

## The effects of parturition season and suckling mode on the puerperium of Santa Ines ewes and on the weight gain of lambs

[Efeitos do período das parições e dos sistemas de amamentação sobre o puerpério de ovelhas Santa Inês e desempenho ponderal de cordeiros]

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### ABSTRACT

Seventy-seven ewes were randomly divided into groups according to parturition season and suckling mode [Rainy season: continuous (n=14) and controlled (n=13); Dry season: continuous (n=25) and controlled (n=25)]. The controlled suckling mode, in both seasons, resulted in a decrease in variables, intervals between parturition and first estrus (reduction of 27.11 and 11.46 days for rainy and dry season, respectively;  $P<0.05$ ) and between parturition and estrus of conception (reduction of 12.81 and 13.58 days, for rainy and dry season, respectively;  $P<0.05$ ). As to the lambs, the weight gain was higher in animals subjected to controlled suckling in relation to continuous, especially when lambing occurred in the rainy season ( $17.83\pm 0.56$  vs.  $13.95\pm 0.52$ kg for Lambs' weight at 90 days old, respectively;  $P<0.05$ ). Therefore, it was concluded that controlled suckling management is better indicated for the Amazonian region, since it allows the ewes to have a shorter puerperium period and the lambs exhibit higher weight gain.

Keywords: sheep, suckling, puerperium, weight gain

### RESUMO

Foram utilizadas 77 ovelhas, divididas aleatoriamente em grupos de acordo com o período de parição e o manejo de amamentação [chuvoso: contínua (n=14) e controlada (n=13); seco: contínua (n=25) e controlada (n=13)]. O sistema de amamentação controlado, em ambos os períodos, resultou em decréscimo para as variáveis intervalos entre parto e primeiro estro (redução de 27,11 e 11,46 dias para os períodos chuvoso e seco, respectivamente;  $P<0,05$ ) e entre parto e estro da concepção (redução de 12,81 e 13,58 dia para os períodos chuvoso e seco, respectivamente;  $P<0,05$ ). Quanto ao desempenho ponderal dos cordeiros, o ganho de peso foi maior para os animais submetidos ao regime de amamentação controlada em relação à contínua, especialmente quando os nascimentos ocorreram no período chuvoso ( $17,83\pm 0,56$  vs.  $13,95\pm 0,52$ kg para o peso dos cordeiros aos 90 dias de idade, respectivamente;  $P<0,05$ ). Contudo, o manejo de amamentação controlada é indicado para a região amazônica, por permitir menor tempo de puerpério das ovelhas e maior ganho de peso dos cordeiros.

Palavras-chave: amamentação, clima, puerpério, ganho de peso, ovinos

### INTRODUCTION

The main objective of the sheep industry is meat production. In these systems, the resumption of cyclicity during puerperium is, without a doubt,

one of the major factors that interferes with the reproductive efficiency of the herd. The reduction in intervals between parturition intensifies the production process since it increases the number of offspring/female/year and, consequently, there is an increase in profitability.

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The interval between parturition and the resumption of normal cycles depends on a number of factors (Mandiki *et al.*, 1990). Suckling is described as the major cause directly involved with duration of postpartum anestrus (Azevedo *et al.*, 2002; Hayder and Ali, 2008). Frequency and intensity of suckling adversely affect the resumption of ovarian activity (Ronquillo *et al.*, 2008).

Physiologically, the stimulus of suckling teats increases the concentrations of oxytocin and, consequently, of prolactin (Negrão *et al.*, 2001). In turn, high concentrations of prolactin inhibits the discharge of the gonadotropin releasing hormone (GnRH), which do not stimulate the secretion of the luteinizing hormone (LH) and regulates resumption of cyclicity (Yavas and Walton, 2000). Thus, controlled suckling has been studied as a potential tool to increase efficiency in production systems (Morales-Terán *et al.*, 2004; Costa *et al.*, 2007).

The climatic factors are also intimately related to reproductive and productive performances in animals. A series of variations are observed according to the region in which they are raised. The Amazonian climate is known to have intense rainfall associated to high temperatures and humidity throughout the year. This combination can cause intense discomfort to animals (Costa *et al.*, 2010), as well as interfere with the production management as a whole (i.e. pasture availability, grazing time and occurrence of related diseases). Even though these climatic conditions seem to be unfavorable at first, the Amazonian region presents great animal production potential. Livestock production has been rapidly intensifying in the region throughout the years (IBGE, 2006) and the interest in the production of small ruminants has been increasing. With this perspective, if management practices do not meet the peculiarities of the region, productive indexes will be lower than ideal, making the system unviable.

