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Original Article

Onset of reproductive activity of white and natural colored corriedale ewe labms

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The objective of this study was to estimate differences in growth, plasma progesterone (P_4) and age at puberty between white and natural colored Corriedale ewe lambs. Thirty ewe lambs with average age of 12 months were randomly allocated to genetic groups: white (WC, n = 15) and natural colored (NC, n = 15). Ewes were maintained under extensive grazing conditions on natural pasture, and herbage mass was estimated over a 28-day experimental period. Morphometric measurements (front and hind height, body length, thoracic perimeter, rump length and width, wool fiber length), body condition score (CC) and weight were taken at 28-day intervals. There was no effect of genetic group on body weight, average daily gain and morphometric measurements ($P > 0.05$). The WC ewe lambs had longer fiber length ($P < 0.05$). Plasma P_4 was similar between genotypes ($P > 0.05$); however, it increased above 1ng ml^{-1} in NC from January onward and in WC from March onwards. Estrus was detected at the same time in both groups. The results of this study indicate that both genetic groups have similar growth patterns and ovarian activities.

INTRODUCTION

Brazil has a sheep herd of 18.4 million heads (IBGE, 2016). The state of Rio Grande do Sul account for 21.5% of this population and for the highest national annual production of meat and wool. The sheep herd is mainly formed by wool and double purpose (wool-meat) specialized breeds, among which Corriedale sheep are the most representative.

During many years, sheep were selected for white-colored wool production; nevertheless, natural colored animals commonly appear in the wool sheep herd (COSTA, 2017). According to the author, natural colored sheep provide diversified by-products such as leather, saddle blankets, clothes, and decorative handcrafts with high commercial value. These products are valued for not using synthetic chemical dyes and, therefore, their lower environmental impact and sustainability.

With the projected increase in the world's population by 2050 (FAO, 2015) and consequent increase in the demand of animal products, the development of sustainable productive systems is imperative, and identifying more productive genotypes is a viable way to accomplish it. According to Ferra et al. (2010), the productive sector demands for selecting ewe lambs for precocity, since the reproductive onset is a premise for the implementation of reproductive and breeding programs.

Puberty is defined as the age at which females have the first estrus followed by a period of luteal function (FREITAS et al., 2004). Plasma progesterone (P_4)

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concentration is an indicator of ovarian activity (SASA, 2006), from which the estrus cycle in ewe lambs can be estimated (MENEGATOS; GOULAS; KALOGIANNIS, 2006). In a normal estrus cycle, P_4 concentration relates with the volume of luteal tissue, which varies among genotypes (BARTLEWSKI; BEARD; RAWLINGS, 1999). Ferra et al. (2010) reported that P_4 concentration and live weight were related with puberty onset in Suffolk crossbreeds.

The social awareness about the animal product origin has increased the demand for "green, clean and ethic" animal products (DURMIC; BLACHE, 2012), as it is the case of products derived from natural colored animals (COSTA, 2017). However, data on growth and reproductive characteristics of Corriedale ewe lambs in the Brazilian sheep farming is lacking. Thus, the study aimed to estimate differences in growth, plasma P_4 and age at puberty between white and natural colored Corriedale ewe lambs.

MATERIAL AND METHODS

This experiment was approved by the Animal Experimentation Ethical Committee (CEEA) with protocol number 5821.

The experiment was conducted at a farm located in the municipality of Pinheiro Machado, in the state of Rio Grande do Sul, Brazil, from September 2013 to April 2014. Thirty ewe lambs averaging 12 months of age were randomly allocated to two genetic groups (n = 15): T1) white Corriedale (WC), and T2) natural colored Corriedale (NC). During the experimental period, the animals were kept in native pasture with water and natural shade available. Forage mass was monitored by the double sampling method described by Haydock; Shaw (1975), and pasture bromatological analyses were carried out according to the Van Soest technique (1965).

The ewes were weighed at the beginning of the experiment and at 28-day intervals, after 12 h of solid fasting. Body condition score (CS) and morphometric measurements such as front and hind height, body length, thoracic perimeter, rump length and width, wool fiber length (OSÓRIO; OSÓRIO, 2005) were also recorded at each weighing.

Blood samples were taken from four animals per group by jugular puncture at 14-day intervals. Samples were collected in heparinized tubes and centrifuged at 2500 rpm for 15 minutes. The serum was separated from plasma, stored in Eppendorf tubes (1.5ml), and frozen at -20°C until the progesterone concentration analysis by radio immunoassay (RIA), using a commercial kit (Cat #IM1188, Immnunotec, Czech Republic®).

