

Changes in the relationship between Hungarian Grey cows (*Bos primigenius taurus Hungaricus*) and their calves in the period from calving to four months of age

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SUMMARY

The ability of cows to care for their offsprings is a very important trait concerning beef cattle. Maternal instincts are highly influenced by breed, specific cow, and social and rearing environment. In 2020, at the Szamárháti farm of the Tiszatáj Public Foundation, we selected 15 dam-calf pairs and studied them for four months from the birth of the calves. We grouped calf-rearing behaviors according to strength and analyzed the related changes during the program. At the beginning of the relationship, "standing close to each other" (53%) and "suckling" (24%) characterized the pairs. After the first month, "standing or lying separated" grew by 69%, and "vocalization" by both animals fell by 66%. Even though the daily frequency of suckling decreased by 34% as the calves grew older, it remained a typical element of the relationship. Over time, the bond between the animals gradually weakened. This natural process of separation takes a month to complete.

Keywords: behavior, Hungarian Grey cattle, offspring care, dam, animal welfare

INTRODUCTION

Animal behaviours are driven by two major instincts: to sustain themselves (by obtaining food), and to sustain their species. Both are needed for the survival of the species, that is, to transfer the genetic material of the individual (Széky, 1979). Like any other animal, cows demonstrate specific behaviours in terms of taking care of their calves, the purpose of which is to make the offspring capable of living independently. Besides ensuring the survival of the species, these behaviours also support the development of social skills. That is why offspring care is considered a social behaviour (Széky, 1979). In the case of cattle, females are involved in offspring care. According to the theory of parental investment, all reproductive behaviours and actions require measurable energy (Trives, 1972). Cows produce only a few offspring with a huge energy investment. Offspring care is an investment in the calves.

In the class of mammals, the ability to take care of the offspring is crucial for the survival of the species. It requires extra energy from the female and means survival for the offspring. In terms of farming, this ability strongly affects production and profit (Gonyou and Stookey, 1987). Mothering ability mainly relates to beef cattle. Good mothering ability means that the calf is provided with enough milk through suckling to develop properly. In this context, dams are also supposed to protect their calves from other individuals and refuse to suckle other dams' calves. This trait is usually measured by the live weight of the calf on the 205th day of its life (time of weaning) (Holló and Szabó, 2011). Prolactin, a hormone involved in the milk production of cows, is produced in the frontal lobe of the pituitary gland (Holló and Szabó, 2011). This

hormone has been identified in other species as well and associated with the intensity of maternal instincts.

To reduce disorders of technology in connection to rearing calves and operation of maternal instincts, it is imperative to ensure an optimal rearing environment for the cows. Cows should be allowed to give birth to their calves away from other cows so that they can establish a relationship with the offspring immediately after calving (Gonyou and Stookey, 1987). Reproductive capacity and maternal instincts are equally important for beef and dairy cattle however, in the case of beef cattle, cows must be able to establish a stronger and lasting bond with their calves. They also have to protect, suckle and rear their calves until separation. In the case of dairy cattle, calves are separated early, which means that, compared to beef cattle, the selection for maternal behaviours can be less strict. The maternal traits of domesticated cattle are very similar to those observed in their wild counterparts. These behaviours enable dams to establish a relationship with their calves and protect them. Dam-reared calves demonstrate a higher level of social activities than those separated right after calving and reared alone (Neindre and Sourd, 1984; Krohn et al., 1999; Hanninen et al., 2005). Breeding programs aimed at increasing the number of beef calves should consider the quality of the relationship between dams and their calves, as the lack of a strong bond between the two animals may hurt the mothering ability of heifers in the future (Price et al., 1986). The most spectacular period of offspring care is the one that takes place right after calving. Almost immediately after calving (within 1–7 minutes), the dam starts to lick the calf dry (Keyserlingk and Weary, 2007; Ramli, 1987; Neindre, 1989; Houwing et al., 1990; Vandenheede et al., 2001). Licking positively affects the biological processes of the calf, including its breathing,

