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Preliminary Study of Prolificacy and Maternal Ability on Six Sheep Biotypes in Uruguay

Estudio preliminar de la prolificidad y habilidad materna de seis biotipos ovinos en Uruguay

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Abstract

The results of the first evaluation of the Prolific Sheep Project of INIA (2008-2011) demonstrated that the crossbred biotypes Corriedale by East Friesian or Corriedale by Finnish Landrace weaned 60 % more lambs than pure Corriedale and, on the other hand, the crossbred East Friesian by Finnish Landrace weaned 85 % more than pure Corriedale. However, and under the same productive conditions, the behavior at lambing and colostrum production of these new biotypes are unknown. In order to find out, an experiment was conducted at INIA La Estanzuela, Colonia, Uruguay (34°S; 57°O) where 61 female lambs 4-6 teeth born in the spring of 2010 were evaluated. Two pure breeds were used: Corriedale (C.C) and East Friesian (M.M), and the crosses Finnish Landrace x Corriedale (F.C), East Friesian x Corriedale (M.C), 3/4 East Friesian - 1/4 Finnish Landrace (M.(F.M)), 7/8 Finnish Landrace - 1/8 Corriedale (F.(FxF.C)), mated with Texel rams. The increase in Finnish blood resulted in more prolificacy (2.2; 2.3 and 2.4 for 1/4; 1/2 and 7/8 Finnish with lighter lambs and less lambing assistance. Both half and pure East Friesian had similar and moderate prolificacy (1.8 M.C and 1.7 M.M) whereas lambing assistance was high. Colostrum production and composition was similar between biotypes, with the exception of M.M, that produced more. There were no differences in placental efficiency between biotypes. Birth weight of lambs affected their behavior in the first hour of life, specifically the time from birth to first stand up to suckle.

Keywords: fetal load, maternal behavior duration of delivery, colostrum production, placenta

Resumen

Los resultados de las primeras evaluaciones del Proyecto Ovejas Prolíficas de INIA (2008-2011) muestran que la cruza Frisona Milchschaf x Corriedale o Finnish Landrace x Corriedale desteta 60 % más corderos que la Corriedale pura y, por otro lado, la cruza Finnish Landrace x Frisona Milchschaf desteta 85 % más que la Corriedale pura. Sin embargo y bajo las mismas condiciones productivas, no se conoce el comportamiento al parto y la producción de calostro de estos nuevos biotipos. Para recabar información, se realizó un experimento en INIA La Estanzuela, Colonia, Uruguay (34°S; 57°O) donde se utilizaron 61 borregas de 4-6 dientes nacidas en la primavera del año 2010. Se utilizaron dos razas puras: Corriedale (C.C) y Frisona Milchschaf (M.M) y las cruzas Finnish Landrace x Corriedale (F.C), Frisona Milchschaf x Corriedale (M.C), 3/4 Frisona Milchschaf - 1/4 Finnish Landrace (M.(F.M)) y 7/8 Finnish Landrace - 1/8 Corriedale (F.(FxF.C)), apareadas con carneros Texel. El incremento de sangre Finnish en la cruza redundó en un aumento en la prolificidad (2,2; 2,3 y 2,4 para 1/4; 1/2 y 7/8 Finnish) con corderos más livianos y menor asistencia al parto. Tanto la media sangre

Milchschaf como la pura tuvieron una prolificidad similar e intermedia (1,8 M.C y 1,7 M.M) mientras que la asistencia al parto fue alta. La producción y composición de calostro fue similar entre biotipos a excepción de M.M que produjo más. No existió diferencia en eficiencia placentaria entre biotipos. El peso vivo al nacimiento de los corderos influyó sobre el comportamiento de los mismos en su primera hora de vida, precisamente en el tiempo desde el nacimiento hasta que lograron pararse y mamar.

