Development of a tail scoring as health indicator for dairy cows

S. Meier, K. Abel and P.V. Kremer-Rücker

Animal breeding and husbandry, Department of Agriculture, Food, and Nutrition, Hochschule Weihenstephan-Triesdorf, Markgrafenstr. 16, 91746 Weidenbach, Germany
Corresponding Author: prisca.kremer-ruecker@hswt.de

Abstract

Research investigating necrotic tail tips in dairy cows resulting in necrotic tissues is scarce. However, there is evidence that in dairy cattle tail tip necroses exist with high prevalence. In piglets, the latest research described tail and ear necroses not because of tail and ear biting only, but because of swine inflammation and necrosis syndrome (SINS). Besides tails and ears, SINS includes inflammation of claws, heels, and teats. In cattle, tail tip necroses are described mainly in fattening bulls. As known so far, these findings are often discussed related to slatted flooring,intensive housing systems and management strategies. However, an association with sub-acute rumen acidosis and laminitis is described.

In order to investigate what kind of and how often tail tip alterations appear in dairy cattle, data of 87 German Holstein dairy cows were collected over a period of 12 months. All cows were evaluated for tail tip alterations, body condition score (BCS), and locomotion score (LMS) every two weeks. In addition, milk yield data resulting from performance testing were included. Thermographic images of the tails were taken once. Firstly, all kind of tail tip alterations were described and collected. After 6 months, we categorized the observed alterations and developed a tail scoring system. The scoring for each specified trait (tail tip, tail ring) ranged from 0 to 4.

The overall prevalence for tail alterations was 94%. Especially tail tip alterations had a constantly high prevalence of 56%. Cows affected by an increased average tail tip score showed higher locomotion scores compared to others ($P = 0.02$). The prevalence of ring-like tail alterations increased from first to second lactation cows from 9 to 46%. Regarding the BCS, lighter cows showed higher scores due to ring-like alterations than heavier cows ($P = 0.054$).The most often occurring anomalies of the tail were sports or scurf (21.6%), followed by verruca-like mass (10.2%), swelling (8.4%), and thinning (4.3%).

The results and especially the scoring system can serve as a template for further studies considering larger samples sizes, to investigate prevalence for tail necroses and other tail anomalies in different herds and management systems. It was hypothesized, that an inflammatory condition in dairy cows showing up in altered/necrotic tail tips or rings exists, which is in relationship with claw disorders indicated by lameness. If so, the tail score of a cow could be used as health indicator to evaluate the health status in dairy production systems.

Keywords: Tail tip necrosis, tail ring constriction, tail tip ring, tail anomalies, dairy cattle production diseases.

Introduction

Tail alterations are described mainly in feedlot cattle and fattening bulls (Drolia *et al.*, 1991; Schrader *et al.*, 2001; Heers *et al.*, 2017). The prevalence of tail tip alterations ranges from 2.5% (Hoedemaker, 2014) up to more than 80% (Kordowitzki, 2015). Findings were often related to slatted flooring, (sub) acute rumen acidosis and laminitis (Kordowitzki, 2015).

In other species, tail tip necroses and tail ring constrictions are already known. They are related to heat stress in buffalo (Barakat *et al.*, 1960) or to chronic inflammation in pigs caused by the Swine Inflammation and Necrosis Syndrome (SINS) (Reiner *et al.*, 2019).

Knowledge regarding tail tip alterations in dairy cows is scarce. *In-vivo* investigations often suffer from small sample sizes (Ural *et al.*, 2007). Scorings to investigate the severeness of tail alterations were developed on cows' carcasses (Freitag *et al.*, 2017; Heers *et al.*, 2017), for feedlot cattle (Drolia *et al.*, 1991) as well as for fattening bulls (Kordowitzki, 2015).

However, there is evidence, that dairy cows dealing with negative energy balance, (sub) acute rumen acidosis and lameness (Cook *et al.*, 2004) because of multifactorial risk factors during lactation also show high prevalence of tail tip alterations. Therefore, our aims were to

1. Identify which kind of tail alterations occur in dairy cattle,
2. Calculate the prevalence of all kind of tail alterations,
3. Develop a tail scoring system, that can be used *in-vivo*,
4. Figure out which traits are in association with the severeness of tail alterations in dairy cattle.

Material and methods

In total, 87 German Holstein cows during their first to seventh lactation were included into the study. They were housed under field conditions in a loose housing system on a German dairy farm. The average milk yield was 10,149 kg containing 4.10% fat and 3.55% protein.