Androgenized males were used to detect estrus in ewe lambs according to Souza; Jaime; Moraes (2005). Briefly, males were intramuscularly dosed with 2 ml of estradiol and impregnated with a mixture of powder dye and edible oil in chest region. Males were introduced to the ewe lambs in November 2013, at a 10% proportion of each group, and remained there until the beginning of the breeding season. Estrus was observed at 14-day intervals. In November, wool growth was measured on the right rib area in all animals after shearing at a 28-day intervals.

Data were submitted to analysis of variance. The Kruskal-Wallis test was applied to condition score and progesterone data as they had a scale-type distribution and non-normal distribution, respectively. Other measurements were compared by the F-test. The Pearson linear correlation analysis was carried out for progesterone, morphometric and body condition score. The Statistical Analysis System (SAS Institute, INC., 2001) was used for parametric and the R program (R Core team, 2013) for non-parametric variables, both at 5% significance.

RESULTS AND DISCUSION

There were no differences in body weight and average daily gain between groups (Table 1). This may be because animals of both groups remained together throughout the experiment, receiving the same feeding regime and because they belong to the same genetic base. This suggest that there is no difference between the WC and NC groups during post weaning period.

Table 1. Mean and standard error of body weight, average daily gain, morphometric measurements and wool length of white Corriedale and natural colored Corriedale ewe lambs.

Parameter	Genotype		F-test
	WC	NC	
Body weight, (kg)	32,51 ±0,85	34,47 ± 0,85	0,1147
Average Daily Gain (kg animal d^{-1})	0,034 ±0,003	0,037 ±0,003	0,5188
Altura do Anterior (cm)	59,71 ±0,58	59,31 ±0,58	0,6385
Altura do Posterior (cm)	59,56 ±0,49	59,43 ±0,49	0,8598
Comprimento Corporal (cm)	59,80 ±0,62	59,58 ±0,62	0,8167
Largura de Garupa (cm)	16,16 ±0,23	16,52 ±0,23	0,2918
Comprimento de Garupa (cm)	16,56 ±0,29	16,20 ±0,29	0,4022
Thoracic perimeter (cm)	78,02 ±0,78	80,19 ±0,78	0,0600
Wool fiber lenght (cm)	2,75 ±0,07	2,51 ±0,07	0,0256

According to Ribeiro et al. (2012), morphometric measures are mainly influenced by genotype. However, in this experiment there were no differences in any of such variables, as both groups are formed from the same crossbreeding. Animals in WC group had higher wool fiber length, with higher fiber growth rate. This could be possible due to the higher nutrient partitioning toward such physiological activity in WC animals. Probably, it reflects the higher selection pressure put on WC animals throughout the years for wool production, differently from NC animals, which has recently begun to be selected to produce better quality wool.

Villarroel; Oliveira; Silva (1991) evaluated the effect of nutritional and reproductive status of Corriedale sheep on wool growth in different periods of the year and concluded that photoperiod, but mainly feeding level, are the factors with higher influence on wool growth, in the State of Rio Grande do Sul. However, in their work, animals of both groups presented the same nutritional condition; therefore, nutrition did not contribute to the observed differences in the wool fiber growth rate between genetic groups. It is worth mentioning that wool fiber length accounts for 15 to 20% of the profit; long fibers (>70mm) are subjected to a combing process, and short fibers (<70mm), to carded. Thus, the short fiber achieves lower commercial price (OSÓRIO et al., 2014). Given this fact, once that WC animals had higher wool growth, it can be said that their wool would generate a higher profit when commercialized.

Natural colored ewe lambs had higher condition score (CS) during the third and fourth evaluations (Table 2). Regardless of the non-statistical difference in the other periods, NC animals had numerically higher CS, which indicates a superior ability to allocate adipose tissue. It is important though, to conduct other studies to confirm this characteristic and identify possible mechanisms underlying it.

Table 2. Mean and standard error of condition score (CS) of white and natural colored Corriedale ewe lambs.