circulation, urination, and defecation (Metz and Metz, 1986). Based on observation, usually, the mother licks her calf starting from the head and proceeding towards the rear. Sometimes, licking occurs in the opposite direction, and 1–2% of the dams refuse to lick their calves for some reason (Gere, 2003). The reason behind this ancient instinct is to eliminate the odor that might attract predators. Presumably, dams eat the placenta for the same reason (Edwards and Broom, 1982; Kristal, 1980; Lent, 1974). The offspring of grazing species that can stand up soon after birth can follow the herd and run from predators. Until then the dam hides the young and returns to suckle it regularly during the day (Haupt and Wolski, 1982). In artificial rearing conditions, these are demonstrated in taking the colostrum (Kovács, 2007). On many farms, calving takes place during winter. By licking the fur of the calf, the cow significantly reduces heat loss due to evaporation. Licking covers 30–50% of the first hour after calving (Edwards and Broom, 1982; Lidfors and Jensen, 1988). If for some reason, licking does not take place (the dam starts to lick the calf of another cow, or does not lick at all), it significantly increases the rejection of the calf by the dam, which leads to the death of the calf (Klopfer et al., 1964; Hudson and Mullord, 1977). Ten % of new-born calves are not licked by their mothers in the first 6 hours (Edwards and Broom, 1982; Lidfors and Jensen, 1988; Illmann and Spinka, 1993). The calf receives intense care in the first 30–40 minutes of its life (Koavlcik et al., 1980). As a result, it stands up and starts to suckle. In 56% of the cases, licking is accompanied by suckling (Neindre, 1984; Veissier et al., 1990). For the cow, 5 minutes of contact (licking) with the calf is enough to maintain a bond for 12 hours of separation. However, 24 hours of separation after calving proved to be too much. Upon reunion, cows did not accept their calves, or only with assistance (Hudson and Mullord, 1977). In case of separation immediately after calving, it may take days for cows, especially for those with their first calves, to re-establish a bond with the young (Neindre and D'hour, 1989).

Suckling is another form of offspring care, which is of high importance in the case of mammals, including cattle. As the survival of calves depends on the success of suckling, they must be strongly motivated to suck in this period, and the lack of suckling should hurt the well-being of the calf (Passillé, 2001). Suckling is an important behaviour for the calf, because it may affect the secretion of the metabolic hormone, directly affects the metabolic processes, reduces the motivation to suckle, and stimulates milk intake (Krohn et al., 1999; Passillé and Rushen, 1997).

It is good to know the behaviour used by the calf for getting food because by restricting this we can influence its physiological response to food (Passillé and Rushen, 1997). In terms of the length of the first suckling, there is a difference between heifer and bull calves. Heifer calves suckle longer and are more active during the process (Lidfors and Jensen, 1988), though bulls are born with bigger birth weight than heifers (Dufty, 1973), which increases the risk of dystocia (Bendixen et al., 1986). Dystocia itself may result in