Palabras clave: carga fetal, comportamiento maternal, largo de parto, producción de calostro, placenta

Introduction

Productive parameters with the greatest impact on the economic result of semi-intensive and intensive ovine systems are the reproductive behavior and maternal ability of sheep (Ganzabal, 2013). Evaluations carried out within the project of integral transfer of the Uruguayan Wool Secretariat (SUL by its Spanish acronym) showed that with weaning of 90% in wool breeds a meat production of 190 kg per hectare can be achieved (SUL, 2006). If terminal crossings with meat-breed rams are performed on the same sheep, meat production can be increased by 26% (Montossi and others, 2013). Likewise, if we change the mother for a prolific biotype, meat production can double with the same wool production (Montossi and others, 2013). Thus, using prolific biotypes as mothers and meat breeds as fathers can reach 150% weaning and 35-38 kg heavy lambs that are slaughtered at six months of age, which implies an annual meat production of 236 to 370 kg/ha and 50 kg/ha of wool (Montossi and others, 2013).

Indeed, the evaluations carried out within INIA's Prolific project (2008-2012), shows that pure Corriedale mothers (C.C), East Friesian (M.M), and Finnish Landrace (F.F) have the weaning potential of 125, 159, and 206%, while crossbred mothers East Friesian x Corriedale (M.C), Finnish Landrace x Corriedale (F.C), and Finnish Landrace x East Friesian (F.M) have the potential to wean 148, 178, and 205%, respectively (Ciappesoni and others, 2014). In this project, measurements at birth were predefined and included only two daily runs to identify born/dead lambs. Therefore, it was not possible to evaluate the behavior at birth, both in colostrum production and in maternal and neonatal behavior of lambs, which escaped the object of study.

The biotypes of the aforementioned study were used for this research, replacing the F.F breed due to its scarce presence in the country and its lack of adaptation by animals that were absorbed on a Corriedale basis (7/8 Finnish Landrace and 1/8 Corriedale, F.(FxF. C)), and the F.M by one of the biotypes that their predictions suggested as promising (3/4 East Friesian and 1/4 Finnish Landrace, Mx(F.M)).

The established objective was to evaluate some characteristics related to reproductive performance in six ovine biotypes, in order to improve our understanding of the factors that may be impacting the overall results of the project.

Material and methods

The general material and methods used in this study are presented in the article by Banchero and others (2014), «Preliminary Study of Growth, Development, and Reproductive Indicators in Females of Six Sheep Biotypes in Uruguay». The animals used and the particular materials and methods are presented below. In this study, only pregnant ewes were taken into account at the time of the diagnosis of gestation and whose gestation came to an end. Two pure races were evaluated: Corriedale (C.C; n = 10) and East Friesian (M.M; n = 10) and the following crosses: Finnish Landrace x Corriedale (F.C; n = 10), East Friesian x Corriedale (M.C; n=14), 3/4 East Friesian - 1/4 Finnish Landrace (M.(F.M); n = 9), 7/8 Finnish Landrace - 1/8 Corriedale (F.(FxF.C); n = 8). The reproductive characteristics evaluated included: prolificacy, lambing assistance, lactogenesis (colostrum production and quality), lambing duration (LD), live weight of lambs at birth (LBW), lamb behavior in their first hour of life, and characteristics of the placenta.

Prolificacy and lambing assistance

In the fall of 2013 all sheep were mated for the first time under natural mount. The service began at the end of March and lasted 32 days. During the mating period all the sheep were jointly managed with three rams of the Texel breed, in order not to favor a certain biotype by assigning possibly superior rams for some of the characteristics studied in the progeny. To diagnose the pregnancy and to know the number of fetuses per ewe, an ultrasound was performed 70 days after the introduction of the rams with an Aloka 500 ultrasound (Tokyo, Japan) and a 7.5 MHz transducer.

All sheep were jointly managed under grazing conditions without supplementation. The grazing was carried out on artificial pastures (alfalfa and red clover; 11 to 27 % CP and 24 to 46 % NDF) and green pastures (ryegrass; 9 to 13 % CP and 25 to 47 % NDF) with a minimum forage allocation of 6 % live weight. Ten days before the first probable date of delivery, all pregnant ewes were managed in a 2 ha paddocks where they were supplied with 1 kg of fully mixed ration (87.7% DM, 17.4% CP; 2.46 MCal of ME/kg DM) per animal and per day.

