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Effects of sire breed-grazing system and environmental parameters on the behaviour of beef calves just after birth☆

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Abstract

Effects of sire breed-grazing system and environmental factors on the first activities of high grade Nellore and crossbred Canchim × Nellore, Angus × Nellore, and Simmental × Nellore calves raised in intensive production systems and high grade Nellore calves raised in an extensive production system, after birth, were studied. During 2 years, 185 calves were observed from birth until the end of first suckling, and the following variables were estimated: duration of maternal attention (cow to calf) during the first 15 min after calving, latency to first attempt to stand up, latency to stand up, latency to first suckling, duration of first suckling and the interval from standing to suckling. Data were analyzed by least squares methods, with models that included fixed effects of year and time of the year of birth (March–April (early autumn) and May–June (late autumn)), sire breed-grazing system (Sy), sex of calf (Se), category of cow (primiparous and pluriparous), time of birth, Sy × Se, year × Sy and year × time of the year interactions and the covariates weight of calf, rainfall, air temperature and relative humidity in the day of birth. Calves born from 6:00 to 8:00 h presented the longest latencies to first stand up (40.3 ± 5.1 min) and the shortest occur from 14:00 to 16:00 h (15.8 ± 2.7 min) ($P < 0.01$). Primiparous cows provided longer attention toward the calf in the first 15 min after birth than pluriparous cows (13.0 ± 0.7 min versus 11.1 ± 0.5 min; $P < 0.05$). This attention was also shorter in earlier autumn (11.0 ± 0.5 min) and longer in late autumn (13.1 ± 0.8 min) ($P < 0.05$). Relative to sire breed-grazing system, Nellore calves raised intensively did take longer to stand and to suckle

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after birth as compared to crossbred calves also raised intensively ($P < 0.01$). However, grazing system did not affect ($P > 0.05$) any behaviour variable studied. As regard to sex differences, female calves did take less ($P < 0.01$) time to suckle after standing than male calves. Results showed that even purebred or crossbred *Bos indicus* calves in subtropical environmental need extra care when born on rainy days, especially during the first hours of the day.

Keywords: Behaviour; Birth; Crossbred calves; Environmental parameters

1. Introduction

Parturition represents a very stressful situation to calves and they need to adapt very rapidly to the new environment. Neonatal calf mortality losses are second only to infertility in contributing to low reproductive rates in cattle (Carstens et al., 1997). In this context, genetic differences and cow–calf behaviour may be very important.

Once the calf is born, the cow usually smells and licks the offspring, removing the amniotic fluids and membranes enveloping the calf. The importance and function of this behaviour for calf survival has been reported by many authors, and includes, among others, stimulation of respiratory and circulatory activities (Naaktgeboren, 1979), removal of fetal membrane and stimulation of defecation and urine elimination (Hediger, 1995), and drying of the skin, decreasing heat loss (Edwards and Broom, 1982). Besides these functions, this behaviour is vital for creating an adequate bond between mother and offspring, which enables recognition of each other among other animals in the herd. For this recognition process to be effective, contact between mother and offspring should occur shortly after calving for a certain length of time. This period, called the critical period, varies from specie to specie. According to Le Neindre and Garel (1976), for ruminants, it lasts about 3 h after birth. Hudson and Mullord (1977) reported that a 5-min contact with the calf immediately post-partum is enough for the formation of a strong specific maternal bond between the cow–calf pair. In addition, the subsequent ingestion of colostrum at the first suckling is required for immune protection.

Some studies have analyzed the influence of environmental factors, such as temperature, rain and relative humidity, and interactions between these factors on the first activities and on mortality rate of calves. Edwards (1982) reported that calves born in colder periods of the year did take longer to stand up and to suckle than those born in warmer periods. Azzam et al. (1993), investigating effects of climatic conditions on neonatal mortality of beef calves of many genetic groups born during a 20-year study, concluded that average ambient temperature and rainfall on the day of calving affected survival nonlinearly and that the magnitude of the effect depended on age of dam, sex and size of the calf. Josey et al. (1993) observed greater mortality rates with an increase in the *Bos indicus* proportion in crossbred *Bos indicus* × *Bos taurus* calves, and they found significant correlations among mortality with rainfall (positive) and air temperature (negative).

