



Validity of physiological biomarkers for maternal behavior in cows – A comparison of beef and dairy cattle



Katrin Geburt^a, Morten Friedrich^a, Marion Piechotta^b, Matthias Gauly^a, Uta König von Borstel^{a,*}

^a Georg-August-Universität Göttingen, Department of Animal Sciences, Livestock Production Systems, Albrecht-Thaer-Weg 3, 37075 Göttingen, Germany

^b University of Veterinary Medicine Hannover, Bischofsholer Damm 15, 30173 Hannover, Germany

HIGHLIGHTS

- Saliva oxytocin is not a valid biomarker for maternal behavior in cattle.
- Eye temperature correlates with cattle's maternal behavior.
- Heart rate and cortisol do not closely relate to cows' maternal ability.
- Dairy cows do not appear to be per se less maternal than beef cows.
- Beef cows are more defensive of their calves than dairy cows.

ARTICLE INFO

Article history:

Received 30 September 2014

Received in revised form 16 October 2014

Accepted 23 October 2014

Available online 6 November 2014

Keywords:

Maternal behavior

Cattle

Thermography

Oxytocin

Cortisol

Heart rate

ABSTRACT

The objectives of the present study were to evaluate the suitability of potential biomarkers for maternal ability in cattle, and in addition to test the hypothesis that dairy cows have a less pronounced motherliness than beef cows. Therefore, maternal behavior of 20 Simmental beef-type (S) and 20 German Black Pied (dairy-type) Cattle (BP) was assessed on the 2nd and again on the 3rd day of the calf's life. Measurements included the frequency of interactions between cow and calf, the cow's willingness to defend her calf, the overall maternal behavior, saliva cortisol, saliva oxytocin, heart rate, and thermal images of the eye (ET). Mixed model analysis revealed that BP had significantly ($P < 0.05$) higher oxytocin (88.6 ± 9.2 vs. 62.8 ± 9.2 pg/ml saliva) and cortisol (1.3 ± 0.1 vs. 1.0 ± 0.1 ng/ml saliva) levels, but lower heart rates (80.0 ± 2.0 vs. 95.8 ± 2.0 bpm) than S cows. Simmental (beef) cows showed more defensive behavior (3.5 ± 0.2 vs. 2.7 ± 0.2 scores), but fewer total interactions between cow and calf (8.1 ± 1.4 vs. 13.8 ± 1.4), compared to BP (dairy). However, with the exception of heart rate and overall maternal behavior, breed differences tended to diminish from the 2nd to the 3rd day of the calf's life. Repeatabilities ranged from $9 \pm 23\%$ (ET) to $77 \pm 7\%$ (maternal behavior measured on a visual analogue scale), and correlations between physiological parameters and behavior differed between breeds and were generally at a low level. In conclusion, beef cows do not seem to be per se more maternal compared to dairy cows, and the assessed parameters are of limited use as biomarkers for maternal behavior.

© 2014 Elsevier Inc. All rights reserved.

1. Introduction

The establishment of a strong maternal bond with the calf, nursing, attention and protection from potential predators are key features of maternal behavior [1]. Therefore, maternal behavior can be defined as the cow's care for the calf, which includes social interactions, provision of milk, as well as protection from danger. Good maternal behavior is considered to be one of the main components of maternal success, i.e. the survival and growth of the offspring. The capability to give birth to a calf and to rear it without human assistance is particularly important in intensive production systems, as commonly used in beef

production. However, also in intensive production systems with increasing sizes of production units and less time for observations by stockmen, the importance of maternal ability is undisputable [1]. On the other hand, a too strong maternal behavior results in several negative aspects. Handling of the calf can be greatly complicated due to highly protective cows that may attack the handler. With such aggressive cows, routine handling procedures such as marking the calf for identification, pose a risk of injury to the human or calf [2]. Factors influencing maternal behavior include the cow's breed [3], parity [4], the sex of the calf as well as its birth weight [5].

However, in dairy cattle, calves are routinely separated from their dams immediately after birth for management purposes as well as for protection of the calf from infections. For example, calves that suckled colostrum from their dams rather than being bottle-fed are at a higher risk

* Corresponding author. Tel.: +49 551 395602.

E-mail address: koenigvb@gwdg.de (U. König von Borstel).

to suffer from severe diarrhea [6]. Thus, in contrast to beef cattle, due to the early separation of dairy cow and calf after parturition, a strong long-term maternal ability is not required in dairy production, and may have been diminished due to relaxed selection pressure during centuries of calf rearing by humans [7]. Indeed, Hopster et al. [8] observed only limited responses of multiparous dairy cows to removal of their calves. We therefore hypothesized that beef cows exhibit stronger maternal behavior than dairy cattle when kept under similar husbandry conditions.

In addition to this breed comparison, the aim of the present study was to detect potential biomarkers that might later be used as indicators for maternal behavior and/or stress for use in breeding programs. Maternal behavior is facilitated by various hormonal changes. For example in different mammalian species, physiological parameters related to stress, such as ACTH or corticosterone, are reduced during motherhood [9]. Also, oxytocin has been shown to reduce fearfulness [9], and perhaps more importantly to induce social bonding as well as to activate maternal behavior [10,11]. Oxytocin is released e.g. during teat stimulation while suckling as well as during vaginocervical stimulation as is the case when giving birth [12,13]. A relationship between oxytocin levels and maternal and/or bonding behavior has been detected in various species such as cattle [14], sheep [11], rats [15], and primates [16], including humans [17]. We therefore hypothesized that saliva oxytocin levels either alone or in combination with parameters indicative of stress may serve as a biomarker for maternal behavior in cattle.

