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Influence of lambing type on body weight changes and productive efficiency of Blackbelly × Pelibuey multiparous ewes in lactation Technical note

Influencia del tipo de parto sobre los cambios de peso y eficiencia productiva de ovejas multíparas Blackbelly × Pelibuey en lactación Nota técnica

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ABSTRACT

During lactation, ewes have a high demand for nutrients, which is frequently not met by voluntary intake in grazing, a situation that causes a reduction in body weight. The objective of this study was to determine the influence of the type of lambing and number of week postpartum on the change in body weight of multiparous hair ewes and that of their lambs during lactation. The study was carried out with productive information from 11 Blackbelly × Pelibuey ewes at their fourth lambing and their 17 lambs. Ewes and lambs were weighed at lambing and every seven days until day 56 postpartum and daily weight gain was recorded. GLM and MIXED procedures were used for statistical analysis. Type of lambing affected the body weight at day 56 postpartum, weight gain during lactation, daily weight gain during lactation ($P<0.05$) and their productive efficiency ($P<0.01$). Number of weeks pospartum affected their daily weight gain of ewes and lambs ($P<0.01$). Type of lambing × number of weeks pospartum had no influence ($P>0.05$) on daily weight gain of lambs. Then it was concluded that in multiparous Blackbelly × Pelibuey ewes, type of lambing explains the variation in body weight changes and productive efficiency. While number of weeks pospartum explains the variation in daily weight gain of ewes and lambs.

Key words: Humid tropics; litter; postpartum; pre-weaning growth

RESUMEN

Durante la lactancia las ovejas tienen una alta demanda de nutrientes, que frecuentemente no es cubierta mediante el consumo voluntario en pastoreo, situación que origina una reducción del peso vivo. El objetivo fue determinar la influencia del tipo de parto y número de semanas posparto sobre el cambio de peso vivo de ovejas de pelo multíparas y el de sus corderos durante la lactancia. El estudio se realizó con información productiva de 11 ovejas Blackbelly x Pelibuey en su cuarto parto y sus 17 corderos. Las ovejas y corderos se pesaron al parto y cada siete días hasta el día 56 posparto, y se determinó la ganancia diaria de peso. Se utilizaron los procedimientos GLM y MIXED para el análisis estadístico. El tipo de parto afectó el peso vivo de las ovejas al día 56 postparto, ganancia de peso total y diaria durante la lactancia ($P<0.05$) y su eficiencia prodcutiva ($P<0.01$). El número de semana posparto afectó la ganancia diaria de peso de ovejas y corderos ($P<0,01$). El tipo de parto x número de semanas posparto no influyeron ($P>0,05$) sobre la ganancia diaria de peso de los corderos. Se concluyó que en ovejas Blackbelly x Pelibuey multíparas, el tipo de parto explica la variación en los cambios de peso y eficiencia productiva de las ovejas. Mientras que el número de semanas posparto explica la variación en la ganancia diaria de peso de las ovejas y corderos.

Palabras clave: Trópico húmedo; camada; posparto; crecimiento predestete

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INTRODUCCIÓN

Multiparous ewes (*Ovis aries*) acquire importance in the structure of a flock because this type of ewes has the highest representation and productivity with respect to primiparous ewes [1, 2]. Ewe productivity is determined during lactation, so it is important to identify the factors that affect it. Body weight at lambing is one of the factors that affect the productive efficiency of ewes, where ewes with a higher body weight than the average weight produce litters with a higher weaning weight than ewes with a lower body weight than the average body weight [3]. A higher body weight at lambing may be related to a greater amount of body reserves, which are important to support milk production when the voluntary intake of ewes under grazing conditions in hot humid climate does not allow covering nutritional requirements [4, 5]. However, further studies are required to identify the factors that affect the daily weight gain (DWG) of ewes and lambs throughout lactation, with the purpose of proposing nutritional management options to optimize their productive efficiency.