problems regarding how the dam accepts the calf, which means that bull calves may need more human assistance (Lidfors, 1985). In the first weeks, the milk of the dam represents the single source of food for the calf. The maternal effect of the dam is highly important and can be measured by the number and quality of calves (Lengyel, 2005). The main elements of offspring care are taking care of the new-born calf, providing the opportunity to suck, and protecting the calf. Weaning weight is one of the most important measures in terms of value. In its variance, the availability of the dam's milk constitutes 2–7%, while environmental factors affecting milk production account for 5–15% (Kovács, 2005). In the offspring care of beef cattle, the availability of the dam's milk is one the most important factors. Suckling is a learned skill, and this is why older, more experienced cows are better caregivers (Neindre and D'hour, 1989). Other authors found no correlation between the age of the cow and the frequency of suckling (Kovács et al., 2007). Suckling shows daily dynamics. It is highly intense and reaches its peak in the morning hours. Smaller peaks can be observed around noon and in the evening hours. Suckling at night is not typical (Kovács et al., 2007). Over time, the daily frequency of suckling decreases (Kovács, 2005), but the length of suckling increases (Kour et al., 2021). Some authors claim that the sex of the calf does not affect the number of suckling per day, and there seems to be a slight correlation between the daily number of suckling and weaning weight (Kovács et al., 2007). Suckling is more typical in the morning and late afternoon. On the first day after their birth calves spend 74% of their time with their mothers. The pair tries to stay away from the rest of the herd. In the first week, calves spend approximately 10% of the time alone, when their mothers eat with the rest of the herd (Vitale et al., 1986). This is the period of "hiding" when calves have contact almost only with their mothers. In 95% of the time, the pair spends together the mother licks the young. In time, the calf begins to spend more time with other calves (Vitale et al., 1986). Before the age of 5 months, the calf spends more than 50% of the time lying. Between the ages of 3 and 5 months, grazing time is increased from 4.8 to 6.0 hours (Neindre and Petit, 1975). Before the age of 5 months, the calf sucks 3–6 times a day, the total amount of time spent sucking is 30 minutes. During suckling, the dam usually licks the calf. As bull calves age, interaction with other members of the herd becomes more frequent (Neindre, 1984). We aimed to find out how the different forms of contact between the dam and the calf (vocalization, sniffing, licking) change as the calf ages. Literature mainly includes information on changes in suckling, the strongest contact element, but fails to provide information regarding the changes of other elements. To identify the best way for weaning, it is important to study all elements concerning changes in their strength.

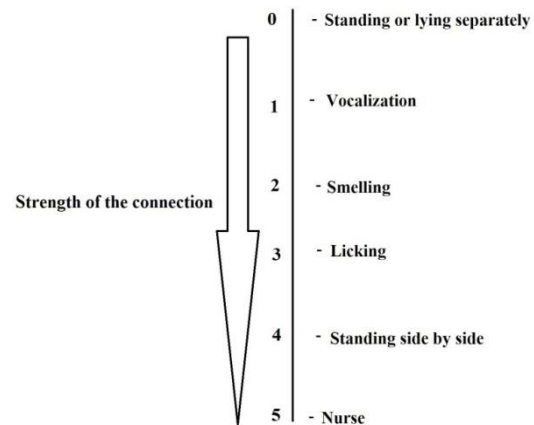
MATERIALS AND METHODS

Data collection

The research was carried out at the Szamárhádi farm of the Tiszatáj Public Foundation. Data collection was performed between 31 December 2019 and 6 August 2020, on previously specified days. 15 calf-dam pairs were selected for the programme, of which 3 calves died during the research at 1 week of age. The cows were vaccinated with ROTAVAC on 27 December 2019, in the calving season. As a result of delayed vaccination, several calves died. The vaccine results in the active immunisation of cows, while calves are passively immunised by taking the colostrum. Immunity develops about 3 weeks after the administration of the vaccine. On 27 January 2020, the investigation of the dead body of a suckling calf with ear tag nr. HU3266707166 at the Laboratory of Pathology and Bacteriology in Debrecen identified coli diarrhoea (*Escherichia coli*), exiccosis and coli – septicaemia. The immune chromatography of intestinal contents also showed rotavirus antigens (reg. nr.: M2020-20003979). Regarding the three calves involved in our programme, no laboratory results are available. However, their initial relationship with their mothers did not differ from what we observed with other pairs in terms of connection strength. The other 12 calves reached the time of weaning and therefore have weight values adjusted to the 205th day of age. The relationship between the calves and their mothers were observed and recorded on Days 0, 3, 7 and 14, and when they were 1, 2 and 4 months of age. On the observation days we observed the pairs and documented their behaviour every 2 hours between 8:00 and 16:00. The documented behaviours according to their strengths were: standing or lying separately (0), vocalisation (1), sniffing (2), licking (3), standing next to each other (4), suckling (5) (Figure 1). When establishing the behavioural categories, we considered methods that we had previously applied (Lenner et al., 2021) and those described in literature. As licking occurs at multiple points in the social network of cattle (cow licking cow, bull licking cow and reverse), it is considered a weaker relationship element than standing or lying next to each other. It is mainly their calves that Hungarian Grey cows let into their personal space. On such occasions they lie in physical contact with each other.