Given the above, the present study had as first objective to evaluate the effect of the suckling mode (controlled vs. continuous) and of the Amazonian climate (rainy season vs. "dry" season) on the resumption of cyclicity and postpartum fertility in Santa Inês ewes. At the same time, to make sure that these systems meet

the production goals (production of meat). The effects on the lambs' weight gain were also evaluated until weaning.

## MATERIAL AND METHODS

The study was conducted between September 2007 and December 2008 in a commercial farm in the North region of Brazil (01°07'44"S and 47°37'12"W). That region has a climate type Am according to Köppen's classification, being characterized by two well defined seasons, rainy (December to May) and "dry" (June to November).

The study was conducted on 77 Santa Inês ewes which exhibited an average weight of 37.0±0.96 kg and average age of 2.5±0.6 years in the beginning of the experiment. The ewes were kept in a semi-intensive management system, in which they were released for grazing in amazonian quicúio grass (*Brachiaria humidicola*) in the morning. At the end of the day, the ewes were taken back to the pen, where they were trough fed crushed elephant grass (*Pennisetum purpureum*), pueró (*Pueraria phaseoloides*) and 200 g/head/day of 18% crude protein feed. Water and mineral salt were provided *ad libitum*.

For this experiment, the ewes were randomly divided into two groups according to parturition season. The rainy season group (n=27) bred during the dry period (September and October/2007) and lambed during the rainy period (February and March/2008). The dry season group (n=50) bred during the rainy period (March and April/2008) and lambed during the dry period (August and September/2008).

After lambing, the ewes and lambs remained confined during the first ten postpartum days. After that, the groups were randomly subdivided according to suckling mode: continuous or controlled. In the group with parturition in the rainy season, 14 ewes were selected for continuous suckling mode and 13 for controlled suckling mode. In the dry season group, the number of ewes was equally divided among the two treatments (25 females per group). In the continuous suckling mode, lambs were kept continuously with their mothers, following the semi-intensive management system. In the controlled suckling mode subgroup, lambs

remained in the pen during the period while the ewes were grazing. At mid-day (12 PM), ewes would return to the pens, remaining with the lambs until 2 PM, when they were again taken to the pasture. At the end of the day, all animals would return to the pens. During the periods in which the ewes were kept in the pens, they were trough fed crushed elephant grass as a supplement and fed at the end of the day. Suckling modes were kept until weaning, 90 days postpartum. All lambs had access to creep-feeding with a commercial concentrate diet containing 18% crude protein.

The puerperium reproductive management started ten days after parturition. Four male breeders previously tested and approved for libido and seminal characteristics were kept with the ewes only during the day, separated during the night. To help in identifying females in estrus, males had their chests painted with colored grease. The color was substituted every 15 days to facilitate reproduction monitoring and control, as described by Souza and Moraes (1998). The females were observed twice a day for markings. Estrus followed by pregnancy was called conception estrus. To confirm conception, a pregnancy diagnosis was performed every 15 days using an ultrasound equipment (100 Falco – Pie medical, Germany) equipped with a multi-frequency linear transducer (6.0 and 8.0 MHz). In summary, transrectal ultrasound was performed with ewes in quadruped position and all portions of the uterus were observed to detect the presence of the embryonic vesicle. The ewes that were considered pregnant were examined in two other consecutive ultrasound scans to confirm diagnosis.

All ewes were weighed at the beginning of the breeding season and right after parturition. To determine the lambs' development and weight gain according to the suckling mode employed, sequential weighing was performed (at date of birth, 15, 30, 50 and 90 days after birth).

Climatic data (maximum, minimum and average temperatures; relative humidity and rainfall) were recorded each month. The temperature-humidity index (THI) was calculated according to Thom (1958);  $THI = 0.8 * T + (H/100) * (T - 14.4) + 46.4$ , in which: T = environmental temperature (°C); H = relative humidity; average and maximum THI were considered. THI values

were used to classify the thermal comfort level of the animals as: absence of stress (THI < 70); alert (between 70 and 72); critical (between 73 and 78); danger (between 79 and 82) and emergency (superior to 83; Hahn, 1985).

Data were expressed in mean and standard deviation and evaluated by ANOVA, using the General Linear Model (GLM) package of SYSTAT 7.0 statistical software (USA). The effects of the parturition season, suckling mode and their interaction with variables related to the ewes (i.e. weight and reproductive efficiency indices) and to the lambs (i.e. weight gain) were evaluated. Regression analysis to verify the lambs' weight gain (weight at birth, 15, 30, 60 and 90 days after birth) was conducted using the REG procedure in SAS system (1999). Differences were considered significant when  $P < 0.05$  and defined as a trend when  $P \geq 0.05$  e  $< 0.10$ .

