**Awards issued prior to January 20, 2025, were funded under previous Administrations and may not reflect the priorities and policies of the current Administration.**

**United States Department of Agriculture**
**Project Initiation**

# Project Data for Accession Number 1032272

## Project Title

Mitigating Injurious Pecking Behavior in Turkeys

## Project Details

| | |
|---|---|
| **Sponsoring Institution**<br>National Institute of Food and Agriculture | **Project Status**<br>ACTIVE |
| **Funding Source**<br>NIFA Non Formula | **Grant Year**<br>2024 |
| **Grant No.**<br>2024-67015-42375 | **Cumulative Award Amt.**<br>$300,000.00 |
| **Proposal No.**<br>2023-07634 | **Multistate No.**<br>(N/A) |
| **Project Start Date**<br>Jul 01, 2024 | **Project End Date**<br>Dec 31, 2026 |
| **Program Code**<br>[A1251] Animal Health and Production and Animal Products: Animal Well-Being | |

## Project Director

Pullin, A.

## Recipient Organization

NORTH CAROLINA STATE UNIVERSITY
2601 WOLF VILLAGE WAY
Raleigh, NORTH CAROLINA 276950001

## Performing Department

Prestage Department of Poultry Science

## Non Technical Summary

A leading cause of euthanasia and death in the United States turkey industry is injurious pecking behavior and cannibalism between birds. The cause of injurious pecking is complex and understudied in turkeys, so it is difficult toprevent the behavior altogther or evenreduceit once it begins. Our goal is to determine the relationship between nutrition and possible underlying behavioral and physiological causes of injurious pecking. Our specific objectives are to evaluate how diet affectsbirds' behavioral motivations for foraging or social dominanceand/or their gut health, as well ashow those factors relate to injury prevalence. Our results aim to identify the best nutritional strategies to recommend to producersfor limitinginjurious pecking in their flocks. We also aimto better understand themost prevalent underlying causes of the behaviorin order to develop further research on effective prevention strategies. By reducing this behavior and its associated mortality, these findings could alleviate economic losses for turkey producers and result in more affordable and available turkey protein for consumers.

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## Animal Health Component

Animal Health Component: 100%

## Research Effort Categories

| | |
|---|---|
| Basic | 40% |
| Applied | 60% |
| Developmental | 0% |

## Classification

| Knowledge Area (KA) | Subject of Investigation (SOI) | Field of Science (FOS) | Percent |
|---|---|---|---|
| 315 | 3230 | 1060 | 70% |
| 315 | 3230 | 1020 | 30% |

## Knowledge Area

[315] Animal Welfare/Well-Being and Protection

## Subject Of Investigation

[3230] Turkey, live animal

## Field Of Science

[1060] Biology (whole systems)

[1020] Physiology

## Keywords

animal welfare, fiber, foraging, gut health, pellet, social behavior, turkey, injurious pecking

## Goals / Objectives

The overall goal of this seed proposal is to evaluate three potential underlying causes of injurious pecking in turkey toms across four nutrition treatments that are focused on feed form and fiber content.The proposed project aligns with the Welfare of Agricultural Animals program priority area of "d) experiments for improved ... behavior and social effects" and "c) understanding the effect of the microbiome on animal welfare." North Carolina ranks first in the nation for the pounds of turkey produced with 1.2 billion pounds of product annually, resulting in a $958 million industry. The state ranks second in the nation for the number of turkeys raised, rearing 30 million birds annually. Of the top 10 turkey producing counties in North Carolina, eight are designated as Tier I, socioeconomically distressed, by the North Carolina Department of Commerce.If losses due to culling and death from injurious pecking could be reduced by as little as 1%, it would save hundreds of thousands of birds annually.Improving turkey welfare and ultimately production yield addresses a key issue of regional and national importance for sustaining the long-term economic viability of turkey operations.We will study our goal across four nutrition treatments:Pellet + Low Fiber,High Fines + Low Fiber, Pellet + High Fiber, and High Fines + High Fiber. We will evaluate this goal through three objectives that reflect thepotential causes of injurious pecking: 1) foraging motivation, 2) gut function, and 3) social dominance.Future

directions for research in my poultry welfare lab will refine effective mitigation strategies based on how these factors do, or do not, contribute to injurious pecking.Objective 1 - Foraging motivation. We will measure the rate of individual foraging behavior (turkey is pecking at litter floor), the rate of individual feeding behavior (turkey is pecking at feed in feed container), and the rate of individual feather pecking behavior (turkey is pecking on the back, tail, and/or wings of a pen mate). These behaviors will be analyzed from video recordings at 4, 9, 15, and 19 weeks of age (2 hours/day at 2 days/age). The prevalence of individual injury scores on the back, tail, and wings will also be scored at the same ages in person using a previously published turkey wound scale.Objective 2 - Gut function.We will evaluate metrics of intestinal inflammation and microbiome, including leaky gut, acute phase proteins, serum lipopolysaccharides (LPS), and bacterial populations in the cecum at 20 weeks of age on 6 toms/pen (48 toms/treatment). FITC-d, LPS quantification kit, ELISA kit, and culture techniques will be utilized to assess these metrics. The selected toms will represent "high feather pecking" and "low feather pecking" individuals.Objective 3 - Social dominance.We will evaluate individual strutting behavior (turkey drops wings, fans out wing and tail feathers, puffs out chest, and glides forward in strutting display) and individual head pecking behavior (turkey is pecking on the head, neck, and/or snood of a pen mate) using the same video recordings and ages described in Objective1. We will also visually score individual injuries on the head and neck at the same ages and using the same scale described in Objective 1.