During data collection, the observed pairs did not always see us, as we were watching them using binoculars from a hidden spot, from a distance of about 10–12 meters. We always wore black clothes to reduce disturbing effects. Behaviours were recorded only if they lasted for at least 15 seconds. We attributed 0 to observation events when there were no contacts; 1 was attributed to events when only vocalization could be observed. On these occasions, oral sounds were generated from a significant distance. Nasal sounds were usually heard when the animals stood closer to each other or during sniffing. Following sniffing, cows licked their calves, then let them suck.

Figure 1: Changes in the strength of connection between the dam and the calf



Statistical analysis

The collection and processing of data was carried out using Microsoft Excel. The statistical analysis was performed in R 4.1.1. in a statistical environment (R Core Team, 2021) RStudio (RStudio Team, 2021) with a graphical interface, using “agricolae” (de Mendinburu, 2021) packages. The graphs were created with Ms Excel 2019. An embedded repeated measurement model was created to investigate the effect of days and intraday on the strength of calf-cow contact. Example code for this in R statistical environment:

```
ism=aov(contact_strength~(intra_day_time*days)+Error(
calf/days*intra_day_time), data = db)
summary(ism). The mean comparison of the strength of the dam and calf relationship was performed by the least significant difference (LSD) method, in which the smallest significant difference was determined. In R statistical environment, for each post hoc test of the repeated measurement model, the degrees of freedom (df) and the sum of squares errors (MSE) must be given individually, which was performed with the following syntax for each model separately: Huzsvai and Balogh, 2015):
df=df.residual (modell$"error:error")
mse=deviance (modell$"error:error")/df
LSD <- with(database, LSD.test (contact_strength, significant_effect_from_model, df, mse, console = T))
```

RESULTS

The time of observation was set according to the age of the calf. After calving, we observed the connection between the dam and the young. On the first three observations (Days 0; 3, and 7), the dam and the calf were very close to each other. The dam left the calf only to eat in the morning but kept watching the young from a distance of 2–3 meters. They spent the rest of the day together. Suckling was documented several times during the day. In the first week vocalization, sniffing, and licking were frequently observed. In this period, calves spent their days around that spot, where they were born. These behaviors became significantly less

frequent as time passed. From Day 14, the connection between the dam and the calf started to change (Figure 3). The calves spent more time resting with other calves. The "suckling and standing" and the "lying next to each other" were the two strongest contact behaviors were continued until the calves became 4 months of age. These were the last two contact behaviors observed. Three calves died in the first week of observation. Before they died, their mothers stood next to them and suckled them several times.

We observed bond strength on the first day of all the 15 calves. Figure 2 shows, that on Day 1 the dam was highly protective of her calf, a behavior making up 53% of the behavior of the calf. Suckling, the second strongest contact element accounted for 24%, but vocalization (5%) and licking the calf (7%) were also more frequent than in the later phases of offspring care (Figure 2). Sniffing as a behavioral element was not documented separately during the observations, as calving took place in the evening hours, and

observations were performed between 8:00 and 16:00. Sniffing is important in the hours after calving (Hudson and Mullord, 1977), and also occurs during licking the young. Standing or lying apart occurred in 11% of the cases.

We compared contact between the mothers and the calves observed on the 3rd, 7th, and 14th day with those contacts when the calves were 1, 2, and 4 months of age, respectively. In the first two weeks, the "standing side by side" and the "suckling" contacts dominated. Sniffing and vocalization are also more accentuated in this period. Over time, the connection between dams and calves changes: standing or laying side by side and suckling fall by 32% and 34%, respectively. From one month of age, standing and lying apart became the most frequent behavior (with no visible contact between the two animals) during grazing and resting as well. Acting separately grew by 69%. At the same time, vocalization fell by 66% (Figure 3).