## RESULTS

The meteorological data allows the confirmation of two climate periods in the region (rainy and "dry", Table 1). The rainfall intensity (total volume of rain) varied between the periods (1955.1 and 720.4mm for rainy and dry seasons, respectively). The average temperature-humidity indexes ( $THI_{average}$ ) showed critical levels of thermal comfort (between 72 and 78) in both periods. Danger (between 78 and 82) and emergency (>83) levels were observed when maximum indexes were calculated ( $THI_{max}$ ).

Data regarding the ewe's weight and reproductive efficiency indexes are shown in Table 2. Parturition season did not influence the ewe's weight (i.e. at beginning of breeding season and at parturition;  $P > 0.05$ ). Animals subjected to controlled suckling mode exhibited reduction in intervals between parturition and first estrus with an average of 27.11 and 11.46 days for the rainy and dry seasons, respectively ( $P < 0.05$ ). As to the interval between parturition and estrus of conception (i.e. the estrus that resulted in pregnancy), a significant effect of suckling mode was seen for the dry season (reduction of an average of 13.58 days for females in the controlled suckling mode group;  $P < 0.05$ ) and a reduction trend was seen for the rainy season (difference of 12.81 days,  $P = 0.06$ ).

Table 1. Mean monthly temperature values (maximum -  $T_{\max}$ ; minimum -  $T_{\min}$  and; average -  $T_{\text{average}}$ ), humidity, rainfall and temperature-humidity index (maximum -  $\text{THI}_{\max}$  and; average -  $\text{THI}_{\text{average}}$ ) in parturition seasons (rainy and dry)

Season	Month	$T_{\max}$ (°C)	$T_{\min}$ (°C)	$T_{\text{average}}$ (°C)	Humidity (%)	Rainfall (mm <sup>3</sup> )	$\text{THI}_{\max}$	$\text{THI}_{\text{average}}$
Rainy	Dec	32.6	22.2	27.4	80	245.2	86	78
	Jan	31.0	22.5	26.7	79	292.4	84	77
	Feb	31.0	22.3	26.6	88	235.4	85	78
	Mar	29.8	22.4	26.1	90	322.2	84	77
	Apr	30.7	22.3	26.5	88	586.4	85	78
	May	31.2	22.5	26.8	77	273.5	84	77
	Average	31.1	22.4	26.7	83.7	325.9	84.7	77.5
Dry	June	31.4	22.2	26.7	79	314.7	85	77
	July	32.0	21.7	26.8	83	153.9	86	78
	Aug	32.8	21.7	27.2	80	90.6	87	78
	Sept	32.8	21.6	27.2	78	56.0	87	77
	Oct	32.3	21.4	26.8	79	47.2	86	77
	Nov	34.2	21.5	27.8	77	58.0	89	79
	Average	32.6	21.7	27.1	79.3	120.1	86.7	77.7

Table 2. Summary of results of the reproductive efficiency (mean±S.E.M.) grouped according to the period (rainy and dry) and suckling management (continuous and controlled) in Santa Ines sheep

Suckling	Rainy season		Dry season	
	Continuous	Controlled	Continuous	Controlled
Ewe's weight at breeding season (kg)	39.21±6.11aA	41.92±5.70aC	38.53±4.28cA	38.69±4.63cC
Ewe's weight at parturition (Kg)	39.51±6.20aA	41.50±5.58aC	40.25±4.47cA	40.30±4.89cC
Interval Parturition and 1st estrus (day)	57.64±18.24aA	30.53±10.93bC	39.30±8.74cB	27.84±5.39dC
Interval Parturition and estrus of conception (days)	71.50±16.47eA	58.69±17.32fC	58.50±9.10cB	44.92±6.62dD
Interval between parturitions (days)	221±17.23 eA	208±16.56fC	208±10.01cB	194±6.34dD

Different letters in the same row indicate differences at  $P < 0.05$  ( $a \neq b$  e  $c \neq d$ , on periods;  $A \neq B$  e  $C \neq D$ , between periods) or  $P < 0.10$  (tendency;  $e \neq f$ ).

The effect of the parturition season on the interval between parturition and first estrus was observed for ewes subjected to continuous suckling mode (reduction of an average of 18.34 days for the group with parturition in the dry season;  $P > 0.05$ ). Similarly, conceptions occurred earlier in ewes with parturition in the dry season (i.e. interval of parturition - estrus of conception was shorter when parturition occurred in the dry season,  $P > 0.05$ ), regardless of the suckling mode employed. The same behavior was observed for the interval between parturitions.

