Effects of tail docking on health and performance of beef cattle in confined, slatted-floor feedlots

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ABSTRACT: Tail docking of feedlot cattle is a management practice used in some confined, slatted-floor feedlots of the midwestern United States. Justification for tail docking in these management systems is to reduce tail injuries and their sequelae and improve performance, but limited evidence exists to support these claims. The primary objective of this study was to determine the effect of tail docking on performance, carcass traits, and health parameters after tail docking in feedlot cattle raised in slatted-floor feedlots. Three separate trials were performed. Trial 1 consisted of 140 Angus-cross (370-kg) yearling steers that spent 144 to 160 days on feed (DOF). Trial 2 consisted of 137 Angus-cross (255-kg) weaned steers that spent 232 DOF. Trial 3 consisted of 102 Holstein steers (370 kg) that spent 185 to 232 DOF. Cattle were randomly assigned to 1 of 2 treatment groups: docked (DK) or control (CN). All steers received an epidural following surgical preparation of the sacrococcygeal area and postoperative intravenous flunixin meglumine. Approximately two-thirds of the tail of DK calves was removed and an elastator band was placed near the tail tip for hemostasis. Performance parameters collected included daily gain, final weight, feed intake, and feed efficiency. Carcass data included HCW, subcutaneous fat thickness, LM area, KPH percent, marbling, USDA yield grade, and USDA quality grade. Morbidity, mortality, incidence of lameness, and incidence of tail lesions were recorded. Across all 3 trials, there was no significant effect (P < 0.05) of treatment on performance parameters, carcass traits, or health parameters. In all 3 trials, tail tip injuries occurred in 60 to 76% of undocked (CN) calves, developed while living in the slatted-floor environment, compared to 100% of DK calves, whose injuries were a result of the tail docking procedure. We were unable to identify a performance or significant health advantage to tail docking. However, tail tip injuries still occur in cattle raised in slatted-floor facilities. Because of the animal welfare issues associated with tail docking and tail injuries, we recommend pursuing alternative solutions to reducing the incidence of tail tip injury in feedlot cattle housed in confined slatted-floor facilities.

Key words: beef cattle, feedlot, health, performance, slatted floor, tail docking


INTRODUCTION

Tail docking is a management practice that occurs in areas of the Midwest United States in confined, slatted-floor feedlots. A survey of Michigan producers found that 50% of slatted-floor farms routinely dock tails of cattle to reduce tail tip injuries and lameness and improve performance (Miller, 2010).

Tail tip injury occurs in confined cattle likely from trauma, which can lead to severe inflammation and infection, causing tail tip necrosis (Madsen and Nielsen, 1985). Of tails examined at slaughter from cattle raised on slatted and solid floors, 34.5% of tails were injured (Drolia et al., 1991). A study on 80,000 confined feedlot cattle in Nebraska reported that 1% were pulled and treated for tail tip necrosis (Thomson et al., 2009). In this study, necropsy of 2 severely lame calves found a common bacterial pathogen present in the tail, spine, lungs, and stifle joint. Spread of tail tip infection to the joint and spine are possible causes for calf lameness.
No studies to date have looked at the impact of tail docking in feedlot cattle. Some work has studied the impact of tail injuries in confined feedlot cattle. A case control study in Denmark identified herds that either had a problem with tail tip necrosis or not and then compared them for various production, health, and housing outcomes (Madsen and Nielsen, 1985). They found that in comparing weight gain and final slaughter weight, herds were not different. Drolia et al. (1990) surveyed farms in Canada and compared slatted-floor facilities with a low or high rate of tail tip necrosis. They found no difference in initial or final weights of cattle, morbidity related to lameness or respiratory disease, or mortality from respiratory disease.

Our study objective was to compare performance, morbidity, and mortality between docked and undocked cattle housed in a confined, slatted-floor feedlot. We hypothesize that no performance or health differences exist among docked and undocked cattle raised in this type of system.

