Livestock Science 143 (2012) 24–28

Contents lists available at SciVerse ScienceDirect

Livestock Science

journal homepage: www.elsevier.com/locate/livsci

Ovarian activity in F1 prepubertal ewe lambs under tropical conditions

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ARTICLE INFO

Article history:
Received 10 March 2010
Received in revised form 12 August 2011
Accepted 12 August 2011

Keywords:
Ewe lamb
Puberty
Follicle
First ovulation
Genotypes

ABSTRACT

Seventy crossbred ewe lambs, born from Pelibuey (PB) dams mated with five sire breeds: White Dorper × PB (WD × PB), Black Head Dorper × PB (BHD × PB), Ile de France × PB (Ile × PB) Katahdin × PB (KT × PB) and Pelibuey (PB × PB), were used to determine age and weight to puberty, follicular populations during prepubertal development, ovulation rate at first ovulation and function of the first corpus luteum (FCL). Ewe lambs were maintained under grazing conditions and were supplemented with 300 g head^{-1} day^{-1} of a concentrate with 14% CP and 3.0 Mcal ME kg^{-1} of DM. From 145 days of age, monthly observations were performed by endoscopy to monitor follicular populations and luteal structures. Ovarian follicles were classified according to size into small (≥1 and <3 mm), medium (≥3 and ≤4 mm) and large (>4 mm). Additionally, weekly observations by ultrasonography were performed in four ewes per genotype to assess follicular populations. Luteal function from first ovulation was determined by circulating concentrations of progesterone. Ovulation rate was not affected by genotype ($P>0.05$). All breed groups had the same pattern of follicular populations, where most of follicles were small, followed by medium and a small proportion of large follicles. Maximum diameter of follicles was similar for all genotypes during prepubertal development ($P>0.05$), with an average range of 3.9 ± 0.20 to 4.4 ± 0.20 mm. The BHD × PB reached puberty at the youngest age of 240.9 ± 13.0 days, compared to all other genotypes ($P<0.05$), 259.1 ± 11.7 for WD × PB, 279.3 ± 9.6 for KT × PB and 289.0 ± 15.3 days for PB × PB and 308.6 ± 11.9 days for Ile × PB ewe lambs. Ile × PB had greater weight to first ovulation (31.5 ± 1.19 kg) as compared to other breed groups ($P<0.01$). The largest percentage of FCL was for KT × PB ewes (100%) ($P<0.05$), followed by BHD × PB (88.9%), PB × PB (83.3), WD × PB (78.6%) and Ile × PB (77.8%). There were no differences in ovulation rate attributable to type of lambing from which ewe lambs came from ($P>0.05$). BHD × PB ewe lambs reached puberty at an earlier age than other in this study. KT × PB ewe lambs had the highest percentage of FCL in their first ovulation. Breed of sire Ile de France increased weight to puberty and decreased FCL at first ovulation. In conclusion, the BHD × PB ewe showed puberty at an earlier age than other genotypes, while the KT × PB had the highest percentage of functional corpus luteum in their first ovulation. Ewe lambs coming from single lambings reach puberty at a heavier weight than those coming from multiple lambings. The ovulation rate in the first ovulation of ewe lambs is not affected by genotype and type of lambing.

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doi:10.1016/j.livsci.2011.08.011

1. Introduction

The industrial systems for meat production in the world have based their strategy in crossbreeding. This has had as an objective to use the hybrid vigor or heterosis by including desirable traits of two or more breeds in the same animal (Velásquez, 2006). In recent years, with the development of new hair sheep breeds crossbreeding has become popular in tropical areas. Here crosses of Pelibuey sheep with new genotypes as Dorper, Katahdin and recently Ile de France, which are used primarily as sire breeds can be found.

One of the most important reproductive and productive characteristics of ewes, which is affected by the sire breed is age at puberty (Dickerson and y Laster, 1975; Kridli et al., 2006; Lammoglia et al., 2000). Under tropical conditions, there is little evidence of the sire breeds mentioned above crossed with Pelibuey dams and the effects on prepubertal development of their F1 daughters. Most importantly, no data exists on physiological and endocrine events reflected in ovarian activity during prepubertal development and fertility of F1 ewe lambs.

