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Nakanishi, Yoshitaka

Kuju Agricultural Research Center, Faculty of Agriculture, Kyushu University

Maehara, Yasunori

Kuju Agricultural Research Center, Faculty of Agriculture, Kyushu University

Masuda, Yasuhisa

Laboratory of Forage Science and Animal Behaviour, Faculty of Agriculture, Kyushu University

Umetsu, Raizaburo

Kuju Agricultural Research Center, Faculty of Agriculture, Kyushu University

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Some Behavioural Aspects of Cow-calf Relationships in a Herd of Beef Cattle in Semi-confinement

Yoshitaka Nakanishi, Yasunori Maehara*, Yasuhisa Masuda**
and Raizaburo Umetsu

Kuju Agricultural Research Center, Faculty of Agriculture,
Kyushu University 46-10, Oita 878-02, Japan

**Laboratory of Forage Science and Animal Behaviour, Faculty of Agriculture,
Kyushu University 46-06, Fukuoka 812, Japan

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Behavioural observation was made on a herd of 6 dehorned Japanese Black Cows and **their calves during** 3 consecutive days (0900-1700 h, exclusive of 1500-1530 h) to investigate the **cow-calf** relationships and the social interactions between cows within the herd when kept together in a dry-lot. The intensive nursing incidents and maternal lickings occurred between 0900 and 1000 h and between 1530 and 1700 h. It appeared that such a relatively high-level behavioural synchronization was related to feed delivery time. The average number of nursing events per cow was 5.1; the average time spent nursing 32.2 min; the average nursing *time* per bout 7.9 min and the average number of maternal lickings 10.4. Older calves suckled less frequently, spent relatively less time suckling and more suckling time per bout. Dams of older calves also licked their own calves less frequently. Cows had a significantly higher frequency of lickings toward their own calves than that toward other cows ($P=0.05$). A total of 35 interruptions of nursing (vs 92 nursing events) induced by agonistic encounters between dams was observed. Interrupted nursing occurred more frequently between 1400 and 1500 h. There was a close negative association between social order and the number of interrupted nursings ($\tau=-0.966, P<0.01$), suggesting that cows lower in the order suffered more interruptions of nursing and their calves were in relatively stressful condition.

INTRODUCTION

Under beef cow-calf farming systems, the performance of natural suckling calves is a matter of paramount importance, and the extent of association between a cow and her calf influences calf growth. The performance of the calf is mainly dependent on its dam's mothering ability (Drewry et al., 1959). The dam's milk production is especially important for calf performance during the initial nursing period (Neville, 1962; Melton *et al.*, 1967; Gleddie and Berg, 1968; Jeffery and Berg, 1371). However, even if the cow produces more milk, her calf may not achieve good development without dam's assured and stable nursing. Therefore, a more detailed knowledge of maternal behaviour of beef cows is of fundamental importance to improving cow-calf management under beef production systems.

Considerable information is available on nursing behaviour of individually housed cow-calf pairs or of suckler herd grazed on pasture (Drewry *et al.*, 1959; Hutchison *et*

* Present address: Ito Ham Inc., Nishinomiya-shi, Hyogo 663, Japan.

al., 1962; Walker, 1962; Wagnon, 1963; Hafez and Lineweaver, 1968; Ewbank, 1969; Somerville and Lowman, 1979; Reinhardt and Reinhardt, 1981; Wood-Gush *et al.*, 1984; Odde *et al.*, 1985; Day *et al.*, 1987; Lidfors and Jensen, 1988; Sato and Wood-Gush, 1988; Shimada *et al.*, 1989). In such situations, it seems that the cows can direct nursings toward their calves relatively undisturbed and securely. By contrast, it may be expected that when two or more cow-calf pairs are kept together in a restricted area, agonistic encounters will occur more frequently and thereby the nursing behaviour of a subordinate animal is often disturbed by a dominant animal. Although there have been a few studies concerning cow-calf behaviour of group-fed beef cattle in confinement (Schake and Riggs, 1969; Lewandrowski and Hurnik, 1983), the effect of social environment on cow-calf behaviour under such conditions has not yet been investigated in detail. Therefore, it appears urgent to clarify the cow-calf relationships in a herd of beef cattle in total- or semi-confinement and to study the effects of agonistic interactions with herdmates on their nursing and calf performance from the viewpoints of health, welfare and production of farm animals kept under modern intensive confinement husbandry systems.