**MATERIALS AND METHODS**

This study consisted of 3 separate trials. All trials were approved by the Michigan State University (MSU) Institutional Animal Care and Use Committee.

**Housing, Animals, Processing, Diet, and Treatment Allocation**

All trials were conducted at the MSU Beef Cattle Teaching and Research Center (BCTRC; East Lansing, MI). Calves were housed at a stocking density of 2.1 m$^2$ per calf in a confined, open-sided, slatted-floor feedlot facility and each pen area consisted of a fully slatted, concrete floor.

**Trial 1.** This trial was conducted beginning in fall of 2009. One hundred forty Angus-cross steers with an initial BW of 370 ± 28.4 kg were acquired from MSU experiment stations (Lake City and Chatham, MI) and the MSU Beef Cow-Calf Teaching and Research Center (East Lansing, MI). Calves were initially acclimated for 26 d while in trial 3 they were acclimated to a pen (n = 6 or 7 calves/pen). Pens were randomly assigned to a treatment group: docked (DK; n = 10 pens) or control (CN; n = 10 pens). Calves were fed a diet of 73% CS, 24.5% HMC, and 2.5% protein–mineral supplement (DM basis). Calves were dewormed with injectable doramectin, (Dectomax; Zoetis Animal Health, Florham Park, NJ), were implanted with a growth promotant that contained 80 mg trenbolone acetate and 16 mg estradiol (Revalor-IS; Merck Animal Health, Summit, NJ), and were vaccinated with a 4-way modified live virus vaccine (BoviShield Gold 5; Zoetis Animal Health) that included bovine viral diarrhea virus (Type 1 and 2), bovine herpes virus-1, bovine respiratory syncytial virus, and parainfluenza-3; a killed clostridial bacterin that contained 8 clostridial antigens, including Clostridium tetani (Covexin-8; Merck Animal Health); and a bacterin against Histophilus somni (Somubac; Zoetis Animal Health). Calves were stratified by farm of origin, blocked by arrival BW, and then randomly assigned to a pen (n = 7 calves/pen). Pens were randomly assigned to a treatment group: docked (DK; n = 10 pens) or control (CN; n = 10 pens). Feed was delivered once daily between 0500 and 0700 h and consisted of 45% high moisture corn (HMC), 30% modified distillers grains plus solubles, 10% corn silage (CS), and 4% protein–mineral supplement (DM basis).

**Trial 2.** Trial 2 began in fall of 2010. One hundred thirty-seven calves with an initial BW of 255 ± 27.2 kg were sourced from MSU experiment stations (Lake City and Chatham, MI) and the MSU Beef Cow-CalF Teaching and Research Center (East Lansing, MI) and processed at the MSU BCTRC. All calves arrived at the MSU BCTRC 26 d before start of trial and were on trial for 232 d. Upon arrival, all calves were allowed to rest for 24 h before processing. Calves were processed in the exact same fashion as trial 1, except they were not vaccinated against Histophilus somni, and they were implanted with a growth promotant from a different manufacturer but containing the same components (Component TE-IS; Elanco, Greenfield, IN). Calves were stratified by farm of origin, blocked by arrival BW, and randomly assigned to a pen (n = 6 or 7 calves/pen). Pens were randomly assigned to a treatment group: DK (n = 10 pens) or CN (n = 10 pens). The diet and feeding routine was the same as described for trial 1.

**Trial 3.** Trial 3 began in spring of 2012. One hundred two Holstein steers with an initial BW of 370 ± 29.1 kg were sourced from 3 different backgrounders in Kentucky. Calves arrived at the MSU BCTRC 8 d before the start of the trial and remained on trial for 185 (n = 52 calves) to 213 d (n = 50 calves). Upon arrival, calves were allowed to rest for 24 h before processing. Calves were weighed and processed the exact same way as trial 2. Calves were stratified by source, blocked by weight, and randomly assigned to a pen (n = 14 calves/pen). Pens were randomly allocated to 1 of 2 treatment groups (n = 8 pens total): CN (n = 4 pens) and DK (n = 4 pens). During the study period, calves were fed a diet of 73% CS, 24.5% HMC, and 2.5% protein–mineral supplement (DM basis). Calves were fed once daily between 0500 and 0700 h.