In addition, they had alfalfa bale *ad libitum* (87.7% DM, 17% CP and 2.3 MCal of ME/kg DM) to cover the pre-lambing requirements (MAFF, 1975).

At lambing, the number of lambs born alive or dead and the assistance at birth, were recorded per ewe. The need for assistance, or not, at lambing was recorded in single-bearing ewes, while multiple-bearing ewes were considered assisted when they needed help in the delivery of at least one of their lambs. The decision to assist delivery was made when there was evidence of malpresentation of the lamb or when there was no progress of delivery in a normally presented lamb, one hour after any limb or head was visualized in the vulva of the ewe (Dwyer and Lawrence, 1999).

Lactogenesis

At the time of delivery, the volume of the udder was recorded, and the lateral and antero-posterior measures of the udder were taken for its calculation, before milking (Bencini and Purvis, 1990). One hour after the last lamb was born, the ewes were injected with 5 IU of oxytocin (Doney and others' technique, 1979), a nipple was completely milked by hand, and weight and viscosity were recorded through Mc Cance and Alexander's score (1959). The total production was estimated as the production obtained in that milking x 2. A colostrum sample (approximately 20 ml) was extracted, which was preserved with Lactopol® (2-Bromo-2- Nitropropane-1,3-diol) and stored at -15 °C until analysis. The composition of the colostrum was analyzed in INIA's milk quality laboratory through a Lactoscan, Milkanalyzer (Nova Zagora, Bulgaria), the percentages of fat, protein, lactose and non-fatty solids were determined.

Lambing duration, weight, and behavior of lambs in their first hour of life

Recordings of each of the lambs included: i) the duration of phase II of the lambing, from the appearance of the hooves to the total expulsion of the lamb (Grunert and others, 1971); ii) birthweight; and iii) behavior in the first hour of life, recording the times in which it attempts to stand (ASt), manages to stand (MSt), attempts to suckle (ASu) and manages to suckle (MSu). It is considered an attempt, when the animal fails to exceed six seconds standing, and success when the lamb stands for at least six seconds (Murphy, 1999).

Placental characteristics

Placentas were weighed and the number and weight of cotyledons were recorded, placental efficiency was estimated as grams of lamb produced per gram of placenta, and cotyledon efficiency as grams of lamb produced per gram of cotyledon.

Statistical analysis

a) Prolificacy and lambing assistance

The weight at the beginning of the service (March 20, 2013) was analyzed using a linear model and the GLM procedure of SAS (Statistical Analysis System, Version 9.2, 2008). A model corrected for the fixed effect of the ewe's biotype was used, also including the type of lambing and age in service. Statistical analysis of prolificacy was performed through the study of the number of lambs born alive per ewe that lambed (TL: 1, 2 or 3). It was analyzed assuming a multinomial distribution (ordered) and cumulative Logit link function. The probability of having greater prolificacy was modeled. Apart from correcting by biotype as a fixed effect, it was also corrected by days from a fixed date (pre-lambing weight measurement) to delivery, as a covariate, aiming to correct the seasonal variations existing during the mating period (for example, variations in ovulatory rate and, consequently, in prolificacy). The analysis was performed using the GENMOD procedure of the SAS statistical package (Statistical Analysis System, Version 9.2, 2008). Contingency tables were used to evaluate lambing assistance by biotype. To detect significant differences, an exact Fisher test was performed.

b) Lactogenesis

The udder volume and colostrum production and composition were analyzed assuming a normal distribution using the GLM procedure of the SAS statistical package (Statistical Analysis System, Version 9.2, 2008). It was corrected by the fixed effects of biotype and type of lambing (1, 2 or 3) of the ewe. As in the previous case, the days from a fixed date (pre-lambing weight measurement) to delivery, were also included in the model, as a covariate, aiming to correct the seasonal variations existing during the delivery period. Contingency tables were made, to evaluate the viscosity and color of colostrum. To detect significant differences, an exact Fisher test was performed.

c) Duration of lambing, weight and behavior of lambs in their first hour of life

(i) Lambs' birthweight was evaluated assuming a normal distribution using the GLM procedure of the SAS statistical package (Statistical Analysis System, Version 9.2, 2008). It was corrected by the fixed effects of biotype, sex and type of lambing (1, 2 or 3)