The number of lambs at birth is another factor that has a marked influence on the productive efficiency of lactating ewes, where litters consisting of two or three lambs have higher birth and weaning weights relative to litters of one lamb; so the type of birth is a factor that should be considered in studies aimed at identifying the causes of variation in the productive efficiency of ewes [2, 6]. The objective of this study was to determine the influence of the type of lambing on the productive efficiency of multiparous ewes. Collaterally, the effect of the lambing type and number of weeks postpartum of multiparous hair ewes on their body weight change and that of their lambs during lactation was determined. As well as the relationship between daily weight gain of the ewe and daily weight gain of the lamb

MATERIALS AND METHODS

Animal care

The animals were treated in accordance with the guidelines and regulations for animal experimentation indicated in Mexican Official Standards [7, 8], on humane treatment in animal mobilization and on technical specifications for the production, care and use of laboratory animals, respectively.

Animals

Eleven multiparous Blackbelly × Pelibuey ewes and their 17 lambs were used. All ewes were in their fourth lambing (six with single lambing and five with multiple lambing). The study was conducted at an experimental sheep unit of the Instituto Nacional de Investigaciones Forestales, Agrícolas y Pecuarias located in Huimanguillo, Tabasco, Mexico.

Location

The municipality of Huimanguillo is located at 17°50′ N | 93°23′ W, at an altitude of 20 masl. It has a warm climate with year-round rainfall (Af) and a mean annual temperature of 27.8°C [9]. The study was developed during the northern climatic season (November 2020 to February 2021) and had a duration of 73 days (d). During this period, information was available for the following climatic indicators: minimum and maximum ambient temperature (°C) and accumulated rainfall (mm). The average minimum and maximum ambient temperatures were 19.0°C and 30.7°C, respectively; the accumulated rainfall during the study period was 232.5 mm.

Management of ewes prior to lambing

The ewes were fed 30 d prior to the probable lambing date based on grazing and supplemental feeding. Grazing was carried out on a pasture with *Cynodon plectostachyus* in an area of 1.0 ha, which was divided into ten sections of variable size. Grazing had a duration of 10 hours –h– (08:00–18:00 h) and was of rotational type (on average the periods of occupation were 3 d in each of the sections for 28 d of rest). In the grazing sections there were areas with natural shade provided by *Erythrina americana* Miller trees.

Feed supplementation consisted of offering commercial feed (300 g·animal^{-1}·d^{-1}, 15% crude protein) and mineral salt (Foscamag ®) at liberty during night housing. The amount of feed supplement was offered on a group basis. Ewes received in the fourth month of gestation an application of doramectin (Dectomax® 1 mL·50 kg body weight^{-1}) for the control of gastrointestinal parasites.

Ewes management during lactation

Lactation duration was 56 d. The ewes were fed during the entire lactation based on grazing and supplemental feeding. Grazing was on a pasture with a total area of 1.0 ha grazed with *C. plectostachyus* and were managed in a similar manner as described for pre-lambing management. Feed supplementation consisted of offering commercial feed (500 g·animal^{-1}·d^{-1}, 15% crude protein) and mineral salt (Foscamag ®) at liberty during night housing.

In the first postpartum week, the ewes were stabled with her litters and received *C. plectostachyus* hay as a grazing substitute. In the second postpartum week, the ewes went out to pasture for 6 h (8:00–14:00 h) and the rest of the day they were with their litters, receiving *C. plectostachyus* hay. From the third week postpartum, the ewes went out to graze for 10 h (8:00–18:00 h).

Lambs management from birth to weaning

At birth, lambs were identified, weighed and a methylene blue solution was applied to the umbilicus. In the first two hours, lambs were checked for colostrum intake and meconium excretion.

The lambs were kept during the entire lactation in stabling (pen with a surface area of 77 m^2). Feeding was based on controlled suckling, access to a commercial feed supplement (15% crude protein) and hay of *C. plectostachyus* and *Gliricidia sepium* (Jacq.) Walp. The control of access to suckling was applied from the second week of life of the lambs for 6 h (8:00 to 14:00 h), later increased to 10 h (8:00 to 18:00 h) until the end of lactation. The feed supplement was offered starting at 5 d of age, beginning with 100 g·lamb^{-1}·d^{-1} and was offered as a group.

The total amount of feed supplement was divided into three portions and offered at the following times: 8:00, 12:00 and 16:00 h. From day 15 of age, the lambs were given free range hay of *C. plectostachyus* and *G. sepium*.

Lambs growth during lactation

The lambs were weighed at 7–d intervals, from birth to the age of 56 d. A clock scale with a capacity of 20 kg and a sensitivity of 25 g (TecnoCor®, DGN 312.01.2005.2576, Mexico) was used.