**Experimental Procedures**

In trial 1, the experimental procedure began after cattle were acclimated to their new environment for 29 (n = 18 calves) or 45 d (n = 122 calves). In trial 2, calves were acclimated for 26 d while in trial 3 the acclimation period was 8 d.
Procedures were performed in the MSU BCTRc cattle handling facility where calves were restrained in a hydraulic chute (Silencer; Moly Manufacturing, Inc., Lorraine, KS). Calves in the DK group had their tail heads prepared aseptically to receive caudal epidural anesthesia. Hair was shaved in a 10 cm² area surrounding the sacrococcygeal area. The area was aseptically prepared using 4 separate 1% betadine scrubs followed by application of 70% isopropyl alcohol and sprayed with 1% betadine solution.

Five milliliters of 2% lidocaine hydrochloride (LidoJect; Bimeda-MTC Animal Health Inc., Cambridge, ON, CAN) was injected into the epidural space using a 4-cm 18-gauge needle. Epidural effectiveness was evaluated by lack of tail tone. Approximately 25 cm distal from the tail head, a circumferential area measuring 15 cm in length was prepared aseptically using the same procedure as described above. The tail was held horizontally by project personnel to keep it from coming in contact with the chute environment or caudal end of the calf. The distal two-thirds of the tail was removed at the aseptically prepared site using commercially available tree limb pruning shears. Between calves, the shears were rinsed in water and then placed in a bucket containing 2% chlorhexidine disinfectant. To control hemorrhage, an elastrator band was immediately placed 1 cm above the distal end of the remaining tail. Elastrator bands remained in place on the tail or until they fell off.

For postoperative analgesia, each calf was administered 1 ml/45 kg of flunixin meglumine (50 mg/ml; FlunixiJect; Bimeda-MTC Animal Health Inc., Cambridge, ON, CAN) intravenously in the jugular vein using a 4-cm 18-gauge needle. Flunixin meglumine was used in an extra-label manner for pain control in accordance with guidelines set forth in the Animal Medicinal Drug Use Clarification Act (FDA, 1994). The CN calves (sham treatment) received percent certified Angus beef (CAB) and percent choice (CHOICE) were calculated based on reported yield and quality grade. Trial 3 carcass data were not included in the analysis due to incomplete data collection at slaughter.

Statistical Analysis

All variables were tested for normality using the univariate procedure of SAS (SAS Inst. Inc., Cary, NC) through assessing for linearity of the probability plots and evaluating the Shapiro-Wilk test. Tests of linearity and homogeneity were done for all variables using the GLM procedure of SAS through a plot of residuals. All variables were found to have normal distribution of variance and normal linearity and homogeneity. Statistical analysis was performed with the linear mixed model of SAS with pen as the experimental unit. Trial (1, 2, or 3) and treatment group (DK or CN) were considered the fixed effects. Variables were reported out as least squares means and then compared using the Student’s t test. Comparisons among treatment groups were considered statistically significant when \( P < 0.05 \). The initial BW variable was tested with the t test procedure of SAS.

RESULTS

Performance Data

Three calves did not complete the study from trial 1 and 1 calf did not complete the study from trial 2 for reasons related to severe morbidity or death. In trial 3, 9

<table>
<thead>
<tr>
<th>Score</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No gross lesion visible</td>
</tr>
<tr>
<td>1</td>
<td>Mild injury to tail: &lt;5 cm involvement of tail injury and no sign of gross infection or hemorrhage</td>
</tr>
<tr>
<td>2</td>
<td>Moderate injury to tail tip: open wound, infected, extending &lt;10 cm length of tail and/or if small tip of necrosis</td>
</tr>
<tr>
<td>3</td>
<td>Severe tail injury: open, active infection and supplicative to necrotic involvement of tail</td>
</tr>
</tbody>
</table>

0, if no gross evidence of open skin or infection was present on visual observation. Pens were observed at least twice daily by farm personnel for signs of morbidity or lameness and treated according to farm protocol. Adverse health and lameness events were recorded.