(ii, iii). The evaluation of the duration of phase II of lambing and the behavior of the lambs, was carried out, as in the previous case, assuming a normal distribution using the GLM procedure of the SAS statistical package (Statistical Analysis System, Version 9.2, 2008). It was corrected by the fixed effects of biotype, sex and type of lambing (1, 2 or 3). Likewise, an alternative model was studied with the inclusion of the lambs' live birthweight, as a covariate.

d) Placental characteristics

The characteristics of the placenta were evaluated assuming a normal distribution, with the same model as for the evaluation of lactogenesis. The P values > 0.05 were defined as non-significant.

Results and discussion

Prolificacy

The ewes presented similar body conditions at the beginning of the service (2.3 ± 0.3 points; mean ± standard deviation). Live weight at baseline was affected by age, type of lambing and biotype (P < 0.0047; P = 0.0415 and P = 0.0007 respectively). The corrected means of the weights at the beginning of the service and their standard errors were: C.C 51.2 ± 2.0; M.M 55.4 ± 2.0; F.C 55.6 ± 1.9; M.C 60.9 ± 1.6; M.(F.M) 61.3 ± 1.9; F.(FxF.C) 53,7 ± 2,0 kg. Prolificacy, in this case, measured as the number of lambs per ewe that lambed, manifested according to expectations, taking into account the breeds that make up the different biotypes.

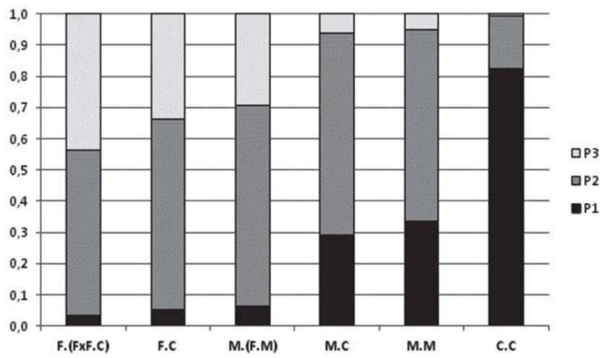
Those with a certain percentage of Finnish had the highest values and doubled the prolificacy of C.C. (2.3 vs. 1.2 respectively). In turn, as the percentage of Finnish increased, so did prolificacy (2.2; 2.3 and 2.4 for 1/4; 1/2 and 7/8 proportion of Finnish blood). This is consistent with what was reported by Goot and others (1984) who presents values of 2.2; 2.5 and 3.0 lambs born per ewe that lambed, per year for 1/4; 1/2 and 3/4 proportion of Finnish blood.

However, Lira (2007) reported minor increases in prolificacy compared to the Corriedale breed, being 1.07, 1.10 and 1.39 (ultrasound fetuses by pregnant ewe) for wombs C.C, 1/4 F 3/4 C and F.C. It is noteworthy that these experiments were carried out in conditions with nutritional limitations where the genetic potential may not have been expressed.

Significant differences (P < 0.05) were found in this research, for the contrasts between F.(FxF.C) - C.C.; between F.C - C.C and between M.(F.M) - C.C. The logarithm of the opportunity ratio (Log OR) for the difference F.(FxF.C) - C.C is 3.97, its exponential (Exp (Log OR)) being 53. This value indicates that the chances of the biotype F.(FxF.C) presenting greater prolificacy is 53 times greater than the opportunities of the C.C (53:1). This is equivalent to saying that the probability that the prolificacy of biotype F.(FxF.C) is greater than that of C.C is 0.982 (Probability = Exp Log OR/(Exp Log OR+1)).

Analyzing the differences in prolificacy according to the type of gestation (Figure 1), the biotype F.(FxF.C) has the highest probability of presenting triple pregnancy (P = 0.44) of all the biotypes evaluated and a probability of 0.53 of presenting a double pregnancy. On the other hand, the probability of C.C. ewes having triple gestation is very low (the lowest of all the biotypes evaluated; P = 0.0058), while the probability of presenting a single gestation is the highest of the biotypes evaluated (P = 0.83). In the F.C.-C.C. contrast, the probability that the prolificacy of the F.C. biotype is greater than that of the C.C. is 0.974.