Results regarding the lambs' weight gain up to weaning are shown in Table 3. The lambs'

weight at birth did not vary between treatments ( $P > 0.05$ ). The suckling mode only exhibited an effect on weight up to weaning on lambs born in the rainy season; higher weights were seen for lambs subjected to controlled suckling ( $P < 0.05$ ). As to the dry period, no variation was observed in regard to lambs' management ( $P > 0.05$ ). An effect of birth season was only seen in the subgroup that was subjected to continuous suckling mode; there was higher weight gain for lambs born in the dry period ( $P < 0.05$ ). For lambs subjected to controlled suckling, the only differentiated development was seen between periods, without exhibiting, however, a variation in weaning weight.

Table 3. Summary of weight performance results (mean±S.E.M.) grouped according to the period (rainy and dry) and suckling management (continuous and controlled) in Santa Ines sheep

Suckling	Rainy season		Dry season	
	Continuous	Controlled	Continuous	Controlled
Lambs' weight at birth (kg)	3.69±0.12aA	3.73±0.13aC	3.47±0.12cA	3.71±0.10cC
Lambs' weight at 15 days old (kg)	6.67±0.34aA	8.14±0.20bC	6.73±0.19cA	6.66±0.43cD
Lambs' weight at 30 days old (kg)	8.85±0.42aA	11.16±0.25bC	9.66±0.35cA	10.01±0.82cD
Lambs' weight at 60 days old (kg)	11.58±0.54aA	14.82±0.41bC	14.31±0.46cB	13.64±1.21cD
Lambs' weight at 90 days old (kg)	13.95±0.52aA	17.83±0.56bC	18.20±0.60cB	18.78±1.20cC

Different letters on the same row indicate differences at  $P < 0.50$  ( $a \neq b$  e  $c \neq d$ , on periods;  $A \neq B$  e  $C \neq D$ , between periods).

Regression analysis allowed us to confirm the effects of treatments on lambs weight gain (Figure 1). All animals showed significant weight gain throughout the observation period ( $P < 0.05$ ). In the rainy season, daily weight gain was higher for the subgroup subjected to

controlled suckling mode (156 vs. 113g/day,  $P > 0.05$ ). No difference was observed between subgroups born in the dry period (167 vs. 163g/day for controlled and continuous suckling, respectively;  $P > 0.05$ ).

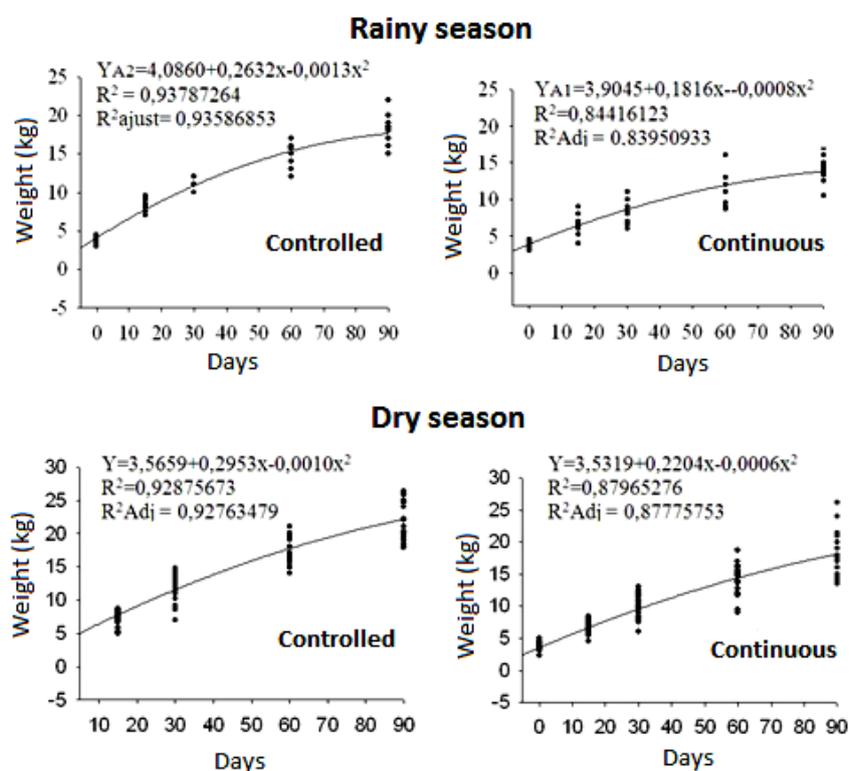


Figure 1. Regression curve according to the equations for the weights of Santa Ines lambs until weaning according to the birth season (rainy and dry) and suckling management (controlled and continuous).