## Project Methods

The proposed project will be conducted at the North Carolina State University Talley Turkey Education Unit (NCSU TTEU) with large white turkey toms from 0 to 20 weeks of age. We will use a 2x2 factorial arrangement in a completely randomized design to evaluate four treatments focused on feed form and fiber content: 1) Pellet + Low Fiber, 2) High Fines + Low Fiber, 3) Pellet + High Fiber, and 4) High Fines + High Fiber. A total of 704 male turkey poults will be obtained from a commercial hatchery, transported to NCSU TTEU on the day of hatch, and randomly distributed throughout 32 floor pens in one house. Pens will be randomly assigned to feed treatments (22 poults/pen; 8 pen replicates/treatment).From day of placement to 5 weeks (wks) of age, all pens will receive the same feed form as a starter crumble. At 6 wks of age, feed form will change for the duration of the trial with half of the pens receiving pelleted feed and the other half of pens receiving high fines feed. Our target is to provide one feed form treatment of 100% pellets and the second feed form treatment of 100% fines. To develop the fiber diets, both diets will be corn and soybean meal based and formulated to be isonitrogenous and isocaloric. The Low Fiber (LF) diet will contain approximately 2% crude fiber throughout the trial with no additional fibrous ingredients. The High Fiber (HF) diet will have wheat middlings added as a fiber source. For the first 5 weeks, the HF diet will contain 3% crude fiber, then fiber will increase by 1% every 3 wks to achieve 8% crude fiber by 17 wks of age. Water will be provided ad libitum via nipple drinkers in all pens.In addition to the methodsdescribed below, production data will be collected from all pens to monitor average body weight, body weight gain, feed intake, and feed conversion ratio every 4 wks (4, 8, 12, 16, and 20 wks of age). The number of birds culled, the reasons for culling, and mortality (birds found dead) will be monitored and recorded daily.To achieve Objectives 1 and 3,individual turkeys will need to be identified in video recordings. At 2 weeks of age, poults will receive unique markings via non-toxic food dye coloring and livestock paint markers on the center of their backs to avoid interfering with body regions that are commonly pecked (e.g., head, neck, snood, tail, wings).At 4, 9, 15, and 19 wks of age, pens will be video recorded for two days in order to have day replication at each age to account for random variation in behavior between days. These ages were selected to represent two early life timepoints when feather pecking is likely to be gentle and exploratory,and two sexual maturity timepoints when feather pecking reportedly becomes severe,head pecking increases, and late mortality is of critical concern. For 2 hours (hrs) /observation day, focal turkey behavior will be analyzed by trained observers to record the number of bouts and duration of each bout for foraging, feeding,feather pecking, head pecking, and struttingfor focalturkeys.To ensure that behavior analysis is completed within the project timeframe, eight trained observers will analyze the video recordings using Behavior Observation Research Interactive Software (BORIS; https://www.boris.unito.it/). To maintain data quality amongst multiple observers, a robust training and reliability program is essential (Kaufman and Rosenthal, 2009). Before analysis begins, observers will be trained with a behavior coding protocol that includes anethogram with operational definitions of behaviors. An inter-rater reliability test will be conducted to ensure excellent agreement between all observers and the trainer for each behavior (? 0.8 Cohen's kappa; Kaufman and Rosenthal, 2009). Once

training is complete, observers will be blinded to treatment and randomly assigned video recordings from each treatment and timepoints.The prevalence and severity of injuries will be evaluated at the same four ages as behavior. Each body region will be scored separately based on a previously published turkey wound scale, where a 0 denotes no injury, a score of 1 indicates the presence of an injury < 5 cm diameter, or a score of 2 having a presence of an injury ? 5 cm diameter (Leishman et al., 2022).At 20 wks of age, FITC-d will be administered at 4.17 mg/kg BW to 6 toms/pen described above. Two hours later, blood collected from the wing vein will be set at room temperature to clot before collection of serum. A standard curve of FITC-d will be used to calculate levels in each sample. Additionally, a commercially available colorimetric LPS quantification kit will be used for quantification of LPS within serum against a standard curve. A validated commercial ELISA kit is available for blood serum turkey alpha-1 acid glycoprotein from Life Diagnostics,and measuring levels in this experiment will follow kit instructions. We also propose to utilize culture techniques to determine if there are quantifiable changes in Gram-negative enteric bacteriacultured on MacConkey's agar, encompassing several species of Proteobacteria and lactic acid bacteria on MRS agar. After blood samples are collected for inflammation metrics, turkeys will be humanely euthanized and cecal digesta will be aseptically collected into sample bags for serial dilutions on a weight:volume basis and spread plating on MacConkey's and MRS agars. After overnight incubation at 37 °C in aerobic conditions, bacteria will be counted for calculation of colony forming units (CFU) recovered for each type of bacteria. Results will indicate if culturable ceca microbial populations differ between high and low feather pecking toms, and can justify more in-depth probing via microbiome analysis in future experiments.All results will be analyzed with linear mixed effects or generalized linear mixed effects models, pending data type and model assumptions,in R Software. Age, nutrition treatment, and their interactions will be included as fixed effects, and pen orturkey nested within pen will be included as a random effect. Significant differences will be reported where $p < 0.05$.Efforts to deliver science-based findings will involve extension and outreach efforts at the North Carolina Turkey Industry Days event and meetings for the National Turkey Federation. Evaluation will include achieving expected outcomes and utilizing data from this grant to apply for a larger, standard AFRI grant.