Figure 1. Probability of a single (L1), double (L2) or triple (L3) type of lambing, depending on the biotype. C.C: Corriedale; F.(FxF.C): 7/8 Finnish Landrace - 1/8 Corriedale; F.C: Finnish Landrace x Corriedale; M.(F.M): 3/4 East Friesian - 1/4 Finnish Landrace; M.C: East Friesian x Corriedale; M.M: East Friesian.



Thomson and others (2004), in Romney-based sheep (R.R.), report differences in prolificacy of 33 % percentage points F.R and R.R in favor of crossbreeds. As for the contrast M.(F.M) - C.C, the probability that the prolificacy of the biotype M.(F.M) is greater than that of the C.C is 0.963. The biotypes

M.C and M.M presented intermediate values of prolificacy (1.8 and 1.7 respectively) and no significant differences were found between them. Although the tendencies reported in the literature are the same, the difference in prolificacy between M.C and C.C presented by Bianchi and others (2000), Barbato and others (2011) and Kremer and others (2010) was only 26, 29 and 12 percentage points respectively; while Thomson and others (2004) found differences of 18 percentage points in favor of M.R. crossbreeds compard to R.R. sheep.

Body weight at the beginning of the service is another factor of great incidence in the determination of OR and, therefore, prolificacy.

For example, Morley and others (1978) reported a 2% increase in lambs born for every extra kg of mating with Australian Merino in Western Australia, while Ganzábal (2005) reported an increase of 1.7% for each extra kg of mating with Corriedale in Uruguay. Thomson and others (2004)

obtained significant effects ($P < 0.05$) of the live weight of the sheep at the beginning of the service on prolificacy, reporting increases of 1.3, 1.1, 0.7 and 1.3 % for each extra kg for F.R, M. R, Poll Dorset (PD). R and R.R respectively. In the present experiment, the LW was significant on prolificacy ($P = 0.0114$), but even when corrected by this factor, the biotype continued to be significant ($P = 0.0068$).

Lambing assistance

The assistance at the ewe's lambing varied between the different biotypes ($P = 0.0001$). The proportion was higher in M.M and their crossbreeds (M.M 50%; M.(F.M) 44.4%; M.C 28.6%).

The F.(FxF.C) were at the other end, no ewe needing assistance. These differences would be explained mainly by the birthweights of their lambs, since all the ewes presented a body condition at lambing, of 2 points (Table 1). Lambs' birthweights differed according to their mother's biotype ($P < 0.0001$) and the type of lambing ($P = 0.0007$). Indeed, Scales and others (1986) found that the proportion of ewes assisted at delivery increased with birthweights above 4.5 kg. In this study, the greatest weight difference was found between lambs born of M.M ewes and lambs born of F.(FxF.C) ewes, this being 1.7 kg in favor of the former. Part of this difference is explained by the type of lambing, where the F.(FxF.C) ewes had greater prolificacy than the M.M. (contrast F.(FxF.C) - M.M, $P = 0.0232$) and lambs from multiple deliveries were 1.0 kg lighter than those from single delivery.

Table 1. Weight and body condition of ewes at delivery.

Biotype	Weight *(kg)	s.d.	Body condition *	s.d.
C.C	52.0	9.3	2.1	0.2
F.(FxF.C)	68.1	8.2	2.3	0.2
F.C	68.1	9.5	2.2	0.2
M.(F.M)	73.6	7.3	2.2	0.2
M.C	67.8	6.2	2.2	0.2
M. M	65.1	6.2	2.0	0.2

C.C: Corriedale; F.(FxF.C): 7/8 Finnish Landrace - 1/8 Corriedale; F.C: Finnish Landrace x Corriedale; M.(F.M): 3/4 East Friesian -1/4 Finnish Landrace; M.C: East Friesian x Corriedale; M.M: East Friesian; *: measurements made on 16 August 2013 (9 days before the first delivery); SD: standard deviation.