Beef cattle management systems in Brazil and in many tropical and subtropical countries do not provide much assistance to the cow–calf pair at birth. Ranch dimension, the large number of animals and lack of qualified resources (personnel, facilities and feed) are some of the causes of inadequate assistance at parturition. For that reason, understanding breed and climatic effects on activities of calves after birth in these regions should help producers to choose more appropriate production and management systems. The objective of this study was to evaluate effects of environmental factors on first activities of beef calves of different *Bos indicus* inheritance.

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2. Methods and Materials

The study was carried out at Southeast-Embrapa Cattle (CPPSE), located in São Carlos, SP, Brazil, latitude 22°01′ south and longitude 47°53′ west. The region presents subtropical climate with dry winter and warm and humid summer. Mean temperatures range from 16.3 °C (July) to 23.0 °C (February). Annual mean rainfall is 1502 mm.

A total of 185 calves from four genetic groups were observed during the calving seasons (March–June) of 1998 and 1999. Calves were the offspring of high grade Nellore cows[1] and were sired by Nellore (NEE and NEI), Canchim (CNI), Aberdeen Angus (ANI) and Simmental (SNI) bulls. Nellore calves and their dams were raised under intensive (NEI; 5 AU[2]/ha in *Brachiaria brizantha* pastures) and extensive (NEE; 1 AU/ha in *Brachiaria decumbens* pastures) management. Crossbred calves and their dams were all raised under intensive (5 AU/ha in *Brachiaria brizantha* pastures) management. Around 15 days before parturition, cows were removed from their pastures and taken to a maternity pasture, where they remained until the day after calving. Maternity was a 14 ha pasture, with few trees, that allowed animals to be observed without being disturbed. When a cow was having difficulty giving birth or labor was taking more than 4 h, recorders were allowed to intervene. Data of these animals were not used in the analysis.

During the first year of study (1998), 89 births were accompanied but only 68 (16 NEE, 12 NEI, 9 CNI, 14 ANI, 17 SNI) were observed until the end of the first suckling because of lack of luminosity. On the second year (1999), 78 births (18 NEE, 16 NEI, 18 CNI, 11 ANI and 17 SNI) of a total of 96 were observed until the end of the first suckling.

Behaviour of calves born in the daytime was directly and continuously observed from birth to the end of the first suckling, recording the time of all occurrences on individual sheets. Data recorded during observations were calculated, in minutes, as follows: duration of maternal attention (cow to calf) during the first 15 min after calving (AMC)—time spent by the cow showing any kind of attention (smelling, licking, touching and/or pushing) towards its calf during the first 15 min after parturition; latency to first attempt to stand up (AST)—time after birth until the first attempt of the calf to stand up on its four legs; latency to stand up (ST)—time after birth until the calf was up on its four legs either still or walking; latency to first suckling (FSU)—time after birth until the calf started to suckle one of the cow's teats (calf's mouth sucking the teat); duration of the first suckling (DSU)—cumulative duration of calf suckling its dam until calf left its mother's teat for more than 5 min; interval from standing to suckling (ISS)—time after the calf was up until it started to suckle its mother's teat. There were a total of 139, 140, 137, 133, 83 and 132 observations for AMC, AST, ST, FSU, DSU and ISS, respectively.

Air temperature, relative humidity and rainfall on the day of birth were recorded at the Embrapa's meteorological station. Station measured total rain over a 24-h period, and air temperature and relative humidity three times per day. For these analyses, the values of air temperature and relative humidity closest to the hour of birth of the calf or the average of two values were used.

