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Ethology of cross-breed cows milked in the presence or absence of calves

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ABSTRACT. The behavior of crossbreed cows, milked in the presence or absence of their calves, was analyzed. The trial was conducted on the Dairy Cattle Sector of UESB School of Animal Science in Itapetinga BA Brazil. Twenty crossbreed Holstein x Gir cows were distributed in a randomized block design with 10 replications for each treatment for the experimental period of 31 days, during lactation. Results were analyzed by nonparametric chi-square test at 5% significance, except the variables time at the milking sector and milk production which were evaluated by analysis of variance and F test at 5% probability. Although cows with the presence of calves during milking had higher reactivity, behavioral activities and more time in the milking sector, milk production was not affected.

Keywords: lactation, production, reactivity, time.

Comportamento de vacas mestiças ordenhadas na presença ou na ausência de suas crias

RESUMO. Estudou-se o comportamento de vacas mestiças ordenhadas na presença ou na ausência de suas crias. O experimento foi conduzido no setor de Bovinocultura de Leite do Curso de Zootecnia da UESB, no município de Itapetinga, BA. Foram utilizadas 20 vacas mestiças Holandês x Gir, distribuídas em um delineamento em blocos casualizados, com dez repetições para cada tratamento sendo o período experimental de 31 dias durante a lactação. Os resultados foram submetidos à análise não paramétrica, utilizando o teste Qui-quadrado a 5% de significância, exceto as variáveis, tempo de permanência na sala de ordenha e produção de leite dos animais, que foram realizadas análise de variância e teste F a 5% de probabilidade. A produção de leite não foi afetada, embora as vacas manejadas com a presença da cria, durante a ordenha, terem apresentado maiores reatividades e atividades comportamentais e maior tempo na sala de ordenha.

Palavras-chave: lactação, produção, reatividade, tempo.

Introduction

Studies on animal behavior have a very important role in animal production since, in the case of rationalizing breeding methods, several management, feed and housing techniques that interfere and depend on behavior are being developed (PARANHOS DA COSTA; BROOM, 2001). According to Russi et al. (2011), the evaluation of well-being is foregrounded on the behavior shown by the animals. In fact, behavior is the manifestation of any effect that may be measured at certain instances, needing only an operational definition to characterize the measurement through observations.

In the main, research on breeding animals still focuses on the physiological area and only recently they have been directed towards ethology. Ethology may actually indicate the way towards a rationalization of animal breeding, especially in intensive production systems (PARANHOS DA COSTA; BROOM, 2001).

Behavioral standards reported to evaluate animal well-being have been employed in recent researches with dairy cows, through which the occurrence of certain categories such as flight, docility and approximation is described and quantified (PASSILLÉ; RUSHEN, 2005), coupled to reactivity, rumination and others (RUSSI et al., 2011) used to analyze management practices (WAIBLINGER et al., 2006). Normally these studies are conducted on the field (UETAKE et al., 2003) and follow management routines. In fact, one may describe the most pure state of animal behavior since it is not limited as in other types of evaluation with animals.

Within the context of the breeding of dairy cows, milking is one of the daily routine activities on farms and is the end of the production process which requires differentiated care. Doubts exist on the behavior of crossbreed dairy cows during the milking process. It may be asked whether the animals manifest a stress complex attributed to management, especially in the presence or absence of their calves, with consequences on their well-being and on production. In fact, dam-calf behavior is highly important for the improvement and preservation of the species (SOUZA et al., 2009).

Research on animal well-being should be conducted on farms so that the applicability of results would increase and the parameters validated. Current assay evaluated the behavior of cross-breed dairy cows milked in the presence or absence of their calves.

Material and methods

Current research was conducted at the Dairy Cattle Culture sector of the Animal Science Course of the Universidade Estadual do Sudoeste da Bahia (UESB), campus Juvino Oliveira, on the margins of BA 263 Road, Itapetinga, in the center-southern region of the state of Bahia, Brazil, approximately 571 km from the capital Salvador. The university lies at 15°14' 56" S and 40° 14' 52" W, at an altitude of 268 m. Average yearly rainfall is 867.5 mm, according to registers by the institution since 1995. Mean rainfall during the evaluation period was 14.1 mm, with average maximum and minimum temperatures respectively at 30 and 21°C.