Response variables

In ewes: a) body weight (kg) at lambing and at 7–d intervals until they were 56 d postpartum; b) total weight gain (kg) and DWG (g) between lambing and 56 d of lactation; c) DWG (g) between 7–d periods until

56 d of lactation; d) and productive efficiency of the ewe [10]; e) body condition, a scale with 5 levels was used to subjectively measure body condition (1: Emaciated, 2: Thin, 3: Average, 4: Fat and 5: Obese [11]. This parameter was measured prior to parturition and at the end of lactation.

In the litter: a) litter weight at birth and at day 56 of age (kg), b) total weight gain (kg) and DWG (g) during lactation.

In lambs: a) body weight (kg) at birth and at 56 d of age, and b) DWG between 7–d periods.

Experimental design and statistical analysis

All analyses were performed with the SAS v 9.1 statistical package [12] and the normality and homoscedasticity of the data were tested with Shapiro–Wilk's and Levene's tests, respectively. Type of lambing and productive efficiency of the ewe and litter. A design completely randomized was used, where the main factor was the type of lambing of the ewe (single and multiple). The experimental unit was the ewe in response variables recorded in the ewes, for example, body weight at lambing. The experimental unit was the litter in response variables recorded in the litter, for example, weight of the litter at birth. In the final model, weight at lambing was used as a covariate (P<0.05) to explain the variation in the response variables: body weight of the ewes on day 56 postpartum, weight gain during lactation and DWG during lactation. The influence of type of lambing on the continuous–type response variables was established with the GLM procedure. The body condition variable was analyzed with the Wilcoxon rank sum test for unpaired data [13].

Type of lambing and productive efficiency of lambs: A design completely randomized was used, where the main factor was the type of birth of the lamb (single and multiple). The experimental unit was the lamb. The data were analyzed whit GLM procedure.

Type of lambing and number of weeks postpartum: A factorial experimental design with two factors with repeated measures in one factor was used to evaluate the DWG in lambs and ewes over time. Type of lambing was considered as fixed effects; and number of weeks postpartum (eight weeks) as a repeated within–animal measure; the interaction type of lambing × week number and animal, as a random factor. The experimental unit was the lamb in response variables recorded in the lambs and the ewe in response variables recorded in the ewes. The influence of type of lambing, number of weeks postpartum and the type of lambing × number of weeks postpartum interaction on DWG was determined with the MIXED procedure.

In the final models, the type of lambing × number of weeks postpartum interaction was excluded because it was not significant (P<0.05). Least squares means were calculated and separated using the PDIFF option. Least square means values were considered statistically significant when P≤0.05.

Correlation analyses: Spearman correlation was used to establish the relationship between DWG of the ewe and DWG of the lamb (by week), according to type of birth.

RESULTS AND DISCUSSION

Type of lambing and productive efficiency of the ewe and litter. In ewes, type of lambing affected the body weight at day 56 postpartum, weight gain during lactation, DWG during lactation (P<0.05) and their productive efficiency (P<0.01), the rest of the variables were not affected by type of lambing (P>0.05) (TABLE I). Ewes with single lambing reduced their live weight to a greater extent on day 56 postpartum compared to ewes with multiple lambing, a result that contrasts with that indicated in hair ewes with multiple type of lambing have a greater reduction in their body weight during lactation with respect to those with single type of lambing [14, 15].

The higher productive efficiency of ewes with multiple type of lambing is explained by a higher production of kilograms of lambs per postpartum day 56 due to a higher number of lambs in the litter and by a higher production of milk to feed the litter [16]. Additionally, ewes with multiple type of lambing could have a higher dry matter intake during grazing, which would support the nutrient demand for milk production in litters with more than one offspring [17]. In this regard, in ewes a higher dry matter intake (111.2% of body weight) has been detected in ewes with multiple type of lambing compared to the dry matter intake of ewes with single type of lambing [15].

In the litters, type of lambing affected all the productive variables studied (P<0.05) (TABLE I). The higher litter weight at birth and at weaning is explained by the greater number of lambs comprising the litter. In agreement with the previous result, litter weight at birth and at weaning in multiparous ewes with a double type of lambing, represented 177% and 152%, respectively, of that of litters from a single type of lambing [15].

Type of lambing and productive efficiency of lambs.