Udder development, colostrum production and quality

The udder volume was different according to the biotype (Table 2; $P = 0.0042$). The M.M. ewes presented the highest volume, possibly due to the specialization of this breed in milk production. If we compare the volume of the udder both full and empty (volume of the udder - colostrum weight) between M.M and the biotypes that do not have East Friesian blood in their genetic composition, we see that the former have a full or empty volume of at least twice the latter. However, the volume of the udder was not affected by the type of gestation, unlike what was found by Gigena and Vázquez (2005) in Corriedale sheep, where twin-bearing ewes had larger udders (almost 30% higher) at the time of delivery, than single-bearing ewes ($P < 0.05$).

Colostrum production was also different between the biotypes ($P = 0.0023$), since the MM tripled production relative to the C.C., this being the largest difference found between the different biotypes. In colostrum production, no differences were found regarding type of lambing, coinciding with studies carried out by Pattinson and others (1995). In F.(FxF.C) ewes, colostrum of greater viscosity, with darker shades of yellow was more frequent, while M.M and C.C had more liquid colostrums with lighter shades (P < 0.0001).

Table 2. Udder volume, production of colostrum and its components.

Biotype	Udder Volume (cm3)	s.e.	Colostrum (g)	s.e.	Fat (g)	s.e.	Protein (g)	s.e.	Lactose (g)	s.e.	NFS (g)	s.e.
C. C	1547.3 a	594.9	414.5 a	182.3	66.7 a	27.6	87.6 a	36.5	14.4 a	6.7	105.9 a	44.6
F.(FxF.C)	1416.5 a	533.6	387.3 a	170.7	67.7 a	67.7	80.0 a	47.3	12.2 a	9.1	95.4 a	57.7
F.C	1320.0 a	490.4	496.0 a	158.0	77.0 a	24.3	97.9 a	32.1	17.5 a	6.2	119.9 a	39.2
M.(F.M)	2655.8 ab	508.6	700.2 a	155.3	106.9 a	23.8	134.4 a	31.5	24.3 a	6.0	165.1 a	38.4
M.C	2086.4 a	416.3	730.9 a	127.7	115.6 a	20.9	143.4 a	27.5	25.0 a	5.3	174.8 a	33.6
M.M	3888.8 b	495.2	1224.9 b	152.0	178.9 b	24.5	243.8 b	32.4	42.8 b	6.2	298.4 b	39.5

C.C: Corriedale; F.(FxF.C): 7/8 Finnish Landrace - 1/8 Corriedale; F.C: Finnish Landrace x Corriedale; M.(F.M): 3/4 East Friesian - 1/4 Finnish Landrace; M.C: East Friesian x Corriedale; M.M: East Friesian; s.e.: standard error. Different superscripts in the same column indicate statistically significant differences between biotypes (P<0.05).

The composition of colostrum was similar in the different biotypes (fat: 14.8 to 18.1%; lactose 3.1 to 3.6%, protein 18.7-21.9% and non-fatty solids 22.9-26.3%). However, the fetal load affected the composition (P = 0.0199), particularly the protein concentration being 20.5 ± 0.7% and 22.4 ± 1.1% for twin and triplet-bearing ewes vs. 18.1 ± 0.9% for single-bearing ewes.

The same occurred for the concentration of non-fatty solids (P = 0.0190; 24.8 ± 0.6% and 26.3 ± 0.9% in twin and triplet-bearing ewes vs. 22.5 ± 0.8% in single-bearing ewes).

These data are in line with those observed by Banchero and others (2010), who reported colostrums with 17.9% and 20.7% protein for ewes with single and twin lambs, respectively.

However, Pattinson and others (1995) observed that the concentration of fat, total protein, IgG, ash, and total solids were not significantly affected by litter size. When calculating the grams produced of the main components of colostrum, MMs produce more fat, protein, lactose and non-fatty solids compared to the rest of the biotypes (P = 0.0188, P = 0.0093, P = 0.0179 and P = 0.0086, respectively), explained by the higher volume of colostrum produced. Likewise, the M.M. biotype produced 64-75% more total solids than the M.C and M.(F.M.) biotypes. On the other hand, the MM produced 142, 177 and 193% more total solids than biotypes F.C, C.C and F.(FxF.C).

