Effects of the anti-sucking device «SuckStop Müller» on calf behavior

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https://doi.org/10.17236/sat00350

Eingereicht: 18.08.2021
Angenommen: 20.12.2021

Die Auswirkungen des Saugschutzring «SuckStop Müller» auf das Kälberverhalten

Wenn das gegenseitige Besaugen über das Kalbsalter hinaus anhält, stellt es ein wichtiges Problem bei Rindern und Milchkühen dar. Es kann Zitzenverletzungen- sowie schwere Mastitiden verursachen und zu erheblichen wirtschaftlichen Verlusten führen. Der «SuckStop Müller», ein neuartiger Saugschutzring, soll dem Kalb beim Besaugen von Artgenossen ein negatives Feedback geben. Das Ziel dieser Studie war es zu beurteilen, ob das Tragen eines SuckStops zu Verhaltensänderungen führt und somit das Wohlbefinden kurz- und längerfristig beeinträchtigen kann.

Sechzehn in Gruppen gehaltene Kälber wurden in Vierergruppen an fünf Tagen vor und nach dem Einsetzen des SuckStop beobachtet: Tag –2, Tag –1, Tag 0, Tag 1 und Tag 9. Allgemeinverhalten (z. B. Fressen, Trinken, Liegen) wurden mit Instantaneous Scan Sampling aufgezeichnet. Zusätzlich wurde das Kontaktverhalten (z.B. Erkunden des Fressgitters, Berühren des eigenen Körpers) durch kontinuierliche Fokustierbeobachtungen erfasst. Das Kontaktverhalten wurde als «beeinträchtigt» oder «normal» eingestuft, je nachdem, ob das Kalb als Reaktion auf den Kontakt zusammenzuckte oder nicht. Schliesslich wurde die Anzahl der Besuche der Milch- und Kraftfutterautomaten aus dem computergesteuerten Fütterungssystem erhoben.

Das Einsetzen eines SuckStop führte an Tag 0 und Tag 1 zu einem höheren Anteil an Liege- und reduziertem Erkundungsverhalten gegenüber Tag –2, Tag –1 und Tag 9 An Tag 0 und Tag 1 wurde 6,3 % des Erkundungsverhalten als beeinträchtigt berurteilt, verglichen mit 0,4 % (Tag –2, Tag –1) vor und 0,2 % (Tag 9) nach dem Einsetzen des SuckStop. Am Tag 9 hatten alle Kälber oberflächliche Ulzerationen an der Nasenscheidewand. Bei vier Kälbern waren diese Ulzerationen mittelschwer, während alle anderen Kälber leichte Ulzerationen aufwiesen.

Summary

When cross-sucking persists beyond calf-hood, it represents an important problem in dairy heifers and cows. It can cause teat injuries and severe mastitis and lead to significant economic losses. The «SuckStop Müller,» a novel anti-sucking device, is designed to give the calf a negative feedback when cross-sucking on a conspecific. The aim of this study was to assess whether wearing a SuckStop would result in behavioral changes other than cross-sucking and thus, impair welfare in the short- and longer-term.

Sixteen group-housed calves were observed in groups of four on five days, before and after fitting the SuckStop: day −2, day −1, day 0, day 1, and day 9. Maintenance behaviors (e.g., feeding, drinking, lying) were recorded using instantaneous scan sampling. In addition, the frequency of contact behaviors (e.g., exploring the feeding fence, touching own body) was recorded by means of continuous focal animal observations. Contact behaviors were classified as «impaired» or «normal» depending on whether or not the calf flinched in response to the contact. Finally, the number of visits to the milk and concentrate feeders was extracted from the computer-controlled feeding system.

Fitting a SuckStop resulted in a higher proportion of observations spent lying and less exploration behavior on day 0 and day 1 than on day −2, day −1, and day 9. On day 0 and day 1, 6,3 % of exploration behaviors were classified as impaired, compared to 0,4 % (day −2, day −1) before and 0,2 % (day 9) after fitting the SuckStop. On day 9, all calves had superficial ulcerations on the nasal septum. In four calves, these ulcerations were moderately severe, whereas all other calves had slight ulcerations.

In summary, the calves habituated quickly to this novel anti-sucking device. Follow-up studies are necessary to assess the long-term relevance of tissue alterations in the nasal septum for calf welfare as well as the effect of the SuckStop on cross-sucking behavior.

Keywords: cross-sucking, behavior, dairy calves, nasal septum, negative feedback

Zusammenfassend zeigte die Studie, dass sich die Kälber schnell an den neuartiger Saugschutzring gewöhnt haben. Folgestudien sind notwendig, um die Relevanz der Gewebeveränderungen an der Nasenscheidewand für das Kälberwohl sowie die Wirkung des SuckStop auf das gegenseitige Besaugen zu beurteilen.

Schlüsselwörter: gegenseitiges Besaugen, Verhalten, Milchkälber, Nasenscheidewand, negatives Feedback

Introduction

Cross-sucking is an abnormal behavior in dairy calves and defined as non-nutritive sucking of another calf's head or body.[19] Cross-sucking is considered to be redirected natural sucking behavior[4] because it only occurs in artificial calf rearing, i.e., when no dam or nurse cow is present.[17, 21, 28] Cross-sucking in calves may result in hair loss and inflammation of the sucked body part or alterations of the udder tissue,[1] but it is questionable whether longer-term damage to the udder system occurs at this early stage of life.[30] However, cross-sucking can persist in individuals beyond calf-hood[3, 15] and lead to udder damage and mastitis in heifers and cows as well as considerable economic losses due to reduced milk yield.[20]

Besides the inability to suckle milk from a cow, the feeding regime (e.g., milk amount;[13] bucket vs rubber teat feeding),[12, 22] the weaning method (e.g., gradual vs abrupt weaning;[24] individual weaning dependent on solid feed intake;[5, 27] appropriate feed rations after weaning),[16] and housing conditions (e.g., access to a run or pasture;[14] group composition)[9] are important factors that influence cross-sucking behavior in artificially reared calves. However, in practice, cross-sucking in calves is abundant on many dairy farms, and farmers use various methods to prevent this behavior.