Type of lambing did not affect birth weight (P>0.05). However, type of lambing influenced weaning weight and pre–weaning DWG of lambs (P<0.01) (Table II). Weaning weights and DWG of lambs from a multiple type of lambing represented 82% and 81%, respectively, of that recorded in lambs from a single type of lambing.

TABLE I
Productive efficiency of multiparous Blackbelly × Pelibuey ewes and their litters considering their type of lambing

Variable	Type of ewe lambing	
	Single (n=6)	Multiple (n=5)
Ewe		
Weight at lambing (kg)	$37.5^{\S} \pm 1.9$	42.0 ± 2.1
Weight at day 56 postpartum (kg)	$31.8^{b} \pm 1.0$	$35.6^{a} \pm 1.1$
Weight gain during lactation (kg)	$-7.7^{a} \pm 1.0$	$-4.0^{b} \pm 1.1$
Daily weight gain during lactation (g)	$-138^{a} \pm 18$	$-71^{b} \pm 21$
Body condition at lambing	4.0 ± 0.0	3.8 ± 0.3
Body condition at day 56 postpartum	3.7 ± 0.2	3.4 ± 0.2
Production efficiency [¤]	$0.48^{d} \pm 0.03$	$0.73^{c} \pm 0.04$
Litter		
Birth weight (kg)	$3.1^{b} \pm 0.6$	$6.0^{a} \pm 0.7$
Weaning weight (kg)	$14.8^{d} \pm 1.5$	$26.8^{c} \pm 1.6$
Weight gain during lactation (kg)	$11.8^{d} \pm 1.0$	$20.9^{c} \pm 1.1$
Daily weight gain during lactation (g)	$210^{d} \pm 17$	$373^{c} \pm 19$

n: number of observations, [§]: Least squares means ± standard error, [¤]: Lamb weight at 56 days of age (kg) / ewe weight at 56 days postpartum, [a,b]: values with different superscript within the same row indicate significant difference (P<0.05), [c,d]: values with different superscript within the same row indicate significant difference (P<0.01)

Pelibuey ewes with a multiple type of lambing produced at least 18% more milk relative to those with a single type of lambing [16, 17]. However, lambs coming from a multiple type of lambing have to share the amount of milk produced by the ewe which could lead to a lower milk consumption per day and consequently of nutrients [18, 19]; this situation may explain the lower productive performance of lambs coming from a multiple type of lambing with respect to those from a single type of lambing.

TABLE II
Influence of the lambing type on weight and pre-weaning daily weight gain of lambs from multiparous Blackbelly × Pelibuey ewes

Variable	Type of lambing	
	Single (n=6)	Multiple (n=11)
Birth weight	3.1 ± 0.2[§]	2.7 ± 0.2
Weaning weight (kg)	14.8[a] ± 0.61	12.2[b] ± 0.45
Daily preweaning weight gain (g)	210[a] ± 11	169[b] ± 8

n: number of observations, [§]: Least squares means ± standard error, [a,b]: Different letters within the same row indicate significant difference (P<0.01)

Type of lambing and number of weeks postpartum

Type of lambing and the type of lambing x number of weeks postpartum interaction did not influence (P>0.05) the DWG of ewes during the eight weeks of lactation. However, number of weeks postpartum affected (P<0.01) DWG (FIG. 1). The greatest reduction in body weight was detected between the second and third postpartum week, a period in which the peak of milk production has been found to occur in the multiparous Pelibuey ewe with single and twin type of lambing [17].

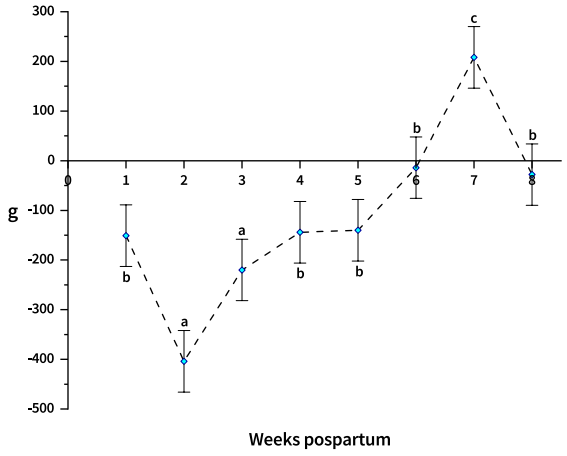

FIGURE 1. Daily weight gains in multiparous Blackbelly × Pelibuey ewes during lactation. a,b,c: different letters at each point on the line (number of weeks postpartum) indicate significant difference (P<0.01)