This investigation was performed as a pilot study on behavioural management of beef cows and calves under a dry-lot feeding system. The purposes of the present study were to investigate maternal behaviour (nursing and maternal licking toward calf), agonistic behaviour and social licking interactions of dehorned Japanese Black Cows and their calves kept in a dry-lot in the daytime and to examine the effects of social environment on their nursing behaviour.

MATERIALS AND METHODS

Animals and management

Six dehorned Japanese Black Cows (3-5 years of age) with their 2 female and 4 male calves were used for this study. The calves ranged in age from 13 to 83 days and in live weight from 33 to 83 kg at the commencement of observation. The cows and their calves were fed as a herd (over 1 wk before the start of the current study) at the Kuju Agricultural Research Center (alt. 950 m). The herd was housed in a loose barn (58.0 m²) from the evening to next morning and kept in a 153.3 m² dry-lot adjacent to the barn in the daytime. Cows received concentrate (at 0830 h) and lucerne hay cubes (at 0830 and 1500h) at feed manger with stanchions in the lot. Calves were allowed access to grass hay in the barn from the evening to next morning. Water and salt were given *ad libitum* in the barn and the lot.

Observations

All cattle were numbered on their sides with decolorizer for individual identification. The whole herd behaviour was observed in a dry-lot between 0900 and 1700 h during 3 consecutive days. However, behavioural data were not recorded during 1500-1530 h, because of feed delivery time for cows. During the feed delivery time, the calves were not allowed to have physical contact with their dams. Nursing frequency, duration of nursing (total time nursed) and frequency of maternal licking to her own calf were recorded for each cow. Definition of a nursing bout was made according to Day *et al.* (1987) who presented it as 'any detectable period of calf-teat contact that

was subjectively determined to represent suckling'. Average nursing time per bout was estimated by dividing total time nursed by nursing frequency. Agonistic behaviour (fighting, bunting, pushing, threatening and avoiding) and social licking interactions between cows were also recorded during the observation period, and the dominance order was determined from the observation of agonistic interactions. In addition, the number of nursing episodes interrupted by agonistic encounters with other cows was recorded for each animal. The interruption of nursing involved a suckling drive suppressed just before calf-teat contact.

Data analyses

Since it has been shown that there was no sex difference in suckling behaviour of Zebu and beef calves within 10 months of age (Reinhardt and Reinhardt, 1981; Odde *et al.*, 1985; Lidfors and Jensen, 1988; Shimada *et al.*, 1989), calves were not separated by sex for data analyses in this study. Behavioural data were analysed by non-parametric statistical procedures (Siegel, 1956). Kendall's rank correlation analysis was used to examine the interrelationship of behaviour variates to calf age or dam's social order.

RESULTS AND DISCUSSION

Nursing behaviour and maternal licking interactions

A total of 92 nursing events and 187 maternal lickings was observed during 3-day daytime period (0900-1700 h, exclusive of 1500-1530 h). Figures 1 and 2 show the diurnal variations in nursing frequency and maternal licking interactions of cattle. There were definite peaks in nursing activity between 0900 and 1000 h and between 1530 and 1600 h. The occurrence of these peaks appeared to be related to feed delivery time and individual feeding using stanchion (adequate feed accessibility resulted from no feed competition between cows); a psychological stability following satiation (after 0830 and 1500 h), motivated cow's nursing drive. As a result, a relatively marked synchronization of nursing behaviour in the cows occurred between 0900 and 1000 h and between 1530 and 1600 h. Similar phenomenon in nursing (synchronized nursing after feed delivery) was found by Shimada *et al.* (1989) who observed the diurnal pattern of nursing in Japanese Black cow-calf pairs housed in separate pens. Reinhardt and Reinhardt (1981) also found synchronized nursing behaviour of grazing Zebu cattle and they ascribed the synchronization to sympathetic induction, i.e. the sight of one calf suckling stimulated another calf's behaviour. Distribution of maternal licking interactions throughout the observation period showed a trend similar to nursing pattern.