Figure 2: Contacts between the calf and the cow on the day following calving

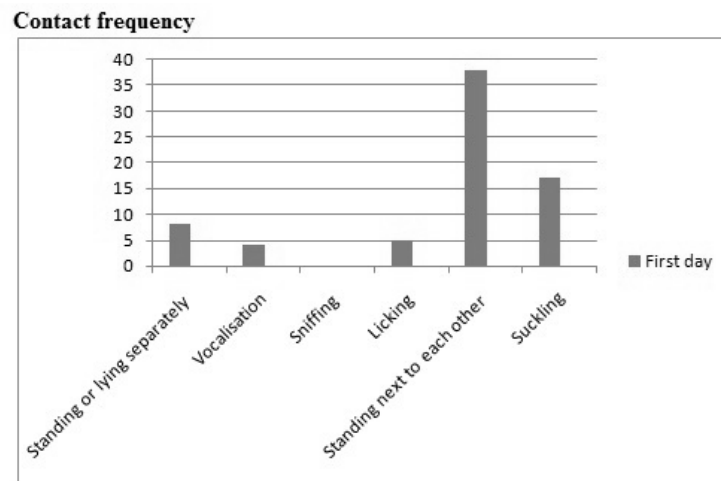
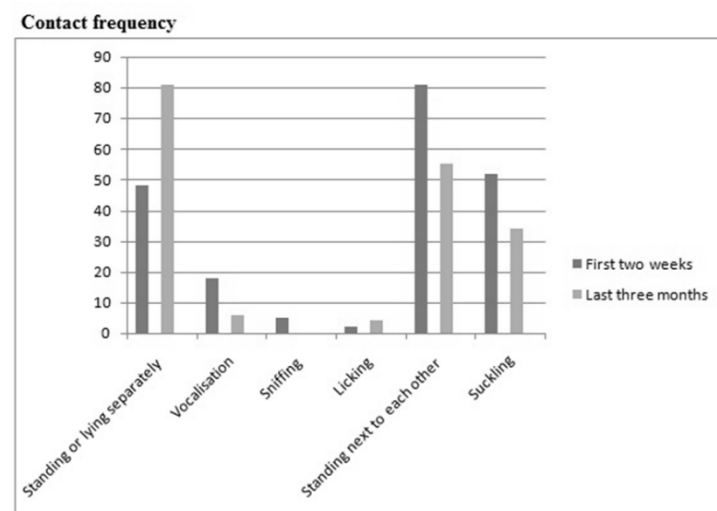


Figure 3: Comparison of dam-calf contact observed in the first week and in the first 1–4 months



DISCUSSION AND CONCLUSION

Suckling is one of the key elements of maternal behaviour. Several studies examined the changes in the frequency of suckling in the offspring-care period and concluded, the more frequented periods are morning, around noon, and in the evening period. For this reason, we observed the pairs every two hours between 08:00 and 16:00. Regarding other forms of contact (vocalization, sniffing, licking), we only found information in the literature for the time of calving. According to researchers, dams often lick the young on the first day after calving. It covers 30–50% of the first hour after calving, followed by vocalization and suckling. We did not make observations in the first hour because calving took place before 8:00, but we observed the first day of the pairs. Standing and lying side by side made up 53% of all contacts, followed by suckling with 24%. We found that as time passed, the quality and strength of contact between the mother and young changed. At the beginning, the "standing side by side" and "suckling" dominated after the first month the "standing and lying apart" grew by 69%. Our observations confirmed that the daily frequency of suckling decreases as the calf ages (34%) along with

vocalization by both animals (66%). Even though the frequency of suckling fell as the calf grew, it still accounted for 18% of the observation time. We can conclude that the strength of the connection between the dam and the calf changes as the calf ages. In the first time, the young stand and lie very close to their mothers, and all contact behaviours are typical in this period. Later they are only close to each other when the calf wants to suck. It seems, that along with the loosening of connection the natural process of separation also takes place. The data we collected may help us select a weaning method that is less stressful for the animals. In the future, it would be worth monitoring changes in the dam-calf connection until weaning.

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