Carcass Data. For trial 1 and 2, carcass data were collected by trained personnel and included HCW, dressing percent, subcutaneous fat thickness, LM area, KPH percent, marbling, USDA yield grade, and USDA quality grade. Percent certified Angus beef (CAB) and percent choice (CHOICE) were calculated based on reported yield and quality grade. Trial 3 carcass data were not included in the analysis due to incomplete data collection at slaughter.

Outcome Variables Measured

Performance Data. Body weight, feed delivery, and feed refusal data were collected at 28-d (range = 25–32 d) intervals to calculate first weigh period daily DMI (First DMI), cumulative daily DMI (Overall DMI), first weigh period daily G:F (First G:F), cumulative daily G:F (Overall G:F), first weigh period ADG (First ADG), and cumulative ADG (Overall ADG).

Health Data. Each weigh day, tails were examined and given a numeric score of 0 to 3 based on presence and severity of tail tip injury (Table 1). The score system was modified from the tail tip injury score rubric described by Drolia et al. (1991). The same researcher scored the tails each time (LeeAnne Kroll) using our modified score system (Table 1). A DK tail was considered healed, with a score of
calves did not complete the trial due to severe morbidity or death. These deaths were not related to the presence of tail tip necrosis or as a result of tail docking. Data from all calves were included in the analysis up to the point of their removal from the trial.

Within each trial, initial BW was not statistically different across treatment groups ($P = 0.536$; Table 2). There was no significant effect ($P < 0.05$) of treatment on First ADG, Overall ADG, First G:F, Overall G:F, final BW, First DMI, or Overall DMI (Table 2). While the effect of trial was significant for all performance variables, there was no interaction of trial and treatment group (trial × treatment) identified for any of the performance parameters ($P < 0.05$).

### Carcass Data

There was no significant effect of treatment on HCW, dressing percent, subcutaneous fat thickness, KPH, USDA yield grade, marbling, USDA quality grade, and percent CAB or CHOICE (Table 3). However, an interaction (trial × treatment) was present for LM. In trial 1, CN cattle had numerically larger LM compared to DK, and it was the reverse for trial 2. This converse relationship may indicate that LM interaction is either simply due to chance or an inconsistent effect of treatment on LM.

### Health Data: Morbidity, Mortality, Lameness, and Tail Tip Injuries

There was no significant difference ($P < 0.05$) in morbidity between CN and DK calves from trial 1, 2, or 3 (trial 1, $P = 0.1221$; trial 2, $P = 0.808$; and trial 3, $P = 0.1429$).
Table 4. Health parameters of control and docked cattle on slatted floors in 3 trials

<table>
<thead>
<tr>
<th>Item</th>
<th>Trial</th>
<th>Treatment groups</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Morbidity</td>
<td>1</td>
<td>Control</td>
<td>Docked</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>20 (69)</td>
<td>21 (68)</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>15 (56)</td>
<td>9 (56)</td>
</tr>
<tr>
<td>Lameness</td>
<td>1</td>
<td>8 (70)</td>
<td>2 (69)</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>3 (69)</td>
<td>4 (68)</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>9 (56)</td>
<td>6 (56)</td>
</tr>
<tr>
<td>Mortality</td>
<td>1</td>
<td>2 (70)</td>
<td>1 (69)</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>1 (69)</td>
<td>0 (68)</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>0 (56)</td>
<td>1 (56)</td>
</tr>
</tbody>
</table>

1Morbidity, lameness, and mortality were diagnosed according to farm protocol by farm personnel. Lameness cases were included in morbidity.
2Trial 1 = 2009 backgrounded Angus-cross steers; Trial 2 = 2010 weaned Angus-cross calves; Trial 3 = 2012 backgrounded Holstein steers.
3Number of cases out of total in treatment group, that is, 8 (70) = 8 cases (70 total in treatment group).

