ewe; SURV72 - survival rate in the first 72 hours.

The average lamb weight at birth, 5.0 ± 1.1 kg, showed no significant correlation with MBS (Table 1), but was correlated negatively with the number of lambs born per birth (r = -0.34, p < 0.05) and positively with average placental weight (r = 0.44, p < 0.05) and survival at weaning (r = 0.33, p < 0.05). Current assay registered that perinatal mortality of lambs caused by low birth weight, 8.0% in this study, was not affected by MBS. The limited effect of maternal-filial relationship indicates that probably other problems of newborn animals, such as reduced energy reserves, coupled with the difficulties of the environment, are more strongly related to high mortality of low weight lambs, than the maternal-filial behavior.

The lamb weight at birth depends on the type of lambing: single birth lambs are heavier than those in multiple births (Dwyer et al., 2003; Rech et al., 2008), highly correlated with placental weight (Mellor, 1983) and associated with the offspring´s growth and survival potential. In current study, average lamb weights of single and twin born were 4.87 and 3.83 kg respectively. Average placental weights of lambs born from single and twin lambing were respectively 436.89 and 278.57 g. Table 2 shows average body condition score of ewes, live weight of lambs and placentas.

Table 2. Average rates of the performance variables of Corriedale ewes and their lambs, Viamão, Brazil, 2010.

	Mean	Standard Deviation	CV
BCS ewe during breeding (1 to 5)	2,03	0.56	27.60
Ewe weight at lambing (kg)	58.03	4.85	8.37
BCS ewe at lambing (1-5)	2.32	0.51	22.06
Lamb weight at lambing (kg)	4.97	0.893	17.97
Lamb weight at lambing (kg)	384.86	128.29	33.33
Lamb weight at weaning (kg)	19.44	4.56	23.46
BCS lamb weaning (1-5)	2.67	0.51	19.05
Ewe weight at weaning (kg)	45.85	5.29	11.53
BCS ewe at weaning (1-5)	2.72	0.46	16.90

BCS – body condition score; CV – coefficient of variation.

Ewes with low body condition score tend to look for food soon after lambing, leaving or remaining less time in lamb care. Low body condition score and weight of ewe at birth (Table 2) may explain the low MBS because, according to Aita et al. (2012), there is a positive correlation between MBS and lamb weight at weaning (r = 0.42).

Maternal-filial behavior and ewes - lambs performance in current analysis did not differ between animals classified with worse and better maternal behavior score (MBS) (p > 0.05), and showed low correlation between MBS and productive performance of lambs, for example, birth weight and weaning weight (Table 1). These data corroborate with reports by Aita et al. (2012) who also registered low MBS correlation with the age of ewe, with the ewe´s weight at birth and at weaning, the behavior of isolation of the flock before lambing, with the act of licking and smelling of the lamb and vocalization, with the time the lamb spend to stand up and suckle, and with the lamb live weight gain from birth to weaning.

Similarly, Rech et al (2008) found no significant difference with the time lambs spent to stand up, latency to ingest colostrum and the attitude of

cleaning the lamb in relation to MBS. Yilmaz, Karaca, Bingöl, Kor, and Kaki (2011) found no effect of MBS on weaning weight and survival rate of lambs. However, these results differ from the results by Everett-Hincks, Lopez-Villalobos, Blair, and Stafford (2005) and by Ekiz, Kocak, Ozcan, and Yilmaz (2007) in which better MBS occurred in older animals with multiple births.

MBS showed no significant correlation with the performance of ewes and lambs until weaning ($p > 0.05$) (Table 1). According to Everett-Hincks et al. (2005), genetic selection of animals through the maternal-filial behavior in New Zealand is inefficient. Result indicates that it is important to consider the environment and management techniques to improve maternal-filial relationship and lamb survival.

Conclusion

Ewes showed adequate behavior of looking after their offspring, facilitating colostrum intake and vocalizing for recognition. The lack of MBS correlation with the ewe´s behavior at lambing, lamb survival rate and lamb weight gain until weaning limits its use to estimate these attributes.

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