Data	Genotype		(p) Kruskal-Wallis
	WC	NC	
21/09/2013	2.20 ± 0.06	2.50 ± 0.12	0.0890
19/10/2013	2.23 ± 0.11	2.53 ± 0.14	0.1344
17/11/2013	2.26 ± 0.08	2.60 ± 0.12	0.0419
14/12/2013	1.70 ± 0.13	2.33 ± 0.15	0.0069
11/01/2014	2.43 ± 0.17	2.78 ± 0.15	0.2731
08/02/2014	2.60 ± 0.17	2.85 ± 0.14	0.3667
08/03/2014	2.63 ± 0.14	2.84 ± 0.11	0.2762
06/04/2014	1.92 ± 0.15	2.17 ± 0.15	0.4176

It was observed a reduction in the CS during the last evaluation in both groups, precisely on the eve of the expected mating period, which can be related to the reduction in the nutritional value of the herbage consumed (Table 3).

Table 3. Herbage mass (HM), crude protein (CP), neutral detergent fiber (NDF), acid detergent fiber (ADF), and ether extract (EE) of herbage offered to animals.

Período	HM (kg ha^{-1} de MS)	CP (%)	NDF (%)	ADF (%)	EE (%)
21/09/2013	497,98	9,71	70,05	37,02	1,16
19/10/2013	505,39	-	-	-	-
17/11/2013	1161,35	13,09	67,37	36,79	1,32
14/12/2013	1021,68	-	-	-	-
25/01/2014	1305,92	-	-	-	-
08/03/2014	1055,98	-	-	-	-
06/04/2014	1466,81	9,63	81,48	32,55	2,74

Plasma P4 concentration showed no difference between genetic groups (Table 4). Results show that NC animals reached mean plasma P_4 concentration higher than 1 ng ml^{-1} from January onwards, while WC animals reach such concentration from March onwards (Figure 1 and 2). In spite of having mean plasma P_4 concentration higher than 1ng ml^{-1}, ewe lambs of the WC group where identified to be in estrus by androgenized males in January, period in which the NC ewe lambs where also detected by males to be in estrus. Plasma progesterone concentrations lower than 1ng ml^{-1} might be representative of anestrus, while values higher than 3ng ml^{-1} reflect luteal activity or pregnancy (MINTON et al., 1990). The anestrus phase is different from the estrus phase when plasma P_4 concentrations remain low for a period longer than 10 days (SASA et al., 2002).

Table 4. Mean and standard error for the plasma progesterone concentration (ng ml^{-1}) of white and natural colored Corriedale ewe lambs.

Data	Genotype		(p) Kruskal-Wallis
	WC	NC	
17/11/2013	0.651 ± 0.10	0.586 ± 0.26	0,2482
30/11/2013	0.494 ± 0.09	0.377 ± 0.06	0,1573
14/12/3013	0.625 ± 0.15	0.426 ± 0.08	0,2482
28/01/2013	0.553 ± 0.09	0.671 ± 0.43	0,3836
11/01/2014	0.473 ± 0.06	0.987 ± 0.54	0,5637
25/01/2014	0.757 ± 0.23	2.919 ± 2.04	1
08/02/2014	0.513 ± 0.07	1.043 ± 0.76	0,7237
22/02/2014	0.736 ± 0.18	0.775 ± 0.34	0,5637
08/03/2014	1.039 ± 0.54	1.545 ± 0.48	0,7728
21/03/2014	2.473 ± 1.46	2.052 ± 0.70	0,7728
06/04/2014	6.566 ± 1.51	4.797 ± 1.53	1
PG*	1,3526	1,4705	0,3173

PG*: general progesterone

Figure 1. Plasma progesterone concentration (ng ml^{-1}) and observed estrus incidence (%) in white Corriedale ewe lambs.