The most commonly used method to reduce cross-sucking are anti-sucking devices such as weaning rings with spikes or nose flaps, which are fastened to the calf's muzzle. These devices elicit avoidance behavior in the individual being approached by the cross-sucking calf[20] rather than preventing the latter from approaching the former. In other words, a weaning ring will not change the behavior of the cross-sucking calf but will cause a defensive reaction in the victim.

In contrast to conventional weaning rings, the «SuckStop Müller» is equipped with two plastic extensions pointing inwards, i.e., towards the nasal cavity of the calf. These extensions are supposed to apply pressure on the nasal cavity and thus give a negative feedback to the calf during cross-sucking. Because it is likely that the negative feedback would occur not only during cross-sucking but also during other behaviors involving the muzzle, our study evaluated the short- and longer-term effects of the SuckStop on maintenance behaviors (e.g., feeding, drinking, lying) and contact behaviors (e.g., exploring the feeding fence, touching own body), and the effect on integrity of the nasal septum. We investigated whether the behavior of the calves would be impaired in the short-term (i.e., in the first two days after fitting the SuckStop) and whether the calves would habituate to the SuckStop over a period of nine days (longer-term). Importantly, we did not assess the efficacy of the SuckStop in preventing or reducing cross-sucking.

Materials and Methods

Animals and housing

Ethical approval to conduct this study was obtained from the Veterinary Office of the Canton of Thurgau (approval number TG08/19-31938). All procedures complied with the Swiss regulations regarding the treatment of experimental animals.

Behavioral observations were performed over a period of five weeks in January and February 2020 at the Strickhof Lindau in Switzerland on 16 calves in total. The calves were housed in a group pen equipped with a straw-bedded lying area (23 m^2), a feeding area with solid flooring and feeding fence (14 m^2), an automated milk and an automated concentrate feeder (both VARIO smart, Förster-Technik GmbH, Engen, Germany), and a water bowl. Hay, silage, water, and a mineral licking stone were provided *ad libitum*. The gate to the permanent outdoor area (14 m^2) was closed during observations to ensure that all calves were within sight.

During the five-week observation period and following the standard management practice on the farm, young calves joined the group and older calves were removed when reaching approximately 130 days of age. Thus, group size and group composition in the pen was not constant, but no more than 14 calves were kept in the pen at the same time.

Figure 1: Left: Anti-sucking device «SuckStop Müller» (transparent) in size «Small» with the two spikes. According to the manufacturer, this size can be used for calves up to 10 months of age (picture: Bayern-Genetik GmbH). Right: Correctly fitted SuckStop in a calf (picture: C. Bisang).

In total, 16 focal calves were observed in four focal groups. The selected 16 calves were of the following breeds: Holstein (six calves), Red Holstein (one calf), Braunvieh (four calves), and Original Braunvieh (five calves). At the beginning of the study, the focal calves were between six and 20 weeks old. Except for one focal calf, none of these individuals was weaned yet. Also, none of the focal calves had previous experience with an anti-sucking device.

Anti-sucking device: SuckStop Müller

We used the anti-sucking device «SuckStop Müller» (Bayern-Genetik GmbH, Kumhausen, Germany; Figure 1) in size «Small.» Because the SuckStop is made of flexible plastic, no tools were needed for fitting. The ring was hooked into one side of the nose, bent and stretched, and inserted into the other side of the nose. Once the ring returned to its original shape, it clamped to the nasal septum with the plastic spikes pointing into the nasal cavity.

To have the intended effect, the SuckStop needs to be fitted correctly, i.e., tight, on top or in front of the muzzle, and with the spikes pointing into the nasal cavity as shown in Figure 1. During the study, it happened multiple times (0,5–5,8 times per calf and observation day) that the SuckStop got out of place with the ring pointing downwards and the spikes positioned outside the nasal cavity. These events were recorded, and the SuckStop was put back in its correct position immediately by the observer.

Experimental design and data collection

Given the sequential design of the study, 16 focal calves were observed in four focal groups. In weeks 1 to 4 of the observation period, a focal group consisting of four female dairy calves was selected each week. The four focal calves within a focal group were observed simultaneously, and observations of the four focal groups were spread across the five weeks of behavioral observations.

The focal calves of a given focal group were observed on five days over a period of 12 days: on two days directly before fitting the SuckStop (day −2, day −1), on two days directly after fitting the SuckStop (day 0, day 1), and on day 9 after fitting the SuckStop. The SuckStop was fitted to the focal animals by the observer in the morning directly before data collection on day 0 and was removed after the last observation on day 9.

The focal calves were directly observed during two two-hour time blocks per observation day: morning (starting at 8:00) and afternoon (starting at 13:00). Based on personal observations, experience of staff, and documentation from the automated feeder, these were the times when the animals were feeding and most active. Each time block was divided into eight 15-minute observation bouts and then split into five-minute increments. Using instantaneous scan sampling,[23] the maintenance behavior (Table 1) of each focal calf was documented at the beginning (i.e., the first minute) of every five-minute increment. During the remaining four minutes per increment, contact behavior (Table 2) of each of the four focal calves per focal group was event-sampled continuously for one minute in a pre-defined order. As a result, each calf was scan- and event-sampled 48 times over a period of four hours per observation day: two time blocks per day with eight 15-minute bouts per time block and three five-minute increments per 15-minute bout.