Therefore, it is important to know the effect of sire breeds (Dorper, Katahdin and Ile de France) crossed with Pelibuey ewes on ovarian activity of F1 daughters during prepubertal development and to know the reproductive potential that they can develop under tropical conditions. The characterization of these new genotypes with regards the ovarian activity of prepubertal ewe lambs can help in making smart decisions about the appropriate time to include them into the breeding flock. The objective of this study was to characterize age at first ovulation, function of first corpus luteum and ovarian follicular population during prepubertal development of F1 and pure Pelibuey ewe lambs under a semi-intensive system.

2. Material and methods

2.1. Location

The study was conducted in Mocochá Research Station in Yucatan, Mexico, located at 21° 05′ N and 89° 32′ W, at 8 meters above sea level, with Aw_0 climate (Köppen, modified by García, 1988), with 900 mm rainfall and an average annual temperature of 29 °C.

Animals and feeding: that 70 crossbred ewe lambs were the offspring of Pelibuey dams that were mated with five sire breeds. Hence, the resulting offspring ewe lamb was examined by sonar to monitor ovarian activity.

Seventy crossbred ewe lambs, offspring born from Pelibuey (PB) dams that were mated to five sire breeds were used: White Dorper × PB (WD × PB), Black Head Dorper × PB (BHD × PB), Ile de France × PB (Ile × PB), Katahdin × PB (KT × PB) and Pelibuey (PB × PB). From weaning at 90 days of age, ewe lambs were kept through the whole study under grazing conditions in African Star grass (*Cynodon plectostachius*) paddocks and supplemented with 300 g head^{-1} day^{-1} of a 14% CP and 3.0 Mcal ME kg^{-1} of DM concentrate.

2.2. Ovarian monitoring

Follicular population and size as well as first luteal structure of all ewe lambs were determined by monthly laparoscopies starting at 145 days of age, using a laparoscope of 7 mm diameter, previous infiltration with lidocaine 2% in the puncture site. Laparoscopies were performed until the first ovulation was detected, through visualization of a luteal structure on surface of the ovary. Additionally, in order to monitor ovaries more closely, weekly ultrasonography using an Aloka SSD 500 equipment with a transrectal linear transducer of 7.5 MHz, was performed in four ewe lambs of each genotype to determine the maximum follicle size and total follicular populations, as well as to detect the first luteal structure (Viñoles et al., 2002). Ovarian follicles were classified according to size into small (≥ 1 and <3 mm), medium (≥ 3 and ≤ 4 mm) and large (>4 mm). Also the maximum follicular diameter in each measurement was recorded (Herrera et al., 2008).

2.3. Blood samples and hormone analysis

To determine corpus luteum function, blood samples were collected via jugular vein twice a week in all ewe lambs. Blood sampling initiated at 120 days of age until a subsequent cycle after detection of a luteal structure. Corpus luteum function was determined by circulating concentrations of progesterone (P4) in serum by RIA in solid phase. A functional CL was determined when two or more consecutive blood samples had progesterone concentrations equal or greater than 1 ng ml^{-1} (Sangha et al., 2002). Additionally, estrus was detected twice daily at 6:00 and 17:00 h for 1 h with the aid of androgenized females (Quintal et al., 1988).

2.4. Statistical analysis

Variables evaluated considered age and weight at puberty, size and number of follicles, largest follicle size, age at first ovulation, function of first corpus luteum and ovulatory rate. Data analysis was performed using the statistical package SAS (Statistic Analysis System, 2000). The age and weight at puberty and ovulation rate was analyzed using a model of fixed effects for a completely randomized design with factorial arrangement of genotype and type of lambing. Data of size and follicular population were analyzed by ANOVA in a repeated measures mixed model. Luteal function was analyzed by chi-square.

3. Results

No difference was found due to genotypes on the population of small follicles ($P>0.05$). However, a significant effect was observed in the population of medium size follicles, where genotype Ile × PB and PB had the highest population with 2.0 ± 0.2 and 2.2 ± 0.4 follicles ($P<0.05$). The lowest population of follicles found in this category was for the BHD × PB ewe lambs, with 1.0 ± 0.2 follicles. The PB ewe lambs had the highest population of large follicles with 0.82 ± 0.13 as compared to other genotypes (0.36 ± 0.08, 0.35 ± 0.10, 0.34 ± 0.09 and 0.30 ± 0.09 for Ile, KT, BHD and WD, respectively) (Table 1).

A significant decrease in small follicles populations was observed as age of the ewe advanced ($P<0.05$); with 10.0 ± 1.0 follicles from the 179 days to 5.4 ± 1.2 follicles at 330 days of age (Fig. 1). There were no differences at any age for medium follicle populations, with a range of $2.0 \pm$