Behaviour variables were studied by analyses of variance, using the least squares method, and the GLM procedure (SAS, 2000). The statistical model included fixed effects of year (1998 and 1999), period of the year (March–April (early autumn) and May–June (late autumn)) of birth, sire breed-grazing system (Sy: NEE, NEI, CNI, ANI and NEI), sex of calf (Se), category of the cow (primiparous and pluriparous), time of birth (6:00–8:00 h; 8:00–10:00 h; 10:00–12:00 h; 12:00–14:00 h; 14:00–16:00 h and 16:00–19:00 h), year × Sy and year × period of the year interactions, and covariates (linear effect) birth weight, rainfall, air temperature and humidity. Despite the number of observations available for each trait studied, there was no confounding among the variables included in the model. Correlation analyses between environmental effects and behavioural traits were also performed, using CORR procedure (SAS, 2000). Data from births that needed to be assisted were not used in these analyses.

[1] High grade Nellore cows = cows that were genetically very close to purebred Nellore cows.
[2] AU: Animal Unit = an animal of 450 kg.

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3. Results

The analyses of variance showed that the following environmental parameters presented significant effects: year of birth on latency to first suckling ($P < 0.05$); period of the year of birth on duration of maternal attention (cow to calf) ($P < 0.05$); time of birth on first attempt to stand up ($P < 0.01$); rainfall on latency to first attempt to stand up, latency to first suckling ($P < 0.01$) and interval from standing to suckling ($P < 0.05$). There was no significant effect of air temperature and humidity on any of the behavioural traits studied ($P > 0.05$).

Animals born in 1998 did take longer to suckle for the first time (64.9 ± 6.5 min) than those born in 1999 (57.5 ± 4.2 min) ($P < 0.05$).

As regard to period of the year, duration of maternal attention (cow to calf) during the first 15 min after calving was shorter in early autumn (11.0 ± 0.5 min) than in late autumn (13.1 ± 0.8 min) ($P < 0.05$).

In relation to birth time, it affected first attempt to stand up. The greatest latencies occurred from 6:00 to 8:00 h (40.3 ± 5.1 min) and shortest from 14:00 to 16:00 h (15.8 ± 2.7 min).

The effect of rainfall was observed for latency to first attempt to stand up and to suckle (FSU), and the interval from standing to suckling increased with higher rainfall (RF). Regression equations of these traits on RFs are presented in Fig. 1.

Relative to the other factors (sire breed-grazing system, sex of calf, category of cow, birth weight of calf and Sy × Se and year × Sy interactions) included in the statistical model, the following effects were significant: sire breed-grazing system on latency to first attempt to stand up (AST) ($P > 0.05$), latency to stand up and latency to first suckling ($P < 0.01$); sex on the interval from standing to suckling ($P < 0.01$); cow category on duration of maternal attention (cow to calf) during the first 15 min after calving ($P < 0.05$).

