

Differences in Growth, Tail Injury, and Immune Markers among Tail-Biting, Non-Biting, and Control Pigs with Intact Tails

Courtney Archer¹, Storey Forster², Benny Mote², Ty Schmidt², Jon Anderson¹, Lee Johnston¹, Yuzhi Li¹

¹University of Minnesota; ²University of Nebraska – Lincoln

Key points:

- Tail-biting pigs had significantly higher TNF- α concentrations, suggesting a possible inflammatory role in tail-biting behavior.
- A higher incidence of tail-biting was observed in gilts compared to barrows, indicating a possible sex-related factor influencing tail-biting behavior.

Introduction

Tail biting is a damaging and unpredictable behavior that poses significant animal welfare and economic challenges in swine production. Pigs involved in tail-biting events may suffer from pain, infection, and reduced performance, while producers face increased labor, veterinary costs, and potential carcass condemnation at slaughter. Although the physical consequences of tail biting are well-documented, the biological and behavioral factors that predispose certain pigs to bite remain poorly understood. Emerging research suggests that underlying immune status or stress-related responses may play a role in the development of tail-biting behavior. Identifying physiological markers associated with biters could help producers and researchers develop predictive tools and targeted management strategies. The objective of this study was to evaluate whether tail-biting pigs differ from non-biters and control pigs in terms of growth performance, tail injury severity, and immune parameters, including cytokine concentrations and acute phase proteins.

Methods

Pigs ($n = 252$) with intact tails were allocated to pens (7 pigs/pen) in a conventional growing-finishing barn at 10 weeks of age based on litter origin (12 pens/treatment): littermates (all pigs in a pen from the same sow), half-littermates (3 pigs from one sow, 4 pigs from another sow), and non-littermates (each pig from separate sows). Pigs remained in these pens until market weight at 22 weeks of age. Growth performance (initial and final body weight, and ADG) was monitored. Tail injury was assessed weekly for all pigs using a 0-4 scale (0=no injury; 1=healed injury; 2=visible blood; 3=wounds or abscesses; 4=tail loss). The greatest tail injury score each pig received during the study was defined as the Maximal Tail Score (MTS). A tail-biting outbreak (TBO) occurred when at least one pig in a pen scored ≥ 2 . On the first TBO in a pen, blood samples were collected from all pigs in the TBO pen and from two pigs in a control pen with no evidence of tail biting. Serum samples were analyzed for 13-panel cytokines, immunoglobulin G (IgG), and Pig Major Acute Phase Protein (Pig-MAP). The behavior of pigs in each pen was recorded over the study period using the NUtrack Livestock Monitoring System created by the University of Nebraska-Lincoln.

Results

Of the 36 pens, 12 experienced a tail-biting outbreak during the study period. On the day of the first TBO, video recordings from 0800 to 1500 h were manually reviewed to identify tail-biters and non-biters in the TBO pen. Tail-biters were defined as the top 25% of pigs that were observed performing tail-biting behaviors. Data were analyzed using the GLIMMIX and Frequency procedures with chi-square tests in SAS. There were no differences in initial weight, final weight, ADG, or MTS among tail-biters, non-biters, and control pigs (Table 1). However, tail-biters had elevated TNF- α concentrations compared to control pigs ($P = 0.03$). No differences were detected in other cytokines, IgG, or Pig-MAP levels among the pig categories. A greater proportion of tail-biters were gilts compared to non-biters ($P = 0.03$).

Discussion

This study identified two key factors associated with tail-biting behavior: elevated concentrations of tumor necrosis factor alpha (TNF- α) and a higher proportion of gilts among identified tail-biters. TNF- α is a pro-inflammatory cytokine that plays a central role in immune and stress responses. Its elevation in tail-biters suggests that inflammatory processes may contribute to the development or expression of tail-biting behavior. Whether TNF- α is a cause or a result of tail biting remains unclear, but its consistent association highlights its potential as a biomarker for identifying pigs at risk. The overrepresentation of gilts among tail-biters suggests a potential sex-based predisposition to this behavior. This finding aligns with previous studies indicating behavioral and physiological differences between sexes that may influence aggression or abnormal behaviors in pigs. These insights provide a foundation for future research aimed at early detection and targeted interventions to reduce the occurrence of tail-biting in commercial swine production.

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Table 1. Comparison of Growth Performance, Cytokine Levels, and Immune Markers among Non-Biter, Biter, and Control Pig Categories.

Item	Pig Category			SE	P-value
	Non-Biters	Biters	Control ¹		
# of Pigs	61	23	17		
# of Pens ²	12	12	7		
BW, kg					
Initial	29.0	29.2	27.6	0.94	0.33
Final ³	123.8	124.6	117.9	2.67	0.12
ADG ³ , kg	1.08	1.09	1.01	0.03	0.10 ⁴
TNF- α ^{5,6}	1.90 ^{ab}	2.63 ^a	1.20 ^b	0.40	0.03
IgG ⁶	8.35	8.35	8.25	0.32	0.19
Pig-MAP ⁶	1.76	1.71	1.74	0.56	0.85
Gilt %	47.5	73.9	-	4.69 ⁷	0.03
MTS ⁸	1.46	1.22	0.88	0.28	0.24

¹Control pigs were two pigs from a separate pen with no evidence of tail biting.

²Includes all treatment groups: Littermates, Half-Littermates, and Non-Littermates.

³Initial body weight was used as a covariate in the statistical analysis.

⁴Indicates a trend ($0.05 > P \leq 0.10$).

⁵A 13-panel cytokine analysis was conducted (GM-CSF, IFN γ , IL-1 α , IL-1 β , IL-1RA, IL-2, IL-4, IL-6, IL-8, IL-10, IL-12, IL-18, TNF- α); only significant values are presented.

⁶Values are based on log-transformed data.

^{ab} Within a row, means with a different superscript differ ($P \leq 0.05$).

⁷Chi-square ($df = 1$).

⁸Maximal Tail Score each pig received during the 12-weeks of the study period.