Table 1: Definition of maintenance behaviors recorded during scan sampling.

Behavior	Definition
Feeding roughage	The head of the calf (including ears) is located within the feeding fence, or the calf feeds or chews hay or silage with a maximal distance of 30 cm between the feeding fence and the muzzle.
Feeding concentrate	The calf's front legs are located in front of the back edge of the concentrate feeder.
Milk intake	The calf is located in front of the back edge of the milk feeder while the calf's muzzle is less than 50 cm away from the rubber teat.
Mineral intake	The calf touches the mineral licking stone with its muzzle, tongue, teeth, or SuckStop, or the calf stands next to the mineral licking stone while its muzzle is less than 10 cm away from the licking stone.
Water intake	The calf stands at the water drinker while its muzzle is less than 10 cm away from the water surface.
Lying with rumination	The calf is lying on the floor while chewing movements are visible.
Lying without rumination	The calf is lying on the floor while no chewing movements are visible.
Standing with rumination	The calf is standing while chewing movements are visible.
Standing without rumination	The calf is standing while no chewing movements are visible.

Table 2: Definition of contact behaviors recorded during event sampling.

Behavior	Definition
Cross-sucking	Touching the udder region of a conspecific[1] (from either the front or rear) with a maximal distance of 30 cm between the calf's muzzle and the udder region of the conspecific.
Touching conspecifics	Touching the body of a conspecific[1] with muzzle, tongue, teeth, or SuckStop[2].
Touching own body	Touching the own body[1] with muzzle, tongue, teeth, or SuckStop.
Touching SuckStop	Touching the SuckStop with tongue. Each contact was recorded as separate event.
Exploration of the environment	Touching parts of the housing system[1] with muzzle, tongue, teeth, or SuckStop[3].
Touching feeding fence	Touching the feeding fence[1] with muzzle, tongue, teeth, or SuckStop while moving the head into or out of the feeding fence.
Touching drinker	Touching the water drinker[1] with muzzle, tongue, teeth, or SuckStop during water intake.
Touching roughage	Touching hay, silage, or feed trough[1] with muzzle, tongue, teeth, or SuckStop.
Touching licking stone	Touching the mineral licking stone[1] with muzzle, tongue, teeth, or SuckStop.
Touching water surface	Touching the water surface[1] with muzzle, tongue, teeth, or SuckStop.

[1] If the contact was interrupted, the next contact was recorded as separate event
[2] If behavior does not match the definition of «cross-sucking»
[3] If behavior does not match the definition of «touching feeding fence» or «touching drinker»

Behavioral observations

Maintenance behavior

To ensure undisturbed behavior and avoid interactions with the observer, the observer was standing outside the pen (in front of the feeding fence) during data collection. Behavioral observations were conducted according to a pre-defined protocol in BORIS software.[7] Table 1 shows the behaviors recorded during scan sampling.

Contact behavior

Contact behaviors were defined as behaviors that may involve contact of the SuckStop with conspecifics or parts of the housing system (Table 2). These behaviors were classified as «normal» (calf does not flinch after contact) or «impaired» (calf flinches with head or full body after contact).

Visits to the milk and concentrate feeders

The protocols of the computer-controlled feeding systems were used to extract the number of rewarded visits (i.e., visits with access to milk) at the milk feeder, the number of unrewarded visits (i.e., visits without access to milk) at the milk feeder, the number of rewarded visits at the concentrate feeder, and the number of unrewarded visits at the concentrate feeder per calf and day.

Effects on the nasal septum

On day 0 and day 9, immediately before fitting and immediately after removing the SuckStop, the muzzle, nose, and the mucous membrane of the nasal septum of each focal calf were visually examined for changes such as swelling, hematoma, bleeding, nasal discharge, or lacerations. Lesions were scored as superficial if prolapse of the connective tissue was not visible and the cartilage of the nasal septum was still completely covered. Slight lesions were defined as superficial ulceration. Moderate lesions were scored if a slight ulceration and prolapse of connective tissue was present. Severe lesions were scored if the ulceration involved the cartilage of the nasal septum.

Data processing and statistical analysis

Data were exported from BORIS as .csv files and processed in Excel. The numbers of observed behaviors during scan and event sampling (Table 1, Table 2) were summed up per calf and time block, resulting in two data points per calf per observation day. The frequency of behaviors observed during scan sampling for a given calf (feeding roughage, feeding concentrate, milk intake, mineral intake, water intake, lying, standing, rumination) were divided by the total number of observations for that calf (24 observations per time block), resulting in the proportion of observations spent performing a certain behavior. Because behaviors recorded during event sampling were assessed continuously, there was no upper limit and values were expressed as the frequency of these

behaviors shown per calf and observation period (= 24 minutes total individual observation time per calf and time block). The numbers of rewarded and unrewarded visits at the computer-controlled milk and concentrate feeders were extracted per calf and observation day and summed up for analysis («total number of visits»). One calf was weaned at the time of the study and thus excluded from the analysis of the number of visits at the milk feeder.

Because many behavioral variables were recorded in this study, data were explored using bar plots, scatter plots, and box plots in a first step. In a second step, data showing patterns of interest for the aim of the study were analyzed statistically. Data that were recorded but not analyzed are presented descriptively. All behaviors related to explorative behavior (touching conspecifics, exploration of the environment, touching feeding fence, and touching mineral licking stone) were summarized as «exploration» for the statistical analysis. Similarly, lying with and without rumination were summarized as «lying.»