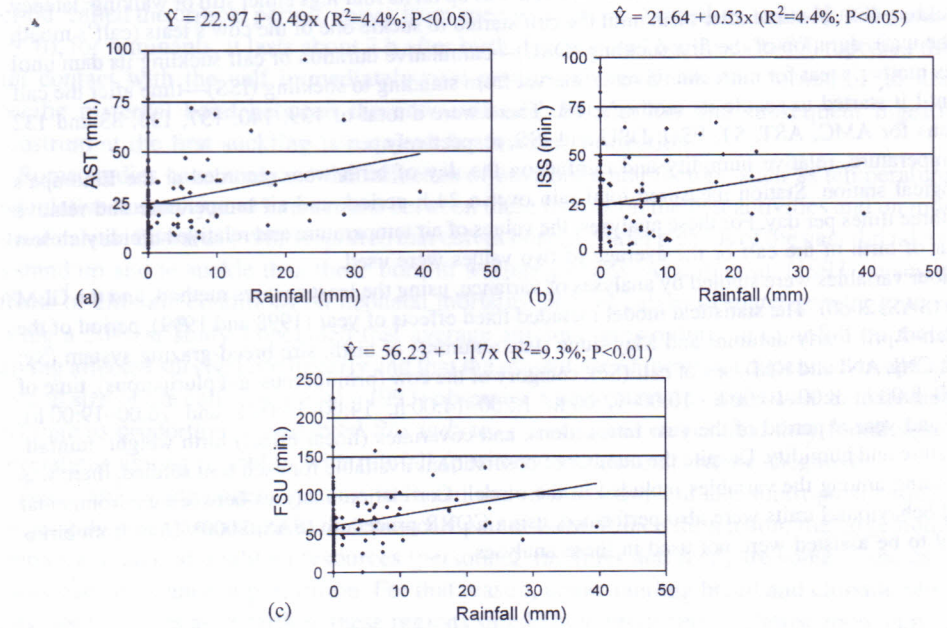

Fig. 1. First attempt to stand up (AST) (a), interval from standing to suckling (ISS) (b), and latency to first suckle (FSU) (c), as functions of rainfall on day of birth.

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Table 1
Least square means (±standard error), in minutes, duration of maternal attention (cow to calf) during the first 15 min after parturition (AMC), latency to first attempt to stand (AST), latency to stand up (ST), latency to first suckling (FSU), interval from standing to suckling (ISS), and duration of first suckling (DSU), according to sire breed-grazing system (Sy)

System[a]	AMC	AST	ST	FSU	ISS	DSU
NEE	12.3 ± 0.8	30.6 ± 2.8 a	44.7 ± 4.2 a	65.9 ± 5.9 a	22.7 ± 3.6	20.6 ± 3.1
NEI	11.8 ± 0.8	29.1 ± 2.8 a	49.5 ± 4.1 a	74.8 ± 5.0 a	25.4 ± 3.5	22.7 ± 3.0
CNI	13.0 ± 0.9	27.7 ± 3.1 a	38.9 ± 4.5 a	66.8 ± 5.6 a	28.1 ± 3.9	17.9 ± 4.3
ANI	11.3 ± 1.0	17.6 ± 3.2 b	24.4 ± 4.6 a	39.2 ± 5.6 a	14.8 ± 4.0	20.4 ± 3.6
SSI	12.0 ± 0.9	31.0 ± 3.0 a	42.0 ± 4.3 a	66.3 ± 5.2 a	23.4 ± 3.6	20.0 ± 2.9
Mean	12.0 ± 0.3	27.2 ± 1.3	37.0 ± 1.8	59.5 ± 2.3	22.8 ± 1.6	20.4 ± 0.9

Means with same letters (a, b) on the same column do not differ by Tukey test ($P < 0.05$).
[a] NEE, NEI, CNI, ANI and SNI = extensive Nellore, intensive Nellore and intensive crossbred Canchim–Nellore, Angus–Nellore, and Simmental–Nellore, respectively.

Table 2
Contrasts between means of the sire breed-grazing system for latency to first attempt to stand up (AST), latency to stand up (ST) and latency to first suckling (FSU), in minutes

Contrast[a]	AST	ST	FSU
C1. NEE vs. NEI	1.48	−4.83	−8.92
C2. NEI vs. other intensive	3.68	14.40**	17.36**
C3. CNI vs. ANI and SNI	3.36	5.69	14.10
C4. ANI vs. SNI	−13.40**	−17.66**	−27.11**

** $P < 0.01$.
[a] NEE, NEI, CNI, ANI and SNI = extensive Nellore, intensive Nellore and intensive crossbred Canchim–Nellore, Angus–Nellore, and Simmental–Nellore, respectively.