## DISCUSSION

Knowledge regarding climate variables, their interaction with the animals and the behavioral, physiological and productive responses are crucial when adjusting a production system to its main objectives (Neiva *et al.*, 2004). The climate difference between the periods was restricted to rainfall. Even though the rainfall potentially interfered with grazing time, there was no compromise in food supply owing to the fact that the diet was supplemented to meet the daily requirements. This can be confirmed by the absence of variation in the ewes' weight when comparing both seasons. This way, nutritional factors were eliminated within the variables studied, as this was not the focus of this study. In the same manner, the estimated comfort of the animals under the climate conditions (temperature and humidity) remained constant. Even though critical levels were observed, no correlation to any factor studied was seen; however, we highlight the need to implement management practices that favor the comfort of the animals (i.e. areas providing shade and shelter from rain in the pasture, access to abundant water, etc.).

When the controlled suckling mode was employed, the interval between parturition and first estrus was reduced, regardless of the parturition season. This anticipation of resumption of ovarian cyclicity shows the intimate relation between the suckling stimulus (i.e. suckling of the teats and milk production) and its endocrine suppression of the ovarian function (Pollot and Gootwine, 2004; Montiel and Ahuja, 2005). This stimulus reduces the hypothalamus' release of GnRH which results in insufficient pulsatile secretion of LH (Williams, 1990). In other words, the pattern of follicular waves is present right after parturition; however, follicles do not complete their growth and maturation due to reduced secretion of LH (Wiltbank *et al.*, 2002). In these conditions, estrus behavior and ovulation are not observed. When the inhibitory factors are reduced or removed, there is reestablishment of cyclicity. This confirms the positive effect of controlled suckling mode on the reduction of the interval between parturition and first estrus. This result corroborates findings by Souza *et al.* (1996); however, it is in disagreement with findings by Azevedo *et al.* (2002) and Costa *et al.* (2007),

which did not obtain significant positive effects from postpartum management in ewes.

Resumption of cyclicity is not always associated with the beginning of a new pregnancy. The interval between parturition and conception estrus is what effectively shows the unproductive period of the ewe. Therefore, a reduction observed for this variable under the control of suckling mode indicates that the management practice is being effective due to the reproductive performance of the female. A similar effect was described by Morales-Terán *et al.* (2004). The shortening of the ewes' postpartum period up to the next conception allows the establishment of three parturitions every two years, in other words, parturition intervals of eight months. This is considered the ideal system for raising slaughter lambs (Roda *et al.*, 1993; Otto de Sá, 2002).

The season in which parturitions occurred had an effect over variables related to the reproductive efficiency of the ewes. The shorter period of resumption of cyclicity and fertility of females with parturition in the dry period could possibly be related to the "stress" caused to the animals by heavy rains during the rainy period. Mies Filho (1988) suggests that the rainy season can affect the hormonal secretion profile and thus, has an important effect on the reproductive performance. Even though it is a possible explanation, there are no studies that prove the mechanism involved with this effect. It is important to highlight that the comfort index of the animals estimated in the present study was based solely on THI, calculated from temperature and humidity data. On the other hand, the incidence of hoof problems, parasitosis and respiratory infections are higher in the rainy season and can also have an effect on the reproductive efficiency of the animals. Based on these possible explanations, the need to develop management practices that address environmental peculiarities and their interaction with animals should be reinforced.

Based on the main goal of Santa Ines sheep raising (i.e. production of meat; Coelho *et al.*, 2006), the evaluation of effects (suckling management and parturition season) on lambs' weight gain is essential. The variations observed for lambs' weight gain throughout the suckling period reinforce the "stress" that animals go

through during frequent and intense rains. Due to the climate conditions during the rainy season, a lower weight gain was seen for lambs born during that period, especially those subjected to continuous suckling mode (lambs that would remain with the mothers in the pasture throughout the whole day). This is confirmed by a lack of difference between birth periods when comparing animals subjected to controlled suckling mode. Under this mode, high rainfall is not expected to affect the animals' behavior.

### CONCLUSION

Controlled suckling mode, in both dry and rainy seasons, is the most suitable management mode for the Eastern Amazonian region since it results in a shorter puerperium for the ewes and higher weight gain for the lambs. Therefore, the initial hypothesis of the study was confirmed. The improvement of these indexes enables better reproductive and productive efficiency of the herd.

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