2. Materials and methods

2.1. Animals and housing

Each 20 cows with their calves of the breeds German Simmental (beef) (S), located on the research farm Relliehausen of the University Göttingen, and German Black Pied Cattle (BP), located on the research farm Frankenhausen of the University Kassel, both central Germany, were tested. On both farms, cows had regular access to pasture, but were brought prior to calving into the stable and were kept for the test period individually. For this purpose, BP were brought into separate calving boxes, while with the S cows for the duration of the test a box was partitioned from the group box. In both cases, animals were housed on straw-bedding for calving and the test period, and the respective test cows could always see the remaining herd members and also had the possibility to interact via tactile contact with the other animals of the herd through the partition. Animals of both research farms were exposed to similar levels of daily contact with humans during routine management procedures for at least one month prior to calving.

However compared to S cows, prior to the dry period, multiparous BP cows were used to additional, more intensive contact with humans during milking twice daily. The following information was collected from the calvings prior to the tests: difficulty of birth (scored 0 (no assistance needed) to 2 (dystocia, intense assistance required)), parity class (primiparous or multiparous), sex of calf and weight of calf.

2.2. Test procedures

2.2.1. Behavioral observations

The tests were performed on the second and again on the third day of the calf's life. In the beginning of the test, cow and calf were observed for 1 h in their box and all apparent cow–calf interactions were documented. Each interaction (see Table 1) was counted towards the frequency of “cow–calf-interaction” (CCI).

In the second part of the test, the calf was tethered with a halter and rope for 2 min according to [18]. The corresponding “calf score” (CS) (Table 1) was used to assess the behavior of the calf during tethering.

The behavior of the cow during handling and tying her calf was evaluated by different scores for the cow's motherliness, docility and will to protect her calf: For the maternal ability a modified “Motherliness score” (MS) by [3], modified according to [19,20] was used (Table 1). The same behavior was evaluated with a different method, based on a 15 cm visual analogue scale. Due to potentially different, underlying motivations for social interactions with the calf and preparedness to defend the calf, the cow's aggressiveness was also assessed separately from the overall behavior score by means of the “defense score” (DS). The parameter “Total Motherliness” (Mtotal) was composed of the mean of CCI and a transformed DS. The DS was transformed such that the highest possible value for DS (i.e. 5) was matched to the maximum value obtained for CCI (i.e. 39). An overview of the different parameters and their description is given in Table 1. Additionally, the time of testing (morning, mid-day, afternoon, evening) was recorded as it was, due to practical reasons, not possible to conduct all tests at the same time of the day.

2.2.2. Physiological measurements

Directly after tethering of the calf and the corresponding behavior observation of the cow, the cow was fixated to allow for collection of the following physiological parameters: eye temperature, saliva cortisol, saliva oxytocin and heart rate (HR). In addition, two weeks before the first calving in S and BP occurred, cows of each breed were fixed for the collection of baseline values for eye temperature, saliva cortisol and HR.

Table 1

List and description of behavioral parameters assessed during the test.

Parameter	Information on	Description
Cow–calf-interaction (CCI)	Maternal behavior without human contact	Every interaction in the observation period (1 h): Quantity of licking (each bout counted as one interaction irrespective of the duration), vocalizations, shifting of the body position to facilitate sucking, nose–calf-contact, defense against other cows
Calf score (CS)	Docility of the calf	Behavior of the calf during tethering (2 min). Scores: 1 = calf is quiet, moves rarely with the rope not or only partially tensioned, 2 = uneasy, frequently moving with tensioned rope, 3 = nervous, partly strong movements with heavy pulling of the rope, 4 = fighting against the fixation with vigorous movements
Motherliness score (MS)	Maternal behavior during the handling period of the calf	Behavior of the cow during tethering the calf. Scores: 1 = cow shows no interest in her calf being handled, 2 = stands quietly, watching her calf, is attentive and observes the situation, 3 = restless, moving, vocalizes, concentrating only on her calf, 4 = nervous, shows strong movements, handler only feels safe when cow is observed, 5 = aggressive/furious, attacks or attempts to attack and has to be prevented from further attacking the handler
Maternal ability (MaS)	Maternal behavior during the handling period of the calf	Maternal behavior on a 15 cm visual analogue scale with the endpoints 0 (cow is perfectly calm) and 15 (cow vigorously attacks the handler)
Defense score (DS)	Defense readiness of the cow	Will to protect and defend the calf. Scores: 1 = cow is only concentrating on her own activity, 2 = observing the situation, 3 = standing beside the calf, try to screen the calf from the handler, 4 = anxious/nervous, 5 = threat/attack attempt
Total motherliness (Mtotal)	Whole maternal ability	Whole maternal ability consisted of maternal interactions (CCI) and the weighted defense (DS) of the calf

Download English Version:

<https://daneshyari.com/en/article/5923981>

Download Persian Version:

<https://daneshyari.com/article/5923981>

[Daneshyari.com](https://daneshyari.com)