The least square means of latency to first attempt to stand up (AST), latency to stand up (ST) and latency to first suckling (FSU) are presented in Table 1, according to sire breed-grazing system. Some contrasts of interest among these means are presented in Table 2. AST, ST and FSU were lower for ANI calves than for SNI ones. ST and FSU were higher for NEI calves than for the mean of the crossbred calves reared under intensive management (NEI versus [CNI + ANI + SNI]/3). No significant effect was observed for any of the variables studied for the contrast between Nellore systems (NEI and NEE), and between crossbred Canchim (CNI) compared with the mean of the other crossbred systems ([ANI + SNI]/2) (Table 2). In general, crossbred Angus calves (ANI) showed shorter latencies in all behavioural variables studied at birth (Table 1).

Relative to sex, females (19.1 min) were quicker ($P < 0.01$) than males (26.7 min) to suckle for the first time after they have stood up (ISS).

For category of the cow, calves out of primiparous cows received more ($P < 0.05$) attention by the mother in the first 15 min after birth than those out of pluriparous cows (13.0 min versus 11.1 min).

4. Discussion

The effect of year of birth on latency to first suckling may reflect numerous factors besides climatic and nutritional effects related to each year, such as differences in the genetic constitution of the animals in each sire breed-grazing system in each year, as the sires and part of the cow herd

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were different each year. We did not analyze climatic differences between the 2 years because we expected that including temperature, rainfall and humidity in the model would account for the differences. Average temperature (23.4 °C versus 22.7 °C), rainfall (4.3 mm versus 2.1 mm) and humidity (68.2% versus 60.9%) were very similar for the 2 years.

Effect of period of the year on attention of the cow toward the calf may be related to climatic differences among months. According to Cromberg et al. (1997), movement of the calf in the first hours after birth affects behaviour of the cow toward it. Therefore, since as in early autumn rainfall in Brazil is greater than in late autumn, and first attempt to stand up was influenced by rainfall ($P < 0.01$), it is possible that, due to higher precipitation, the calf delays its first movements, which would draw less attention of the cow.

Similarly, effect of time of day on latency to first attempt to stand up, greatest from 6:00 to 8:00 h (40.3 ± 5.1 min) and shortest from 14:00 to 16:00 h (15.8 ± 2.7 min), could be related to environmental conditions. Edwards (1982) observed greater latency to stand up at dawn, and the fact was related to lower air temperature in the first hours of the day.

Toledo (2001) studied environmental effects on zebu calves at birth using a mean index of temperature and relative humidity (ITU), observing negative correlations ($P < 0.01$) of latency to stand up (−0.29) and to suckle (−0.24) with ITU values. In this study, even crossbred zebu calves presented higher latencies to first attempt to stand up and to suckle with higher rainfall, while the latencies to stand up and to first suckling showed negative correlations ($P < 0.05$) with precipitation (−0.26 and −0.29, respectively).

Some studies have shown that effects of environmental factors on first activities of calves may depend on genetic characteristics of the animals. Josey et al. (1993) observed greater mortality rates with increased proportion of *Bos indicus* in crossbred *Bos indicus* × *Bos taurus* calves, and that this was positively related to increases in rainfall and lower air temperatures. These conditions may decrease heat loss, resulting in a chilling of the calf that would delay its first activities. These conclusions may be assessed both by the greater latency to first attempt to stand up in first hours of the morning, when environmental temperature is lower, and by the increase in latency to first attempt to stand up, in the interval from standing and suckling, in latency to stand up and in latency to first suckling as functions of the increase in rainfall (Fig. 1), as observed in this study.

Relative to latency to first suckling (FSU), no data were found in the literature involving crossbred calves, such as those used in this study. Independently of the sire breed-grazing system, FSU least square means ranging from 39.2 ± 5.7 to 74.8 ± 5.0 min, with a overall mean of 59.5 ± 2.3 min, obtained in this study were lower than those reported by Ardesch et al. (1995) for zebu breeds such as Nellore (111.6 min), Caracu (149.1 min), Guzera (197.8 min) and Gir (260.3 min) calves. Some other authors studying *Bos taurus* breeds also reported higher FSU values. Tshibangu et al. (1980), studying Dutch Friesian and Belgian and Blue White calves reported means of 228 and 597 min, respectively. Kiley-Worthington and De La Plain (1983) found values around 90–120 min in calves of several *Bos taurus* breeds. In the present study, despite the effect of sire-breed grazing system on latency to first suckling (FSU), all groups presented means that would be considered short and would allow an adequate acquisition of immunity from colostrum.