Twenty multiparous crossbreed cows (Holstein x Gir) were used alternately in two treatments according to occurrence of births. The behavior of cows in two milking management systems was compared, or rather, milking in the presence and in the absence of calves, with ten replications for each treatment, during lactation, for a 31-day experimental period. Experimental design consisted of randomized blocks comprising the seasons in which birth occurred, spring and summer. During the lactation phase the dairy cows were maintained in management conditions similar to those undertaken at the Dairy Cattle Culture sector of the UESB.

Cows were milked once a day at 6h by a mechanical milking machine during the entire lactation period, in a milking hall with corridors and ditch. Milking was done by two experienced milking men working on alternate days. The cows were admitted one by one in the milking hall. In the case of cows milked in the presence of their calves, the latter were led towards the dam and tied to the mother´s front foot to stimulate milking secretion. After milking, the calves were led to the waiting room and remained there till the end of the milking process of all the dairy cows. The calves then received commercial milk, similar to the milking management system without the calves.

Dairy cows received sugar cane (*Saccharum officinarum*, RB 72-454) roughage sliced in the trough. The third cut sugarcane roughage consisted of soluble carbohydrates rates equal to 21° Brix measured by field refractometer with the addition of 1 g kg^{-1} of a mixture of urea and ammonium sulfate (9:1) plus concentrate. Feed was formulated according to NRC (2001) prescribed for productions at 8 kg of milk.day^{-1} and weight gain of 0.5 kg day^{-1} for calves. Roughage:concentrate ratio was 70:30, based on dry matter for cows´ diet. The calves received 1 kg day^{-1} of concentrate while water and mineral salt were provided *ad libitum*.

Tables 1 and 2 give the estimated proportions of the ingredients, based on the natural matter in the concentrates and the chemical composition of the roughage, respectively.

Table 1. Composition of ingredients, based on natural matter, in concentrates given to cows and calves

Ingredients	Concentrate (g kg^{-1} of natural matter)	
	Dairy cows	Calves
Ground corn grain	244	400
Soybean meal	100	166
Wheat meal	600	400
Urea	24	-
Bone flour	12	-
Ammonium sulfate	4	-
Mineral salt[1]	16	27
Common salt[2]	-	7

[1]Composition: Calcium = 185 g kg^{-1}; Phosphorus = 90 g kg^{-1}; Magnesium = 4 g kg^{-1}; Sulfur = 10 g kg^{-1}; Sodium = 117 g kg^{-1}; Selenium = 30 ppm; Copper = 1,500 ppm; Zinc = 4,000 ppm; Manganese = 1,200 ppm; Iodine = 150 ppm; Cobalt = 150 ppm. [2]Sodium chloride.

Roughage and concentrate samples were previously dried in a forced air buffer at 60°C and ground in a knife mill (1 mm sieve). Rates of dry matter (DM), crude protein (CP), ether extract (EE), mineral matter (MM), neutral detergent fiber (NDF), acid detergent fiber (ADF), non-fibrous carbohydrates (NFC) were obtained following method by Silva and Queiroz (2002).

Non-fibrous carbohydrates (NFC) were obtained by the equation below, following recommendations by Sniffen et al. (1992):

$$NFC = 100 - (\%CP + \%EE + \%MM + \%NDF)$$

where:

NFC = non-fibrous carbohydrates;

%CP = percentage of crude protein;

%EE = percentage of ether extract;
%MM = percentage of mineral matter;
%NDF = percentage of neutral detergent fiber.

Table 2. Chemical composition of sugar cane (*Saccharum officinarum*) and concentrates supplied to cows and calves.