All cattle were housed at a stocking density of 2.1 m², which is within the range of 1.7 to 2.3 m² for finishing beef cattle on slatted floors, as recommended in the Guide for the Care and Use of Agricultural Animals in Agricultural Research and Teaching (FASS, 2010). Our study was designed to describe how the tail docking intervention might impact health and performance of confined feedlot cattle raised on slatted-floor facilities.

To our knowledge, this is the first controlled experimental study looking at the effect of tail docking on performance, health, and carcass traits of confined feedlot cattle. Our findings are consistent with the case control study by Madsen and Nielsen (1985), which found no difference in weight gain and final weight at slaughter of cattle from herds with evidence of tail tip necrosis when compared to those without tail tip necrosis. Performance studies following tail docking have been conducted in young dairy replacement heifers. Tom et al. (2002) monitored 36 7- to 17-d-old Holstein calves for 3 wk following rubber ring or hot iron docking and found no significant differences in milk intake and weight gain between docked and undocked calves. Another study monitored weekly BW on 56 heifers for 6 mo following tail docking and was unable to identify any significant differences between docked and undocked heifers (Matthews et al., 1995).

We observed a lack of treatment effect amongst all the trials; however, we did observe an effect of trial. This trial effect was likely due to the differences in cattle backgrounds, breeds, and ages of calves on arrival at the feedlot. For example, final weights of cattle may have varied due to various factors such as breed differences (Holsteins versus Angus-based breeds) and days on feed. Similarly, other growth variables such as ADG and G:F may be affected by the backgrounding of calves before arrival, initial arrival weight, or change in environment (pasture to feedlot), to name a few.

In all of the 3 trials, we did not find that tail docking reduced the incidence of overall morbidity, lameness-related morbidity, or mortality in docked cattle reared...
Effects of tail docking in feedlot cattle

A survey of Michigan feedlot producers by Miller (2010) found that major rationales for tail docking in feedlot cattle on slats are to reduce morbidity, specifically lameness, and to reduce mortality. The possibility of cattle becoming lame due to tail injury is plausible. In a Nebraska case report, tail tip injury and infection preceded severe lameness in 2 calves (Thomson et al., 2009). Our average tail tip injury rate is similar to a report on feedlot bulls that found 5.8 to 30% affected with only tail lesions, and some of these bulls had inflammation observed in the scrotum, muscle, hind leg joints, and thoracic cavity (Buczek et al., 1984). While there is a possibility that tail tip necrosis may be an etiology for specific animals’ lameness, identifying pathogenesis of lameness was not the focus of our study.

Since it is established that slatted-floor facilities are known to increase risk of lameness and culling in feedlot cattle (Drolia et al., 1991), it is possible that producers subjectively associate tail tip injuries with lameness or early culling. Drolia et al. (1991) surveyed southern Ontario feedlot producers and compared farms that identified themselves to have a problem with tail tip necrosis with those that did not. They were unable to identify a causal relationship between tail tip necrosis and lameness; greater lameness on a farm could result from tail tip necrosis or cause tail tip necrosis, or both could be the result of another factor, such as floor type or stocking density. The incidence of tail tip injury was shown to increase on slatted floors compared to deep litter packs (Madsen and Nielsen, 1985; Schrader et al., 2001) and on slatted-floor compared to solid-floor systems (Drolia et al., 1990, 1991). Many researchers have correlated slatted floors to an increased risk of lameness in feedlot cattle (Schulze Westerath et al., 2007; Graunke et al., 2011). An investigation of health status in finishing beef cattle of 29 farms found that bedding use was associated with a 33% reduction in culling risk compared to slatted-floor pens (Cerchiaro et al., 2005). Sundrum and Rubelowski (2001) surveyed 50 farms and found that farms that raised bulls on slatted floors reported greater losses than deep-litter housing. Regardless of the practice of tail docking, some feedlot producers might expect to see higher levels of lameness and mortality in general when raising cattle in slatted-floor feedlots.