Some reports showed a relationship of birth weight of calf with latency to stand up and latency to first suckling. Lighter calves were observed to be quicker (Selman et al., 1970; Houwing et al., 1990). In this study, effect of birth weight on latency to first attempt to stand up (AST) approached significance ($P < 0.07$), showing an increase in AST with increasing birth weight. For the other traits studied, this effect was not significant (Table 1). However, in this study, birth weight of calf did not provide an explanation for the greater latencies of Nellore calves when

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Table 3
Least square means (±standard error), in minutes, of latency to first attempt to stand (AST), latency to stand up (ST), latency to first suckling (FSU), duration of first suckling (DSU), interval from standing to suckling (ISS), according to the category of the mother[a]

Category of the mother	AST	ST	FSU	DSU	ISS
Primiparous	29.5 ± 2.6	43.6 ± 3.9	64.6 ± 4.8	22.3 ± 2.6	21.4 ± 3.3
Pluriparous	25.0 ± 1.7	32.2 ± 2.5	60.2 ± 3.0	18.3 ± 1.9	24.4 ± 2.1

[a] Differences between primiparous and pluriparous were not significant ($P > 0.05$) for all traits.

compared to the crossbred ones, since NEI (31.7 ± 4.1 kg) calves were lighter than crossbred CNI (32.5 ± 2.6 kg), ANI (33.0 ± 3.2 kg) and SNI (33.0 ± 4.4 kg) ones.

Studies by Godfrey et al. (1991) and Carstens et al. (1997) showed that metabolic activity of *Bos indicus* calves at birth is lower than that of *Bos taurus* ones. According to Carstens et al. (1997), this difference is related to the greater relationship "surface area:body weight" and to the smaller quantity of thermogenically active brown fatty tissue in *Bos indicus* calves, which combine to produce less heat and to increase heat loss in *these breeds* compared to *Bos taurus* calves. Thus, the greater latencies observed in Nellore calves relative to crossbred ones may be related to lower thermogenic ability of these calves to adapt to the extrauterine environment, delaying beginning of first activities, especially in the present study, in which a large number of births occurred in rainy months.

In regard to category of the cow (primiparous versus pluriparous), despite its nonsignificant effect of category of cow ($P > 0.05$) on latency to first attempt to stand up, to stand up, to first suckling and to the duration of first suckling, the means of these traits tended to be greater for the offspring of primiparous cows (Table 3). Similar results were reported by Houwing et al. (1990).

The greater maternal ability of pluriparous cows has been reported in several studies, such as Brown (1998) and Felício (1998). These authors suggested that mammals are, in general, better mothers after the second pregnancy, and that this is both a consequence of learning and of neuroendocrine changes related to previous reproductive experience. In this study, the longer attention of primiparous cows toward their calves in the first 15 min after birth did not result in positive effects on latency to first attempt to stand up, to stand up and to first suckling. This is due to the fact that the longer attention of the cow toward the offspring may not be related only to care, but also to curiosity, and the mother licks, touches and pushes the calf more frequently. However, since in the initial phase it is more difficult for the calf to keep its balance, this curious behaviour of the mother makes it more difficult and delays the first activities of the calf.

5. Conclusion

Results showed that even purebred or crossbred indicus calves in subtropical environment need extra care when born in rainy days, especially in the first hours of the day. Even though Nellore calves are slower to stand up and to suckle as compared to the crossbred ones, the means presented by all groups are considered adequate for the acquisition of immunity from colostrum after birth.

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