Components	Roughage*	Concentrate	
		Cows	Calves
DM (g kg^{-1})	214.2	927.7	926.5
CP[1]	762	258.6	181.2
EE[1]	190	34.4	41.0
MM[1]	403	132.7	97.9
NDF[1]	629.9	519.9	487.5
ADF[1]	449.7	201.5	99.1
NFC[1]	234.6	54.4	192.4

DM = dry matter; CP = crude protein; EE = ether extract; MM = mineral matter; NDF = neutral detergent fiber; ADF = acid detergent fiber; NFC = non-fibrous carbohydrates.[1]g kg^{-1} DM. *Sugarcane with 1 g kg^{-1} of a mixture of urea and ammonium sulfate.

After birth, the calves were kept 24h with the dams in the maternal pen; on the second day the calves of the milking system without the calves were definitely separated from their dams and started to receive 4 L of milk a day. Calves received the usual care such as navel care with a solution of iodine during at least three days, coupled to the providing of colostrum of the first milking during the first 6 hours. In the milking system with the calves, the milking of the dams during the whole lactation period occurred without the taking of milk by the calves which also received 4 L of milk per day within an artificial milking system.

In the system with calves, the latter were taken to the milking hall to their respective dams at the instance of milking, whereas the calves within the milking system without calves did not have any contact with their dams. All calves from both systems were bred in individual wooden pens covered with roof tiles. They were tied with 1.50 m cords fixed to the floor by an iron hook at one end, with a numbered label for identification. Distance between animals was approximately 1.20 m to avoid any physical contact. They were provided diet *ad libitum* till they reached 1 kg day^{-1} plus 4 L of milk per animal a day in two meals. It should be underscored that fresh milk was provided to the calves. The position of the calf pens was changed according to the hygiene conditions of the place, depending on rain. The calves were release from their individual pens at 90 days of age and placed in two collective pens separated according to the management system.

Prior to the experimental evaluations all the animals were clinically examined but no physical ailment that would make them restless, and thus compromise results, was diagnosed. Evaluations were undertaken daily during the milking process. The following scores were given to register behavior: reactivity and activity, registered during the preparation of the udder, comprising pre-disinfection of the nipples, fixation and removal from nipplers and post-milking disinfection. The number of times the event occurred was not evaluated but only whether it took place or not. Reactivity is a behavioral response that shows present animal stress conditions, perceived by forward or backward movements, movement of the hind legs and absence of any movement. Activity score comprised the variables rumination, urination, defecation and vocalization, characterized by the emission of mouth sounds, characteristic of the species, at the milking instance.

Besides the described behavioral variables, the time spent in the milking hall, from the moments the dams were admitted to the milking hall till their release, was also individually registered, in minutes. Milk daily average and total were further registered. Non-parametric analysis on experimental, reactivity and activity scores were performed by χ^2 test at 0.05 significance. Simple observations for each animal.

Further, χ^2 results were obtained by the following formula, proposed by Pearson (1886):

$$\chi^2 = \sum [(o - e)^2 / e]$$

where:
o = frequency for each class;
e = expected frequency for that class.

Actual frequencies were directly retrieved from samples´ data and expected frequencies were calculated from the former. When observed and expected frequencies almost coincide, χ^2 rate is low. However, when there are great divergences, deviant (o – e) is also big, with χ^2 high rates. Significance level is the maximum probability error when a hypothesis is rejected. The higher the χ^2 rate, the more significant is the relationship between the dependent and independent variable. Behavior occurrence frequency totaled 612 observations with 366 for the milking system with calves and 246 without calves. Time spent in the milking hall and milk productions were evaluated by analysis of variance (ANOVA), by the System of Statistic and Genetic Analyses - SAEG (RIBEIRO JR., 2001) and F test at 5% significance.

Results and discussion

All reactive behavior of the dairy cows for the milking system in the presence of calves had higher frequencies when compared to the milking system without the presence of calves (Table 3). Results show that activities applied in the management of

dairy cows milked with the presence of their calves, such as the milkman´s movements to bring the animals from the calf pen up to his arrival and the accompaniment of the calves during the milking process and their quittance, modify the frequency of reactive behavior when compared to that of dairy cows milked in the absence of their calves.