Statistical analysis was performed in R version 4.0.3[26] using linear mixed-effects models (LMER function) with package «lme4».[2] Model assumptions (normality of errors and random effects as well as homoscedasticity of errors) were checked through graphical analysis of residuals. Data were transformed if necessary. The final models were obtained with a stepwise-backwards elimination using parametric bootstraps for model comparison package «pbkrtest»; [10] and a p-value of $<0{,}05$ as a criterion of exclusion. Model estimates were calculated and displayed using the package «effects».[6]

Selected outcome variables were: lying, feeding roughage, exploration (square-root transformed), touching own body (log transformed), visits at the milk feeder, and visits at the concentrate feeder (square-root transformed). Explanatory variables were SuckStop (categorical variable with three levels: day −2 | day −1, day 0 | day 1, day 9) and days of age at the start of the study (continuous variable). A random effect with time block (morning, afternoon) nested in observation day (day −2, day −1, day 0, day 1, day 9) nested in calf nested in focal group (categorical variable with four levels corresponding to four groups differing in composition over time) was included in the model to account for group-to-group and individual-to-group variation and to avoid pseudo-replication.

Results

Behavior

Most behaviors were shown to a similar degree across observation days, i.e., before, during and after fitting the SuckStop (Table 3).

Lying

The calves spent more observations lying on day 0 and day 1 than on day −2, day −1, and day 9 ($p = 0{,}018$; Figure 2). The proportion of observations spent lying decreased with increasing age at the start of the study ($p = 0{,}024$).

Exploration

On day 0 and day 1, calves showed less exploration than on day −2, day −1, and day 9 ($p = 0{,}031$; Figure 3). Exploration behavior did not differ between ages at the start of the study ($p = 0{,}777$). Across all calves, 0,4 % of all exploration events on day −2 and day −1, 6,3 % of all exploration events on day 0 and day 1, and 0,2 % of all exploration events on day 9 were classified as impaired (Table 3). Most impaired exploration events occurred on day 0 (11,3 %), whereas the proportion of impaired exploration events decreased to 1,7 % on day 1.

Touching own body

The calves touched their own bodies most often on day 9, the least often on day 0 and day 1, and at an in-

Table 3: Maintenance behavior (proportion of observations) recorded during scan sampling and contact behavior (average number of events per calf in 24 minutes) recorded during event sampling. The proportion of impaired contact behaviors is given in parentheses. Asterisks denote variables that were analyzed statistically.

	Proportion of observations		
Normal behavior	day −2 | day −1	day 0 | day 1	day 9
Feeding roughage*	12 %	11 %	17 %
Feeding concentrate	1 %	1 %	2 %
Milk intake	2 %	1 %	2 %
Mineral intake	1 %	0 %	1 %
Water intake	1 %	1 %	1 %
Lying with rumination*[1]	22 %	25 %	25 %
Lying without rumination*[1]	44 %	49 %	39 %
Standing with rumination	1 %	0 %	1 %
Standing without rumination	16 %	13 %	14 %
	Average number of events per calf in 24 minutes (% impaired)		
Contact behavior	day −2 | day −1	day 0 | day 1	day 9
Cross-sucking	0,2 (0,0 %)	0,03 (0,0 %)	0,1 (0,0 %)
Touching conspecifics*[2]	10,6 (0,6 %)	8,9 (5,3 %)	12,3 (0,5 %)
Touching own body*	9,2 (0,0 %)	6,9 (0,9 %)	11,3 (0,0 %)
Touching SuckStop	0,0 (0,0 %)	0,2 (0,0 %)	0,0 (0,0 %)
Exploration of the environment*[2]	19,9 (0,3 %)	12,4 (6,5 %)	17,3 (0,0 %)
Touching feeding fence*[2]	1,0 (0,0 %)	1,7 (9,4 %)	2,4 (0,0 %)
Touching drinker	0,3 (0,0 %)	0,4 (0,0 %)	0,9 (0,0 %)
Touching roughage	14,3 (0,4 %)	11,0 (1,4 %)	16,7 (0,7 %)
Touching mineral licking stone*[2]	1,2 (0,0 %)	0,5 (5,9 %)	0,8 (0,0 %)
Touching water surface	1,3 (0,0 %)	0,7 (0,0 %)	1,3 (4,8 %)

[1] Summarized as «lying» for statistical analysis
[2] Summarized as «exploration» for statistical analysis
* Analyzed statistically

termediate frequency on day −2 and day −1 ($p = 0{,}011$; Figure 4). An effect of age at the start of the study on how often calves touched their own bodies could not be detected ($p = 0{,}099$).

Feeding roughage

The older the calves were at the start of the study, the more observations they spent feeding roughage ($p = 0{,}024$). An effect of wearing a SuckStop on roughage feeding was not evident ($p = 0{,}108$).

Visits to the milk and concentrate feeders

An effect of wearing a SuckStop on the number of visits at the milk feeder was not detectable ($p = 0{,}371$; Table 4). The older the calves were at the start of the study, the more visits at the milk feeder were recorded ($p = 0{,}003$). Similarly, calves that were older at the start of the study visited the concentrate feeder more often than younger calves ($p = 0{,}003$), whereas the SuckStop did not affect visits at the concentrate feeder ($p = 0{,}675$).