The type of lambing and number of weeks postpartum of lamb age affected their DWG (P<0.01) (FIG. 2). The type of lambing x number of weeks postpartum interaction did not influence the DWG of lambs (P>0.05). Lambs reduced their DWG from week four of age until week five, after which an increase was detected. This type of trend in pre-weaning DWG could be associated with an increase in the body weight of lambs and in their nutrient requirements, which are not covered by the amount of milk produced by the ewes. In this regard, in Pelibuey ewes it is indicated that from the fourth week of lactation there is a decrease in milk production, both in ewes with single and multiple type of lambing [17] or no significant increase in milk production is detected [16, 20]. On the other hand, in Pelibuey lambs with restricted suckling, there is a lower DWG in the first three weeks of life in relation to lambs with continuous suckling [21]. It is possible that the amount of milk consumed by the lambs during the evening-night (free suckling) did not compensate for the amount of milk that the lambs stopped ingesting during the period of controlled suckling during the daytime [22].

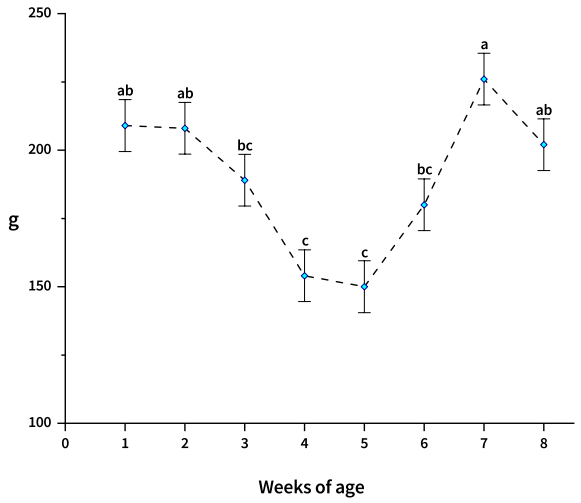

FIGURE 2. Daily pre-weaning weight gain in Blackbelly x Pelibuey lambs considering the number of weeks of age. a,b,c: different letters in each point of the line (number of weeks of age) within the same line indicate significant difference (P<0.01)

In Pelibuey lambs from primiparous and multiparous ewes, a reduction in pre-weaning DWG has been recorded between day 10 and 30 of age and subsequently an increase in DWG between day 30 and 60 of age [23]. The previous result has certain similarity with the influence of the number of weeks of age on DWG detected in the present study, where lambs reduce their DWG in the intermediate stage of lactation, a circumstance that could be associated to the feeding system of the ewe and her litter, the tendency in the milk production curve and the digestive adaptation process of the lamb to the complement offered.

On the other hand, no relationship between DWG of the ewe and DWG of the lamb (P>0.05), according to type of birth (Table III).

Table III
Phenotypic correlation matrix between daily weight gains in multiparous Blackbelly × Pelibuey ewes during lactation and average daily weight gain of lambs (by week), according to type of birth

Lactation week	Type of birth	
	Single (n=6)	Multiple (n=11)
1	-0.15 ns	-0.62 ns
2	0.52 ns	0.59 ns
3	0.70 ns	-0.25 ns
4	-0.49 ns	0.11 ns
5	-0.52 ns	0.53 ns
6	0.79 ns	0.16 ns
7	0.60 ns	0.36 ns
8	-0.72 ns	0.20 ns

n: number of observations, ns: non significant (P>0.05)

CONCLUSIONS AND IMPLICATIONS

In multiparous Blackbelly × Pelibuey ewes in lactation, type of lambing affected the body weight change during lactation and its productive efficiency. Additionally, number of weeks postpartum explains the variation in DWG, with a negative daily weight change occurring during the first six weeks postpartum. Ewes with multiple type of lambing produce litters with higher weaning weights, but lighter lambs with respect to ewes with single type of lambing. In Blackbelly × Pelibuey lambs, variation in pre-weaning DWG was explained by type of lambing and number of weeks of age. Between the fourth and fifth week of lamb age, there was a reduction in DWG in relation to the first two and last two weeks of lactation.

Conflicts of interest

The authors declare no competing interests.

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