Table 3. Absolute and relative frequency and χ^2 rates for reactive behavior of cows milked in the two management systems.

Items	Behavior			
	HM	FBM	MHL	LM
Presence of calves				
Absolute frequency	264	164	149	148
Relative frequency (%)	75	80	60	52
Absence of calves				
Absolute frequency	90	41	98	139
Relative frequency (%)	25	20	40	48
χ^2	76.23	52.30	23.57	15.25
Probability	0.00000	0.00000	0.00000	0.00942

HM = head movement; FBM = forward or backward movement; MHL = movement of hind legs; LM = lack of any movement. Frequency of total behavior occurrences = 612 observations in the two treatments in which the non-parametric test χ^2 was employed at 5% probability.

Reactivity is the animal´s specific expression to a stressing stimulus which is measured by the movements of its hind parts. Current research evaluated the reactive behavior of cows with regard to the presence or absence of their calves during the milking process. Several situations exist on a farm that may provoke the animals to manifest stress, such as a different milking timetable, shock stick, nutritional deficiencies, social pressure of dominating cows, the presence of adverse milk people, flies (BREUER et al., 2000). Current analysis also shows that, when compared to the calves´ absence during milking, the influence of the calf´s presence may also demonstrate a maternal behavior. However, in the treatment with the milking system without calves, dairy cows had low movement frequencies when compared to those of the other system. The above characteristics reveal ease of management, with results on the primordial health care in dairy cattle culture.

Breazile (1988) describes that stressing conditions during the milking procedures may cause milk retention. Adrenalin released in the blood during stress has an opposing action to oxytocin in the process of milk discharge. Although most authors in the literature generally attribute cows´ reactivity to a surrounding aggressive agent and to physiological mechanisms, current study showed great agitation in the cows only when they perceived the calves´ presence.

Absolute and relative frequency rates and the χ^2 value of the cows´ behavior during milking in the presence or absence of their calves show that urination, defecation and mooing were more frequent in treatment with the presence of the calf ($p < 0.05$), probably a maternal behavior, whereas it was similar for the variable rumination ($p > 0.05$) by χ^2 test (Table 4). Breuer et al. (2000) reported that urination, defecation and movements are associated with fear and stress during milking.

Table 4. Absolute and relative frequency and χ^2 rates for activity behavior of cows milked in two management systems.

Items	Behavior			
	Rumination	Urination	Defecation	Mooing
Presence of calves				
Absolute frequency	71	62	43	106
Relative frequency (%)	61	87	86	99.1
Absence of calves				
Absolute frequency	46	9	7	1
Relative frequency (%)	39	12	14	0.9
χ^2	0.05	25.30	15.54	83.15
Probability	0.82912	0.00000	0.00008	0.00000

Behavior occurrence frequency totaled 612 observations in the two treatments by non-parametric test χ^2 at 5% probability.

Similarity in rumination occurrence may be explained by cows´ pattern in the presence of their calves since the latter accompanied their dams throughout lactation and, consequently, the rumination behavior did not occur only when they were at ease.

Fell and Shutt (1986) measured the cortisol levels in cattle and showed that the animals may become accustomed to the routine procedures of management and adapt themselves hitherto.

Time spent by the cows in the milking hall was also evaluated to verify whether management evaluated affected the variable (Table 5). Difference ($p < 0.05$) was reported between the treatments. In other words, cows with their calves spent more time in the hall (8.18 min.) than those without calves (7.43 min.). The above results may be attributed to the management with the calves present during the milking procedures. Although the calves´ pen was built close to the milking hall to minimize time, the milkman had to come out of the ditch where the mechanical milking machine lay, place a leash on the calf, take it to the next cow and tie it to its front leg. These minutes were the difference on evaluation.

Table 5. Time spent in the milking hall in the two management systems.

Treatment	Time (minutes)	CV	P
Presence of the calf	8.18	6.32	0.00000
Absence of the calf	7.43		

CV = Coefficient of variation; P = Probability at 5% significance.

Mean daily production and total production of milk obtained from cows managed within the two management systems, with and without the calves, are

shown in Table 6, with no significant results ($p > 0.05$).