Placenta: weight, quantity and weight of cotyledons and placental efficiency

Type of lambing and biotype affected placental weight (P = 0.0214 and P < 0.0001 respectively). Single gestations had lighter placentas (0.43 ± 0.07 kg) followed by twin and triplet gestations (0.7 ± 0.04 kg and 1.0 ± 0.08 kg respectively). This was directly related to the total LW of the litter, with the placenta representing between 8.8 and 9.2% of its weight. Within the biotypes, ewes with East Friesian blood and C.C presented the heaviest placentas (Table 3). This is also likely to respond to the LW ratio of lambs to placental weight, where a high, positive, and quadratic-type association between placental weight and lamb's birthweight has been described (Montossi and others, 2005).

Table 3. Placenta weights and individual weight of cotyledons.

Biotype	Placenta (kg)	s.e.	Cotyledon (g)	s.e.
C.C	0.72 a.b.c	0.096	2.37 a	0.47
F.(FxF.C)	0.51 c	0.088	2.06 a	0.43
F.C	0.64 bc	0.077	2.68 a	0.38
M.(F.M)	0.72 a.b.c	0.076	3.13 a.b	0.37
M.C	0.88 a	0.062	3.86 b	0.30
M. M	0.80 a.b	0.078	3.80 b	0.38

C.C: Corriedale; F.(FxF.C): 7/8 Finnish Landrace - 1/8 Corriedale; F.C: Finnish Landrace x Corriedale; M.(F.M): 3/4 East Friesian - 1/4 Finnish Landrace; M.C: East Friesian x Corriedale; M.M: East Friesian; s.e.: standard error. Different superscripts in the same column indicate statistically significant differences between biotypes (P<0.05).

The number of cotyledons and their total weight were affected only by the type of lambing (P = 0.0087 and P = 0.0004 respectively). The placenta of ewes with a single lamb had between 25 and 30% fewer cotyledons (n = 66 ± 6) than ewes with twin or triplet lambs, which did not differ from each other. This is due to the fact that the potential number of cotyledons is limited because the number of caruncles in the ewe is finite (80 to 90; Bottle, 1993), and the highest number is achieved in twin pregnancies without observing an increase with greater fetal loads (Dwyer and others, 2005). As for the total weight of cotyledons, ewes with three lambs had the highest weight (0.33 ± 0.032 kg), this being 37 and 135% higher than ewes with twin and single lambs (P = 0.0024 and P = 0.0001, respectively).

The individual weight of cotyledons was affected by biotype (P = 0.0033) and type of lambing (P = 0.0398). In general, placentas of biotypes with East Friesian blood had heavier cotyledons. On the other hand, ewes with three lambs presented the highest individual weight of cotyledons (3.78 ± 0.39 g), this being 37 and 55% higher than the weight of cotyledons of ewes with twin and single lambs (P = 0.0237; P = 0.0161, respectively). No significant differences were found in the individual weight of cotyledons of ewes with single and twin lambs.

No statistically significant differences were observed between the different biotypes and type of lambing on placental and cotyledonary efficiency. This is in line with the explained above, where the lower the number of cotyledons, the greater their weight, within each biotype.

Duration of lambing, weight and behavior of lambs in their first hour of life

Concerning LD, the time it took for each lamb to be born was determined by the type of lambing (P = 0.0194). Single lambs took 41.7 ± 6.9 minutes to be born, (22-23 minutes longer than lambs in multiple births). These differences are explained by the LBW (P = 0.0088), for each kilogram that increased the LBW, the LD increased by 7.26 ± 2.71 minutes. Single-born lambs weighed more than multiple-birth lambs (P = 0.0007; 4.88 ± 0.24 kg for single lambs vs. 4.03 ± 0.11 and 3.62 ± 0.17 kg for twins and triplets that did not have statistically significant differences between them). Neither the mother's biotype nor the sex of the lambs presented significant differences in LD.

The LBW was affected by the mother's biotype (Table 4; P < 0.0001). As the percentage of East Friesian blood increased, the LBW also increased; conversely, as the percentage of Finnish blood increased, the LBW decreased.