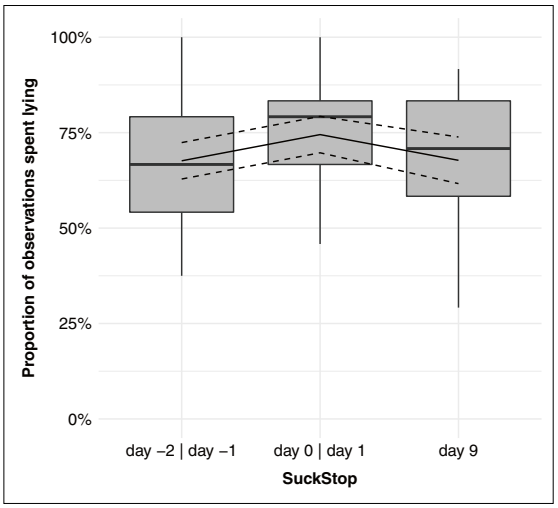

Figure 2: Effect of SuckStop on the proportion of observations spent lying (p = 0,018). Box plots show medians, interquartile, and absolute ranges of raw data. The solid line represents the estimated mean, dashed lines show the estimated 95 % confidence interval.

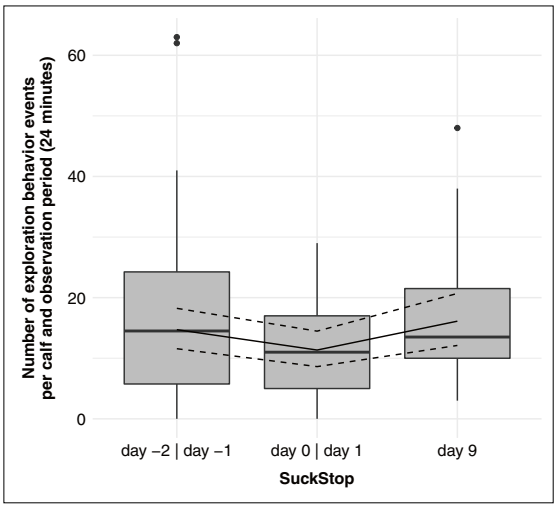

Figure 3: Effect of SuckStop on the number of exploration behavior events (p = 0,031). Box plots show medians, interquartile, and absolute ranges of raw data. The solid line represents the estimated mean, dashed lines show the estimated 95% confidence interval.

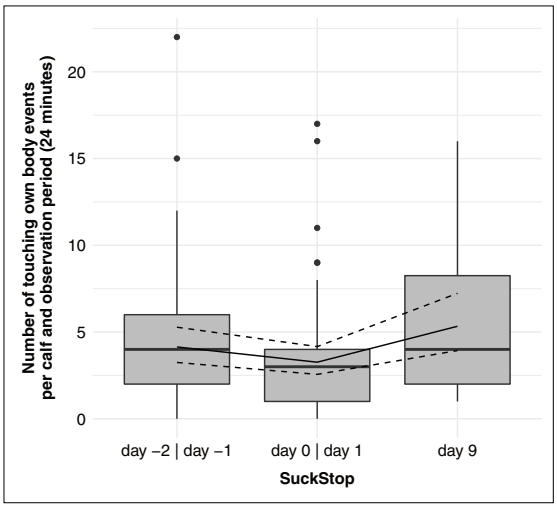

Figure 4: Effect of SuckStop on the number of touching own body events (p = 0,011). Box plots show medians, interquartile, and absolute ranges of raw data. The solid line represents the estimated mean, dashed lines show the estimated 95% confidence interval.

Effects on the nasal septum

Before fitting of the SuckStop, all calves had a pink, moist, mucous membrane without swelling, bleeding, or hematomas. Four calves showed seromucous nasal discharge.

Immediately after removing the SuckStop, all 16 calves had round superficial ulcerations (approximately 1 cm in diameter) on the nasal septum where the SuckStop was located. A moderately severe ulceration was found in four calves (Figure 5), whereas the ulcerations of all other calves were slight. Of the four calves with nasal discharge at the beginning of the study, only one calf still had discharge at the end of the study. Three other calves showed slight to moderate seromucous nasal discharge when the SuckStop was removed.

Discussion

We could show that the anti-sucking device «SuckStop Müller» affected some of the calves' behaviors on day 0 and day 1 but not in the longer term, i.e., on day 9 after fitting the SuckStop. Although we expected that calves might show changes in a variety of behaviors, we found that lying, exploration, and self-touching were the only behaviors affected by wearing a SuckStop. Apparently, the SuckStop did not restrict the calves in their access

to hay and silage offered at the feed fence and to water, and it did not lower the frequency of visits at the milk feeder and the concentrate feeder.

None of the observed behavioral responses persisted beyond day 9 after fitting the SuckStop, indicating that the calves habituated quickly to the anti-sucking device. Besides the frequency of contact behaviors, the quality of a behavior – i.e., normal or impaired – served as an indicator of potential restrictions due to the SuckStop. The proportion of impaired contact behaviors was low (i.e., <10 % across observation days), and most impaired events happened when the calves were exploring parts of the housing system. Looking at each observation day individually, we found that the proportion of impaired behaviors dropped numerically between day 0 and day 1, suggesting that the calves habituated to the SuckStop within 24 hours.