In the current study, cattle were housed at a stocking density of 2.1 m\(^2\) per animal and 60 to 76% of undocked cattle were observed to have a lesion at some points. This is comparable to other studies that identified tail tip injury occurred in 5 to 30% (Buczek et al., 1984) and 34.5% (Drolia et al., 1991) of feedlot cattle. Slatted floors (Madsen and Nielsen, 1985; Drolia et al., 1990, 1991; Schrader et al., 2001), high stocking densities (Drolia et al., 1990, Schrader et al., 2001), and large BW of animals on slats (Schrader et al., 2001) are all previously identified risk factors for tail tip injury. Madsen and Nielsen (1985) identified tail trampling as 1 reason for tail tip injury to occur. In a study on space allowance and cleanliness, crossbred bulls with an average start weight of 339 kg were housed at different space allowances (2.5, 3, 3.5, and 4 m\(^2\)) and observed for various behaviors (Gygax et al., 2007). They found that bulls were less likely to get stepped on and were more spread out from each other at higher space allowances; the recommended space allowance was determined to be 4 m\(^2\). The study also concluded that cattle were cleaner at higher space allowances, and therefore the self-cleaning effect of slats was not lost. Our cattle weights are similar to the previous study, so it is reasonable to assume that some of our cattle may have experienced tail injury from tail trampling and that their risk was increased at our stocking density of 2.1 m\(^2\).

In itself, the creation of tail injuries in all of the docked cattle is considered detrimental to cattle welfare because it is acutely painful and has potential for chronic pain, and the open wound may become infected and lead to sequelae. In our study, up to 81% of docked cattle had postsurgical infection of tail tips while on trial. In contrast, as many as 76% of undocked cattle developed tail tip injuries by the end of the feeding period, and up to 54% developed infected and/or necrotic tail tips while on trial. It is evident that undocked cattle develop significant levels of infection.

![Figure 2](image1.png) Figure 2. Percent of cattle with tail lesion score (0 through 3) by weigh intervals in docked (DK) and control (CN) cattle in trial 2.

![Figure 3](image2.png) Figure 3. Percent of cattle with tail lesion score (0 through 3) by weigh intervals in docked (DK) and control (CN) cattle in trial 3.
of tail tip injury when raised in the slatted-floor feedlot, which may lead to tail infection and/or necrosis. The practice of tail docking guarantees that cattle will have a tail lesion, which similarly has the potential to develop severe detrimental consequences such as tail infection.

Tail injuries developed at variable rates for all 3 trials. For example, tail lesions were first identified in control cattle of trial 1 by 43 d whereas in trial 2, tail lesions were first identified in control cattle by 81 d. In trial 3, Holstein cattle tended to have more injuries early on in trial (32 d) when compared to the Angus breed cattle of trials 1 and 2. The differences seen in these trials are likely due to variations in arrival BW, days on feed, stocking density, and breed differences. Cattle with a lighter arrival BW started with more space per animal and may have had less chance for tail injury early on in the trial. Cattle that spent more days on feed had more time for lesions to develop and, as a confounder, will also weigh more later in the feeding period, which also means less space per animal and increased risk for tail injury. Holstein cattle’s larger BW (Table 2) and possible breed differences may help to explain why Holstein cattle from trial 3 tended to have an increased incidence of tail injuries.

While our study showed no apparent performance or health benefit to tail docking, tail tip injury persisted in our undocked cattle raised on confined slatted flooring. This in itself is concerning from an animal welfare perspective. Because of the lack of apparent performance or health benefit beyond eliminating tail tip injuries and the probable compromise of animal welfare through the tail docking procedure (which results in injury for all animals receiving the procedure), alternative solutions to address the issue of tail tip injuries should be sought. Alternative solutions such as decreased stocking density and softer flooring may prove beneficial by reducing the risk of tail injuries from occurring in confined slatted-floor facilities. Additionally, these improvements in housing conditions have been shown to improve cattle welfare and therefore are recommended regardless of the possible reduction in tail tip injury.

LITERATURE CITED