Table 4. Lambs' birthweight and lambing duration.

Biotype	LBW (kg)	s.e.	LD (minutes)	s.e.
C.C	4.20^{bc}	0.27	25.6	8.0
F.(FxF.C)	3.23^{d}	0.22	13.7	6.0
F.C	3.60^{cd}	0.20	21.0	5.5
M.(F.M)	4.35^{b}	0.21	31.1	6.1
M.C	4.74^{ab}	0.19	29.5	5.1
M. M	4.93^{a}	0.23	39.1	6.8

C.C: Corriedale; F.(FxF.C): 7/8 Finnish Landrace - 1/8 Corriedale; F.C: Finnish Landrace x Corriedale; M.(F.M): 3/4 East Friesian - 1/4 Finnish Landrace; M.C: East Friesian x Corriedale; M.M: East Friesian; LBW: Live birthweight; LD: Lambing duration; LBW Corrected by live birthweight; s.e.: standard error. Different superscripts in the same column indicate statistically significant differences between biotypes (P<0.05).

Regarding the lamb's behavior (Tables 5 and 6), none of the studied characteristics (i.e. ASt, MSt, ASu and MSu) were affected by the mother's biotype, type of lambing or sex of the lamb. However, the LBW influenced the times when the lambs managed to stand and suckle (P = 0.0247 and P = 0.0101). For each extra kilogram of LBW, the MSt and MSu times occurred 2.86 ± 1.25 and 10.54 ± 4.00 minutes earlier, respectively.

Table 5. Behavioral characteristics of the lamb (minutes) in its first hour of life according to its mother's biotype.

Biotype	ASt	s.e.	MSt	s.e.	ASu	s.e.	MSu	s.e.
C.C	7.3	1.5	18.3	3.0	23.9	3.0	51.9	8.8
F.(FxF.C)	4.6	1.4	11.3	2.8	21.4	3.0	64.9	7.9
F.C	6.6	1.2	14.1	2.5	17.9	2.6	48.5	7.2
M.(F.M)	7.4	1.2	11.9	2.6	20.7	2.5	49.6	6.0
M.C	7.8	1.0	17.0	2.0	20.5	2.0	57.0	6.0
M. M	8.1	1.3	14.5	2.8	20.6	2.6	48.9	7.9

C.C: Corriedale; F.(FxF.C): 7/8 Finnish Landrace - 1/8 Corriedale; F.C: Finnish Landrace x Corriedale; M.(F.M): 3/4 East Friesian - 1/4 Finnish Landrace; M.C: East Friesian x Corriedale; M.M: East Friesian; ASt: time in which it attempts to stand; MSt: time in which it manages to stand; ASu: time in which it attempts to suckle; MSu: time in which it manages to suckle; s.e.: standard error.

Table 6. Behavioral characteristics of the lamb (minutes) in its first hour of life according to type of lambing.

		ASt	s.e.	MSt	s.e.	ASu	s.e.	MSu	s.e.
Type	1	6.6	1.4	11.8	3.0	16.8	2.9	44.2	8.9
of	2	5.8	0.6	13.4	1.3	21.3	1.2	50.6	3.6
lambing	3	8.4	1.1	18.3	2.2	24.5	2.4	65.7	6.4

ASt: time in which it attempts to stand; MSt: time in which it manages to stand; ASu: time in which it attempts to suckle; MSu: time in which it manages to suckle; s.e.: standard error.

Conclusions

The increase in Finnish blood at the crossings resulted in an increase in prolificacy with lighter lambs and lower lambing assistance. The use of East Friesian blood at the crossing resulted in a lower prolificacy than that obtained with Finnish and greater lambing assistance. Colostrum production and composition were similar among all evaluated crossbred biotypes.

We consider that this study contributes to the knowledge of the behavior of the new prolific ovine biotypes, managed in national conditions, where information is currently scarce. Objective information on the behavior of these animals, both from a productive and reproductive point of view, is required to generate robust technologies. Similar studies should be repeated with a higher number of animals so as to have results that allow drawing conclusions with greater confidence.

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