Regarding the reduced contact behaviors exploration and self-touching on day 0 and day 1, the behavioral response to the SuckStop could be explained in two ways: First, the decrease in exploration and self-touching on day 0 and day 1 could have occurred due to the fitting of the SuckStop itself, e.g., pressure on the nasal septum or novelty of a foreign object attached to the muzzle. Second, the calves may have received a negative feedback from the SuckStop during exploration and self-touching. If the calves reacted to the fitting of the SuckStop itself, the return to normal behavior on day 9 would indicate habituation to wearing the SuckStop. In contrast, if exploration and self-touching decreased due to a negative feedback elicited through the spikes pointing into the nasal cavity, the calves would have habituated to the negative feedback within nine days. Based on our study, we cannot draw conclusions whether the SuckStop elicited a negative feedback during exploration and self-touching. Nevertheless, it would be interesting to assess why some contact behaviors were affected by wearing a SuckStop, while others were not. For instance, given that the calves' feeding and drinking behaviors did not change in response to the SuckStop, exploration and self-touching may involve the muzzle directly and thus result in direct contact with the SuckStop while performing these behaviors. On the other hand, feeding on hay and silage as well as drinking seem to involve lips, tongue, and teeth predominantly, which may allow the calves to lessen contact with the SuckStop.

The calves spent a higher proportion of observations lying directly after fitting the SuckStop. Changes in lying behavior can serve as an indicator of calf welfare. For instance, increased lying times have been used as an indicator of pain and distress.[11, 29] However, results on changes in lying behavior in response to stressful procedures are inconsistent. For example, Gingerich et al.[8] reported shorter lying duration after disbudding, whereas Winder et al.[31] found no changes in lying behavior thereafter. In our study, the calves' lying behavior normalized within nine days, indicating that the possibly stressful fitting of the SuckStop only had a short-term effect. Moreover, we conclude that the observed behavioral responses were not likely to be biologically relevant for calf welfare because the effect size was rather small (6 % more observations spent lying directly after fitting the SuckStop).

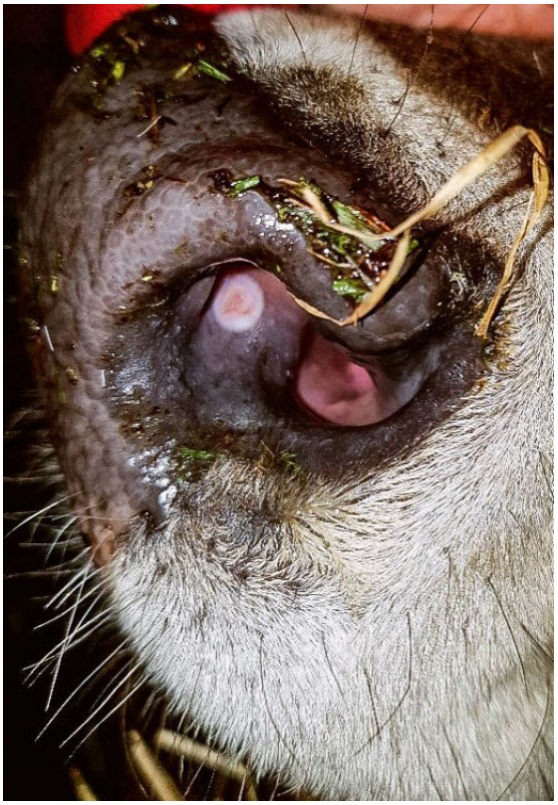

Figure 5: Ulceration of moderate degree on the nasal septum in a calf immediately after removing the anti-sucking device «SuckStop Müller».

Table 4: Number of visits (total, rewarded, and unrewarded) at the milk and concentrate feeders. Only the total number of visits at the feeders was subject to statistical analysis.

	Number of visits at the feeder per calf and day		
	day –2 | day –1	day 0 | day 1	day 9
Milk feeder			
Total	8,8	7,3	9,4
Rewarded	3,7	3,5	3,8
Unrewarded	5,1	3,8	5,6
Concentrate feeder			
Total	17,7	15,6	16,5
Rewarded	17,0	15,2	14,9
Unrewarded	0,7	0,4	1,6

All 16 calves had superficial ulcerations on the nasal septum after removal of the SuckStop, with a moderately severe ulceration being apparent in four calves. In our view, because standard anti-sucking devices are made of rigid plastic or metal and often fastened to the nasal septum with a screw or pliers, they are likely to cause comparable if not more severe changes to the nasal septum. While anti-sucking devices vary with regards to the rigidity of the ring, material (e.g., rubber coating), contact area, and pressure distribution, it is unclear which of those aspects result in lesions to the nasal septum.

To our knowledge, studies investigating the long-term effect of anti-sucking devices on the health of the nasal septum in calves are lacking, and it is unclear whether tissue alterations as observed in our experiment are problematic or painful for calves in the long term. In humans, decubital ulcers (injuries to the skin and underlying tissue due to prolonged pressure; «bedsores») are associated with pain even in early stages.[25] Similarly, shoulder decubitus ulcers in sows are assumed to cause pain and distress based on behavioral indicators.[18] Because the area of tissue affected in calves wearing a SuckStop is considerably smaller and because it is not clear whether skin and mucosal decubitus ulcers are directly comparable, targeted studies should address whether decubitus and ulcers on the nasal septum cause discomfort and pain.

In conclusion, our study demonstrates that calves habituate quickly to the anti-sucking device SuckStop Müller. This quick habituation indicates that the calves' behavior was affected for only a short period, and thus animal welfare does not seem to be impaired in the long term. Follow-up studies are necessary to assess if the SuckStop can prevent cross-sucking behavior in calves. In addition, the long-term relevance of changes to the nasal septum should be investigated to further evaluate the effect of weaning rings on calf welfare.

Acknowledgments

We thank the staff at Strickhof Lindau, especially Nerina Spalinger und Mirjam Hunziger, for excellent animal care and support during data collection. This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Effets du dispositif antisuccion «SuckStop Müller» sur le comportement des veaux.