Table 6. Production of milk by cows milked within the two management systems.

Variable	Milking system		CV(%)	P
	Presence of calf	Absence of calf		
Mean daily production (kg)	8.09	6.93	6.16	NS
Total production (kg)	2044.6	1753.9	3.34	NS

CV = Coefficient of variation; P = Probability at 5% significance. NS = Not significant ($p > 0.05$).

Although cows in the management system with calves were more reactive and revealed better maternal behavior during activities, as shown in Tables 3 and 4, the interference in milk production failed to occur.

Conclusion

Crossbreed cows managed without their calves during the milking process have better behavior results and justifies this type of management.

References

BREAZILE, J. E. **The physiology of stress and its relationship to mechanisms of disease and therapeutics**. Philadelphia: Saunders Company, 1988.

BREUER, K.; HEMSWORTH, P. H.; BARNETT, J. L.; MATTHEWS, L. R.; COLEMAN, G. J. Behavioural response to humans and the productivity of commercial dairy cows. **Applied Animal Behaviour Science**, v. 66, n. 4, p. 273-288, 2000.

FELL, L. R.; SHUTT, D. A. Adrenocortical response of calves to transport stress as measured by salivary cortisol. **Canadian Journal of Animal Science**, v. 66, n. 3, p. 637-641, 1986.

NRC-National Research Council. **Nutrient requirements of dairy cattle**. 7th ed. Washington, D.C.: National Academy, 2001.

PARANHOS DA COSTA, M. J. R.; BROOM, D. M. Consistency of side choice in the milking parlour by Holstein-Friesian cows and its relationship with their reactivity and milk yield. **Applied Animal Behaviour Science**, v. 70, n. 3, p. 177-186, 2001.

PASSILLÉ, A. M.; RUSHEN, J. Can we measure human-animal interactions in on-farm animal welfare assessment? Some unresolved issues. **Applied Animal Behaviour Science**, v. 92, n. 3, p. 193-209, 2005.

PEARSON, K. **A history of the theory of elasticity and of the strength of materials from galilei to the present time**. Cambridge: Cambridge University Press, 1886.

RIBEIRO JR., J. I. **Análises estatísticas no SAEG** (Sistema para análises estatísticas). Viçosa: UFV, 2001.

RUSSI, L. S.; ROSA, M. S.; BARBALHO, P. C.; COSTA-E-SILVA, E. V.; ZÚCCARI, C. E. S. N. Etologia Aplicada em Bovinos. **Revista de Etologia**, v. 10, n. 1, p. 45-53, 2011.

SILVA, D. J.; QUEIROZ, A. C. **Análise de alimentos**: métodos químicos e biológicos. 3. ed. Viçosa: UFV, 2002.

SNIFFEN, C. J.; O'CONNOR, J. D.; VAN SOEST, P. J. A net carbohydrate and protein system for evaluating cattle diets: II. Carbohydrate and protein availability. **Journal of Animal Science**, v. 70, n. 11, p. 3562-3577, 1992.

SOUZA, E. A.; ANDRÉA, M. V.; SANTOS, C. S.; PARANHOS DA COSTA, M. J. R; CALMON DE BITTENCOURT, T. C. B. S.; MARCONDES, C. R.. Relações materno-filiais e sua influência no peso pré-desmama de animais Nelore da Bahia. **Archivos de Zootecnia**, v. 58, n. 224, p. 729-732, 2009.

UETAKE, K.; MORITA, S.; KOBAYASHI, Y.; HOSHIBA, S.; TANAKA, T. Approachability and contact behavior of commercial dairy calves to humans. **Animal Science Journal**, v. 74, n. 1, p. 73-78, 2003.

WAIBLINGER, S.; BOIVIN, X.; PEDERSEN, V.; TOSI, M. V.; JANCZAK, A. M.; VISSER, E. K.; JONES, R. B. Assessing the human-animal relationship in farmed species: A critical review. **Applied Animal Behaviour Science**, v. 101, n. 3-4, p. 185-242, 2006.

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