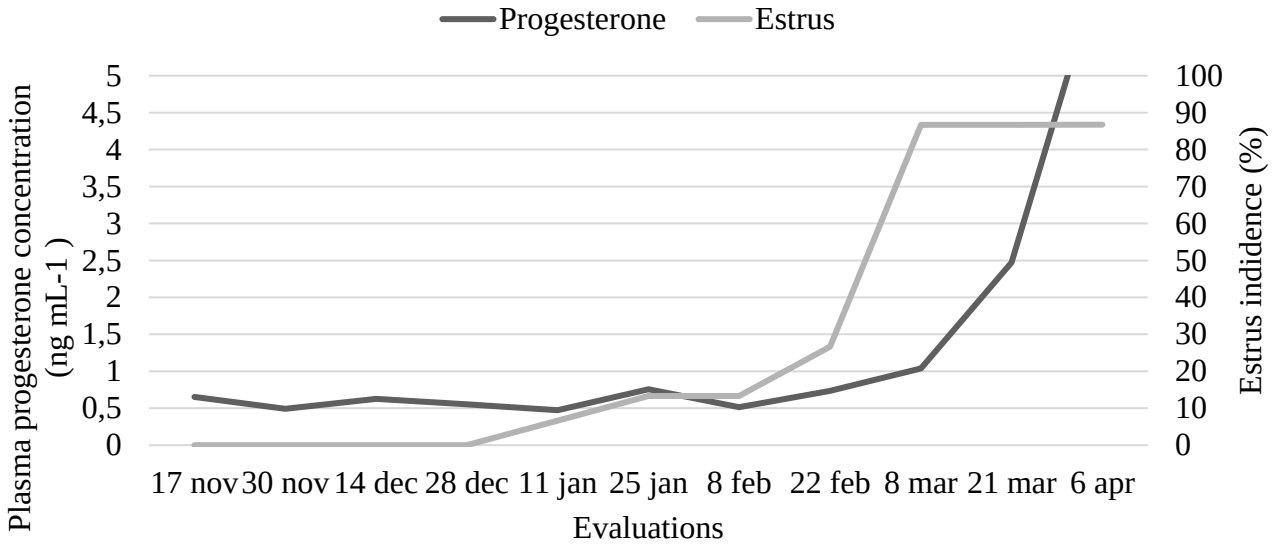
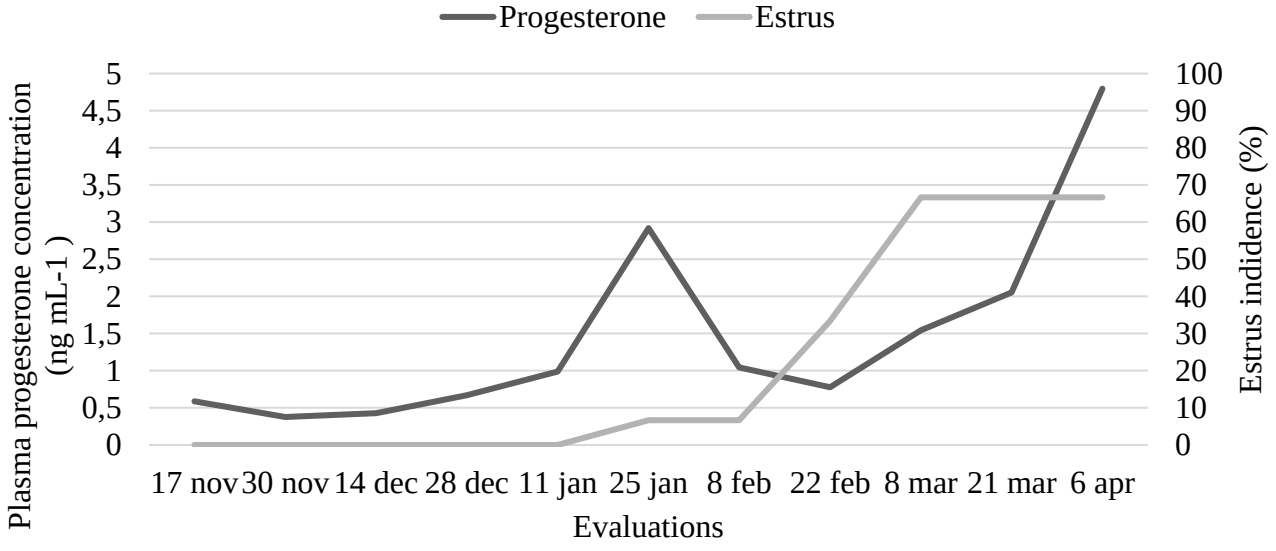