Lorsque la succion croisée persiste au-delà de l'âge de veau, elle représente un problème important chez les génisses et les vaches laitières. Elle peut provoquer des blessures aux trayons et des mastites graves et entraîner ainsi des pertes économiques importantes. Le «SuckStop Müller», un nouveau dispositif anti-succion, est conçu pour donner au veau un feedback négatif lorsqu'il suce un congénère. L'objectif de cette étude était de déterminer si le port d'un SuckStop pouvait entraîner des changements de comportement autres que la succion croisée et, par conséquent, nuire au bien-être à court et à long terme.

Seize veaux logés en groupe ont été observés par groupes de quatre pendant cinq jours, avant et après la pose du SuckStop: jour –2, jour –1, jour 0, jour 1 et jour 9. Les comportements d'entretien (par exemple se nourrir, boire, se coucher) ont été enregistrés à l'aide d'un échantillonnage par balayage instantané. En outre, la fréquence des comportements de contact (par exemple, explorer le râtelier, toucher son propre corps) a été enregistrée au moyen d'observations continues de chaque animal. Les comportements de contact ont été classés comme «altérés» ou «normaux» selon que le veau a tressailli ou non en réponse au contact. Enfin, le nombre

Effetti sul comportamento dei vitelli con il dispositivo anti-succhio «SuckStop Müller»

Quando la suzione reciproca continua oltre lo svezzamento, questa diventa un problema importante per i bovini e le vacche da latte. Essa può causare lesioni ai capezzoli, gravi mastiti e portare a significative perdite economiche. Il «SuckStop Müller», un nuovo dispositivo anti-succhio, è progettato per fornire un feedback negativo al vitello quando succhia dei conspecifici. Lo scopo di questo studio era di valutare se l'applicazione di un SuckStop possa indurre a dei cambiamenti comportamentali diversi dalla suzione dei conspecifici e quindi influenzare il benessere a breve e lungo termine.

Sedici vitelli tenuti in gruppo sono stati osservati in gruppi di quattro per cinque giorni prima e dopo l'applicazione del SuckStop: giorno –2, giorno –1, giorno 0, giorno 1 e giorno 9. I comportamenti di mantenimento (ad esempio mangiare, bere, sdraiarsi) sono stati registrati utilizzando il campionamento a scansione istantanea. Inoltre, la frequenza dei comportamenti di contatto (ad es. esplorare la griglia di alimentazione, toccare il proprio corpo) è stata registrata tramite osservazioni continue degli animali di riferimento. Il comportamento di contatto è stato classificato come «compromesso» o «normale» a seconda che il vitello si sia mosso o meno in risposta al contatto. Infine, il nu-

de visites aux distributeurs de lait et de concentré a été extrait du système d'alimentation contrôlé par ordinateur.

L'installation d'un SuckStop a entraîné une proportion plus élevée d'observations de comportements couchés et moins de comportements d'exploration le jour 0 et le jour 1 que le jour –2, le jour –1 et le jour 9. Le jour 0 et le jour 1, 6,3 % des comportements d'exploration ont été classés comme déficients, contre 0,4 % (jour –2, jour –1) avant et 0,2 % (jour 9) après la pose du SuckStop. Au jour 9, tous les veaux présentaient des ulcérations superficielles sur la cloison nasale. Chez quatre veaux, ces ulcérations étaient modérément graves, tandis que tous les autres veaux présentaient de légères ulcérations.

En résumé, les veaux se sont rapidement habitués à ce nouveau dispositif anti-suceur. Des études de suivi sont nécessaires pour évaluer la pertinence à long terme des altérations tissulaires de la cloison nasale pour le bien-être des veaux ainsi que l'effet du SuckStop sur le comportement de succion croisée.

Mots clés: succion croisée, comportement, veaux laitiers, septum nasal, rétroaction négative.

mero di visite alle mangiatoie del latte e al concentrato è stato ricavato dal sistema di alimentazione computerizzato.

L'applicazione di un SuckStop ha portato a una maggiore proporzione di inattività e meno comportamenti di esplorazione il giorno 0 e il giorno 1 rispetto al giorno –2, il giorno –1 e il giorno 9. Il giorno 0 e il giorno 1, il 6,3 % dei comportamenti di esplorazione sono stati classificati come compromessi, rispetto allo 0,4 % (giorno –2, giorno –1) prima e allo 0,2 % (giorno 9) dopo l'applicazione del SuckStop. Il giorno 9, tutti i vitelli avevano ulcerazioni superficiali del setto nasale. In quattro vitelli, queste ulcerazioni erano moderatamente gravi, mentre tutti gli altri vitelli avevano ulcerazioni leggere.

In sintesi, i vitelli si sono abituati rapidamente a questo nuovo dispositivo anti-succhio. Ma sono necessari ulteriori studi per valutare la rilevanza a lungo termine delle alterazioni dei tessuti nel setto nasale per il benessere dei vitelli, nonché l'effetto del SuckStop sul comportamento di suzione reciproca.

Parole chiave: suzione reciproca, comportamento, vitelli da latte, setto nasale, feedback negativo

Literaturnachweis

[1] Bak Jensen M: The effects of feeding method, milk allowance and social factors on milk feeding behaviour and cross-sucking in group housed dairy calves. Applied Animal Behaviour Science 2003: 80: 191–206.

[2] Bates D, Mächler M, Bolker B, Walker S: Fitting Linear Mixed-Effects Models Using lme4. Journal of Statistical Software 2015: 67(1): 1–48.

[3] de Passillé AM, Borderas F, Rushen J: Cross-sucking by dairy calves may become a habit or reflect characteristics of individual calves more than milk allowance or weaning. Applied Animal Behaviour Science 2011: 133(3–4): 137–143.