The region of the tail tassel was shaved and investigated every two weeks. Tail alterations were recorded over a period of 12 months from December 2019 to November 2020. First of all, tail alterations were described and collected. After 6 months, we categorized the observed alterations and developed a tail scoring system. The scoring for each specified trait ranged from

- 0 (physiological),
- 1 (hairloss),
- 2 (scab/constriction),
- 3 (bloody lesions/constriction),
- 4 (necrotic tissue, part loss).

It was applied on the tail tip including ring-like alterations. Additionally, the body condition score (BCS) ranging from 1 to 5 (Edmonson *et al.*, 1989) and locomotion score (LMS) ranging from 1 to 5 (Sprecher *et al.*, 1997) were recorded at the same time. Milk yield recording data of the same period were added; thermal images of the tail tips (FLIR® T1030) and urine density data were taken once.

Data analyses were performed using R (R Core Team, 2020). Prevalence for all six groups of tail alterations were calculated by dividing the number of affected cows by the total number of cows under investigation and given in percent. Means between two groups were compared using a Wilcoxon test.

Results

All different kind of tail alterations were categorized using the following descriptions: tail tip alteration, ring-like alteration, swelling, thinning, scurf, and verruca-like mass. Prevalence for all tail alterations during this study was 94%; only five cows were unaffected. The prevalence for all groups of tail alterations were: tail tip alteration 56%,ring-like alteration 38%,scurf 21.6%, followed by verruca-like mass 10.2%, swelling 8.4%, and thinning 4.3%.

The group of tail tip alterations had a high prevalence during all lactations (Figure 1). Ring-like alterations were on a low level during the first lactation (9%) and increased to the second (46%) and ≥third lactation (52%). On average, verruca-like mass showed low prevalence, but increased from first (4%) to ≥third lactation (14%). Scurf showed a decrease from the first lactation (27%) to ≥third lactation (19%).

The tail scoring system ranging from 0 to 4 was used to describe the severeness of tail tip alterations and ring-like alterations. The scoring for tail tip alterations increased by higher LMS ($P = 0.015$, Figure 2). Cows with a LMS of 1 (normal walk) had a mean tail tip score of 0.9, which was suggestively different to cows with LMS of 2 (mildly lame) with a mean tail tip score of 1.2 ($P = 0.092$) and significantly different to cows with a LMS of 3 (moderately lame) and a mean tail tip score of 1.5 ($P = 0.012$). LMS 4 (lame, n = 8) and 5 (severely lame, n = 2) were not significantly different.

Cows affected by ring-like alterations were grouped into lighter and heavier cows with an average BCS of ≤ 3 and ≥ 3 during the whole lactation period, respectively. The lighter cows showed suggestively ($P = 0.054$) higher ring-like alterations (tail ring score mean = 1.9) compared to heavier cows (mean = 1.1).

Discussion

The prevalence for all kind of tail alterations in dairy cows was high. Especially tail tip alterations were found showing a higher prevalence (56%) compared to other studies (2.5% to 37%; Hoedemaker, 2014; Freitag *et al.*, 2017; Heers *et al.*, 2017). This could be due to the use of a different scoring system and to the preparation of shaved tail

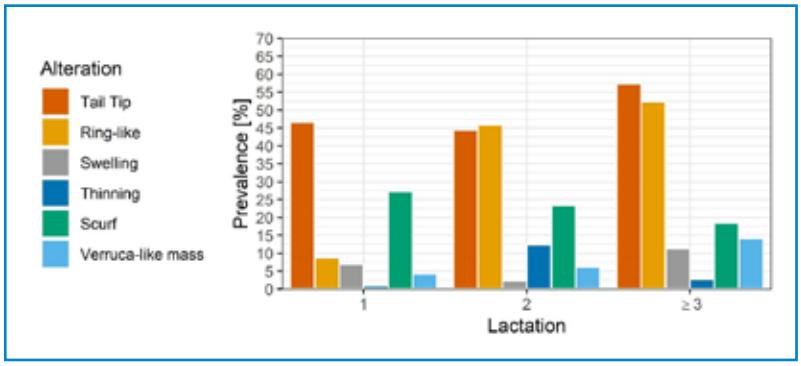

Figure 1. Prevalence grouped as tail tip alteration, ring-like alteration, swelling, thinning, scurf, and verruca-like mass per lactation (1st, 2nd, ≥3rd).

tassels during our study, which allows a better investigation of the tail tip compared to unshaved tail tassels.