Table 1 shows the means and ranges of nursing behaviour and maternal licking interactions of cattle during observation period. The average number of nursing events per cow obtained from the present study nearly coincides with 4.9 times of Lewandrowski and Hurnik (1983) who observed daily nursing behaviour of beef cattle housed 4 cow-calf pairs per pen. Although the data on nursing behaviour during the nocturnal period were not collected in this study, many workers reported that 'most nursing activities of beef cattle occurred in the daytime (Drewry *et al.*, 1959; Walker, 1962; Schake and Riggs, 1969; Lewandrowski and Hurnik, 1983; Odde *et al.*, 1985; Day

et al., 1987). From the present findings and other work it appeared that daytime nursing activity was nearly representative of 24 h nursing activity.

The relationship between nursing behaviour and maternal licking with calf age are shown in Table 2. The frequency of nursing and total time nursed were negatively correlated with calf age ($P < 0.05$ and $P < 0.10$), indicating that cows with older calves nursed less frequently and tended to spend less time nursing. Additionally, it was shown that cows with older calves had longer nursing time per bout than those with

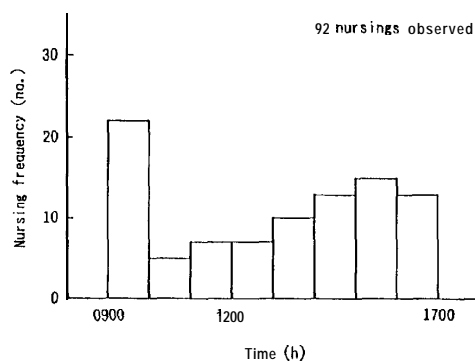


Fig. 1. Nursing frequency within a herd during three observation days (exclusive of 1500-1530 h).

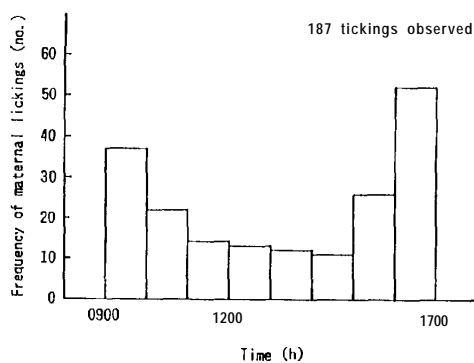


Fig. 2. Frequency of maternal lickings toward dam's own calf within a herd during three observation days (exclusive of 1500-1530 h).

Table 1. The means and ranges of nursing behaviour and maternal licking interactions for each cow during observation period.

Item	Mean	Range
Nursing events (no.)	5.1	2-16
Total time spent nursing (min.)	32.2	12.2-50.8
Nursing time per bout (min/no.)	7.9	2.9-16.1
Maternal licking interactions (no.)	10.4	4-19

Table 2. Kendall's rank correlation coefficients (τ) between nursing and maternal licking behaviour and calf age.

	Calf age
Nursing events	-0.745 *
Total time spent nursing	-0.600 +
Nursing time per bout	0.733 *
Maternal licking interactions	-0.733 *

Cow having the most nursing or licking activities was ranked as 1 and the oldest calf was ranked as 1.

+ $P < 0.10$, * $P < 0.05$.

Table 3. Frequencies of maternal licking toward dam's calf and social licking interactions with other cows within a herd.

Item	Observation days			
	1st	2nd	3rd	Mean
Maternal lickings (no.)	65	61	61	62.3
Social lickings (no.)	25	22	26	24.3

“Total of 6 cows.

Values for maternal and social lickings were significantly different ($P = 0.05$, Fisher exact probability).

younger calves ($P < 0.05$). The relationship between nursing events and calf age in this study is generally consistent with other studies on beef or Zebu cattle under grazing or individual feeding conditions (Drewry et al., 1959; Hutchison et al., 1962; Walker, 1962; Wagnon, 1963; Ewbank, 1969; Reinhardt and Reinhardt, 1981; Le Neindre, 1982; Day et al. 1987; Shimada et al., 1989). A significant correlation between maternal lickings and calf age ($P < 0.05$) suggested that cows with older calves directed less licking toward their calves. Kiley-Worthington and de la Plain (1983), Wood-Gush et al. (1984) and Sato and Wood-Gush (1988) reported that the interactions between a cow and her calf including maternal licking tended to decrease with calf's age.