[4] de Passillé AM, Rushen J: Motivational and physiological analysis of the causes and consequences of non-nutritive sucking by calves. Applied Animal Behaviour Science 1997: 53: 15–31.

[5] de Passillé AM, Rushen J: Using automated feeders to wean calves fed large amounts of milk according to their ability to eat solid feed. J Dairy Sci 2016: 99(5): 3578–3583.

[6] Fox J: Effect Displays in R for Generalised Linear Models. 2003 2003: 8(15): 27.

[7] Friard O, Gamba M: BORIS: a free, versatile open-source event-logging software for video/audio coding and live observations. Methods in Ecology and Evolution 2016: 7(11): 1325–1330.

[8] Gingerich KN, Choulet V, Miller-Cushon EK: Disbudding affects use of a shelter provided to group-housed dairy calves. Journal of Dairy Science 2020: 103(11): 10519–10529.

[9] Größbacher V, Winckler C, Leeb C: On-farm factors associated with cross-sucking in group-housed organic Simmental dairy calves. Applied Animal Behaviour Science 2018: 206: 18–24.

[10] Halekoh U, Højsgaard S: A Kenward-Roger Approximation and Parametric Bootstrap Methods for Tests in Linear Mixed Models – The R Package pbkrtest. Journal of Statistical Software 2014: 59(9).

[11] Herskin MS, Nielsen BH: Welfare Effects of the Use of a Combination of Local Anesthesia and NSAID for Disbudding Analgesia in Dairy Calves—Reviewed Across Different Welfare Concerns. Frontiers in Veterinary Science 2018: 5(117).

[12] Jensen M, B., M. B: The Effects of Milk Feeding Method and Group Size on Feeding Behavior and Cross-Sucking in Group-Housed Dairy Calves. J Dairy Sci 2006: 89(12): 4778–4783.

[13] Jung J, Lidfors L: Effects of amount of milk, milk flow and access to a rubber teat on cross-sucking and non-nutritive sucking in dairy calves. Applied Animal Behaviour Science 2001: 72: 201–213.

[14] Keil N, Audigé L, Langhans W: Factors associated with intersucking in Swiss dairy heifers. Prev Vet Med 2000: 45: 305–323.

[15] Keil NM, Audigé L, Langhans W: Is Intersucking in Dairy Cows the Continuation of a Habit Developed in Early Life? J Dairy Sci 2001: 84: 140–146.

[16] Keil NM, Langhans W: The development of intersucking in dairy calves around weaning. Applied Animal Behaviour Science 2001: 72(4): 295–308.

[17] Krohn CC, Foldager J, Mogensen L: Long-term effect of colostrum feeding methods on behaviour in female dairy calves. Acta Agriculturae Scandinavica, Section A – Animal Science 1999: 49: 57–64.

[18] Larsen T, Kaiser M, Herskin MS: Does the presence of shoulder ulcers affect the behaviour of sows? Research in veterinary science 2015: 98(0): 19–24.

[19] Lidfors L: Cross-sucking in group-housed dairy calves before and after weaning off milk. Appl Anim Behav Sci 1993: 38: 15–24.

[20] Lidfors L, Isberg L: Intersucking in dairy cattle – review and questionnaire. Applied Animal Behaviour Science 2003: 80: 207–231.

[21] Lidfors LM, Jensen P, Algers B: Suckling in free-ranging beef cattle – temporal pattering of suckling bouts and effects of age and sex. Ethology 1994: 98: 321–332.

[22] Loberg J, Lidfors L: Effect of milkflow rate and presence of a floating nipple on abnormal sucking between dairy calves. Applied Animal Behaviour Science 2001: 72: 189–199.

[23] Martin P, Bateson P: Measuring behaviour. An introductory guide. Cambridge University Press, UK. 1993.

[24] Nielsen PP, Jensen MB, Lidfors L: Milk allowance and weaning method affect the use of a computer controlled milk feeder and the development of cross-sucking in dairy calves. Applied Animal Behaviour Science 2008: 109: 223–237.

[25] Pieper B, Langemo D, Cuddigan J: Pressure ulcer pain: a systematic literature review and national pressure ulcer advisory panel white paper. Ostomy Wound Manage 2009: 55(2): 16–31.

[26] R Core Team. R: A language and environment for statistical computing. 2020, R Foundation for Statistical Computing: Vienna, Austria. http://www.R-project.org.

[27] Roth B, A., Hillmann E, Stauffacher M, Keil N, M.: Improved weaning reduces cross-sucking and may improve weight gain in dairy calves. Applied Animal Behaviour Science 2008: 111(3–4): 251–261.

[28] Roth B, Barth K, Gygax L, Hillmann E: Influence of artificial vs. mother-bonded rearing on sucking behaviour, health and weight gain in calves. Appl Anim Behav Sci 2009: 119: 143–150.

[29] Stock ML, Millman ST, Barth LA, Van Engen NK, Hsu WH, Wang C, Gehring R, Parsons RL, Coetzee JF: The effects of firocoxib on cautery disbudding pain and stress responses in preweaned dairy calves. Journal of Dairy Science 2015: 98(9): 6058–6069.

[30] Vaughan A, Miguel-Pacheco GG, Marie de Passillé A, Rushen J: Reciprocated cross sucking between dairy calves after weaning off milk does not appear to negatively affect udder health or production. Journal of Dairy Science 2016: 99(7): 5596–5603.

[31] Winder CB, LeBlanc SJ, Haley DB, Lissemore KD, Godkin MA, Duffield TF: Clinical trial of local anesthetic protocols for acute pain associated with caustic paste disbudding in dairy calves. Journal of Dairy Science 2017: 100(8): 6429–6441.

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