Tail tip alterations were evaluated using the new scoring system ranging from 0 to 4. The locomotion score was collected using the scoring of Sprecher *et al.*, 1997. Data showed that cows affected from mildly lameness (LMS 2, mean = 1.2, $P = 0.031$) and moderate lameness (LMS 3; mean 1.5; P=0.004) were also affected from higher tail scores. Lameness is caused by painful conditions of the limb or claw, which can also result from systemic disorders, e.g. laminitis, which is amongst others caused by sub-acute rumen acidosis. According to literature, sub-acute rumen acidosis influences both, laminitis and tail tip alterations (Cook *et al.*, 2004; Kordowitzki, 2015). Especially high yielding dairy cows are at risk of (sub-) acute rumen acidosis because of high concentrate amounts. This could eventually explain the high prevalence of tail tip alterations during this study (øherd milk yield >10,000 kg), however the feed ration was not evaluated here.

Interestingly, ring-like alterations were on a lower level during the first lactation (9%) and increased to the second (46%) and ≥third lactation (52%). As mentioned before, the average BCS tended to be related to the severeness of ring-like tail alterations. This effect could eventually be explained by the metabolic stress of cows, especially caused by high milk yield contemporaneous to low feed intake during the early lactation period (Römer, 2011).

Conversely, neither LMS showed an effect on ring-like tail alterations nor BCS did on tail tip alterations. This could be due to the fact, that these alterations have to be considered independently from each other, or that the sample size was too low to observe significant relations. Data from milk performance testing (milk yield, fat and

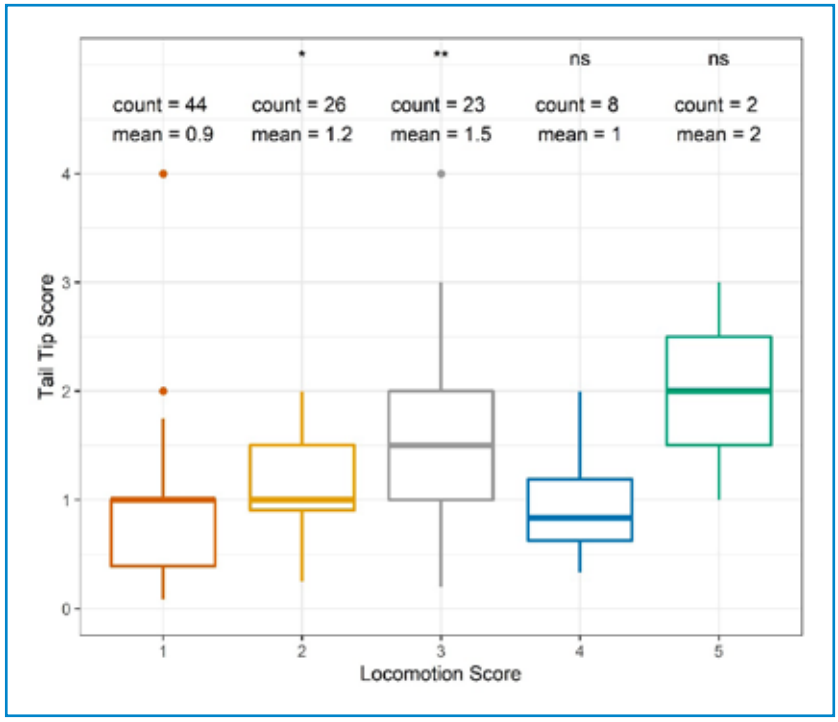

*Figure 2. Cows affected by tail tip alterations measured by the Tail Tip Score (ranging 0-4) showed higher Locomotion Scores (ranging 1-5). Number of data (count) and mean tail tip score are given above box plots besides level of significance (*P <0.05; **P<0.01, ns = not significant) from Wilcoxon test comparing each mean to the mean of LMS 1.*

protein content and ratio, somatic cell count, days in milk) also did not show an effect on our dataset.

Conclusion

There is evidence that high yielding dairy cows, amongst other performance- and feed-related diseases, show health disorders accompanied by tail tip alterations. Since 2019 (Reiner *et al.*, 2019), in pigs SINS is reported to influence tails, ears, teats, and claws, appearing as chronic inflammation and necrotic tissue. Finally, we hypothesized that there might be also health disorders and inflammatory conditions in dairy cows resulting in tail alterations, which could be part of a Bovine Inflammation and Necrosis Syndrome (BINS).Further studies are required to evaluate if the tail scoring presented here could potentially be used as an early-warning system to measure the severity of tail alterations in dairy cows.

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