Table 3 shows frequencies of maternal lickings and social licking interactions with other cows in the herd. Cows devoted significantly more lickings (2.6-fold) to their calves than to other cows for 3 observation days ($P = 0.05$, Fisher exact probability). This supports the general hypothesis that maternal bond between dam and her offspring is much stronger than social attachment between herdmates (Le Neindre, 1982, 1989; Kiley-Worthington and de la Plain, 1983; Veissier et al., 1990).

Although it was argued that the mother-young bond was (or not) weakened by the formation of 'crèche' of calves (Wood-Gush et al., 1984), there was no evidence of 'creche' as described by Kilgour and Dalton (1984) and Arnold (1985) in the present study. The lack of 'creche' in the herd is probably because the calves could get sight of their dams easily in a small corral (dry-lot) unlike under extensive grazing conditions.

Relationship between nursing behaviour and agonistic interactions with other cows

It is suggested that in the dry-lot which is restricted in area, social impact within a herd is much stronger (increase in frequency of agonistic interactions) than in extensive grazing conditions (Kondo et al., 1989). Under the dry-lot feeding condition in this study, some effect of a social environmental factor (the presence of other cows) on the cow-calf relationship was suggested, though there was a close association between a cow's nursing behaviour and her calf's age (Table 2). Actually, a total of 35 interruptions of nursing (resulted from agonistic encounters between cows) were observed. Figure 3 shows diurnal variation in the number of interrupted nursings of cattle. Interrupted nursing occurred more frequently between 1400 and 1500 h, and the pattern was definitely different from the nursing behaviour pattern. A possible explanation for this phenomenon may be as follows; during 0900-1000 h and 1530-1600 h for the observation days most cows directed nursings toward their calves (synchronization of nursing behaviour), resulting in relatively lower frequency of interrupted nursing. Waggon (1963) reported that nursing behaviour of beef cows on a California range was partly disturbed with the cows' fighting for supplements. In this study, the interrupted nursing of the cows was elicited when some agonistic encounters occurred during a time of day other than feeding time. There are two possible reasons for this difference in the frequency distribution of interrupted nursing between the two studies. One is that there was no feed competition between cows during feeding time in this study; individual feeding using stanchions never caused interruption of nursing. The other is that confrontations with herdmates (agonistic encounters in the herd) occur more frequently in a corral than on extensive range as suggested by Kondo et al. (1989), so that the confrontations partly induced the interrupted nursing.

Relationship between interrupted nursing and cow's social order

Relationship between the number of interrupted nursings and a cow's social order was tested by Kendall's rank correlation method. There was a significantly high negative correlation between social order of cow and the number of interrupted nursings ($\tau = -0.966$, $P < 0.01$), indicating that lower ranking cows had more interruptions of nursing and their calves were subjected to social stress. This phenomenon is

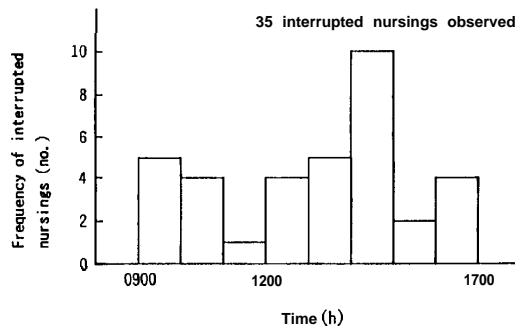


Fig. 3. Frequency of nursings interrupted by other cows within a herd during 3 observation days (exclusive of 1500-1530 h).

presumably due to increased confrontations between animals in a limited lot space (semi-confinement condition) as mentioned above. However, how stressful it is for subordinate cows to suffer disturbed nursing is not known.

CONCLUSION

Results of this study suggested that under the current daytime dry-lot feeding system utilizing a space allowance of 25.6 m² per cow-calf pair and individual feeding stanchions, the detrimental behavioural response of cow-calf to social environment within the herd was mainly manifested by interrupted nursing by dominant cows. With higher stock density (decrease in space allowance per animal), increased feed competition among animals or social disruption (e.g. exchange of strange cow-calf pairs between groups), interrupted nursings may be expected to increase. At present it is difficult to judge how stressful it is for a cow to have interrupted nursing or how much interrupted nursing impairs her calf's performance. Further information on the relationship between nursing behaviour and social environment under different feeding conditions are required in order to determine the most effective cow-calf group management.

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