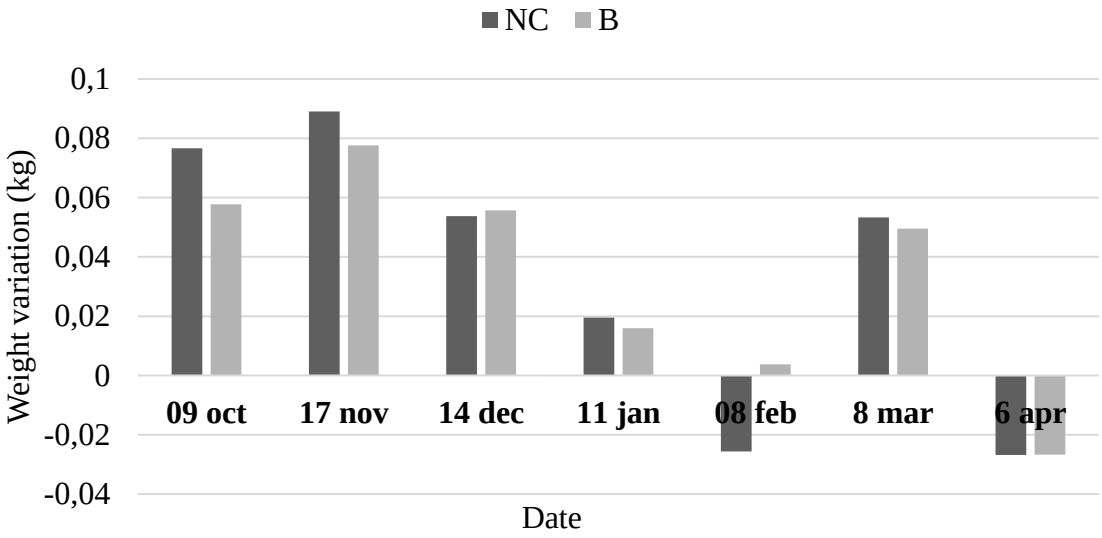
Figure 2. Plasma progesterone concentration (ng ml^{-1}) and observed estrus incidence (%) in natural colored Corriedale ewe lambs.



Rodriguez et al. (2007) monitored the annual estrus activity of Santa Ines, Rommey Marsh, and Suffolk sheep in Northern Brazil and observed that plasma P_4 of Santa Ines sheep remained higher than 1ng ml^{-1} throughout the year, differently from the other breeds. The authors observed values higher than 1ng ml^{-1} from January in Rommey Marsh and Suffolk sheep, the former maintaining such concentration until August and the latter until October. Sasa et al. (2011) evaluated the seasonal P_4 concentration in the same breeds, but in seasonal anestrus (September-November), before and after being subjected to the "male effect", and verified higher concentrations ($P < 0.01$) in Santa Ines, followed by Suffolk and Rommey March females, with 2.21 ± 0.13, 0.47 ± 0.4 and 0.24 ± 0.01 ng ml^{-1}, respectively.

The curves of estrus identified by androgenized males are coincident with plasma P_4 values (Figures 1 and 2). However, during the last 30 days of experiment, it was observed a stabilization in the estrus detection, even with the continuous increments in plasma P_4. This may be due to the observed depletion of body reserves (Table 2) and weight loss (Figure 3), because of the low nutritional value of the herbage, which could have interrupted the sexual activity. The body condition score is positively related with the presence of a peak and pulsatile behavior of the luteinizing hormone in sheep (YILDIZ et al., 2003).

Figure 3. Variation in daily mean weight (kg) in white and natural colored Corriedale ewe lambs during the experimental period.



Viñoles (2003) concluded that a satisfactory body score condition increased the ovulation rate in sheep, and that nutritional supplementation from day 8 to 14 of the estrus cycle increased that of sheep with moderate body score condition. In the present study, plasma P4 positively correlated ($R = 0.37$) with the CS, which demonstrates the importance of the nutritional status of animals for reproductive performance. On the other hand, P_4 concentration showed no correlation with any morphometric characteristics. Belibasaki; Kouimtzis (2002) argued that the onset of sexual activity is more related with corporal development than with chronological age. According to Ribeiro et al. (2003), there exists a strong relationship between body condition at mating with pregnancy rate, recommending a higher nutrient supply before and during the breeding season. This would lead to increment in pregnancy rates and prolificness, given the higher ovulation rate of supplemented sheep (BIANCHI et al., 2001).

According to Short; Adams (1998) insufficient nutrient intake is the common cause of reduced fertility, given the delay of time at puberty and the broader post-partum anestrus by inhibition of ovarian activity. This occurs because of the alterations in neuroendocrine and metabolic feedback mechanisms, including changes in gonadotropins secretions, progesterone production during luteal phase and pregnancy, and the higher sensitivity of the hypothalamus-hypophysis axis to steroid hormones, influencing the ovarian activity.

CONCLUSIONS

White and natural colored Corriedale ewe lambs present the same growth patterns during the first mating season, with similar plasma progesterone concentration and ovarian activity.

Under same breeding conditions, white Corriedale ewe lambs had higher wool fiber growth than natural colored animals.

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