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MICROBIOTA AND TRANSCRIPTOMIC (RNA) EFFECTS OF AN ESSENTIAL OIL BLEND AND ITS DELIVERY ROUTE COMPARED TO AN ANTIBIOTIC GROWTH PROMOTER IN BROILER CHICKENS

Introduction

The poultry industry has been diligently evaluating the use of various feed additives, including probiotics, prebiotics, organic acids, and essential oils, as potential alternatives to the use of low dose antibiotic growth promoters (AGPs) to preserve gut health and intestinal microbiota balance and improve growth performance. Research results on the effect and efficacy of alternatives to AGPs on chicken microbiota are somewhat inconsistent, which may be associated with limitations characterized by in-feed and in-water delivery. Several factors can modify the gut microbiota profile, although nutrition (including type of feed and time of feeding) has been regarded as the main influencing factor. Studies also suggest that the microbiota might vary depending on the segment of the small intestine considered.

The microorganisms that populate the gut of poultry are known to play a critical role in the growth and health of the bird. However, genetics also play an important role in overall health. Epigenetics is the study of how behaviors and environment can cause changes to how specific genes work. Our genes encode protein, and protein dictates how a specific cell will function. Proteins are controlled by the availability of certain nutrients and thus impacts gene expression. Gender also has an influence on epigenetics (O'Connor et. al. 2014).

Essential oils have been shown to modify the microbiota and to influence the expression of several genes involved in fat synthesis and deposition and antioxidant activity (Sabino et. al. 2018).

Objective

This study evaluated the effect of the delivery of a commercial essential oil blend containing the phytonutrients star anise, cinnamon, rosemary, and thyme oil (via different routes) on broiler chickens'

ileal and ceca microbiota and liver transcriptome (RNA) compared to an antibiotic growth promoter.

Industry Impact

The results of this study will benefit animal health companies looking to develop specific probiotic products (now referred to as "precision biotics") that guarantee improved growth performance in broiler production. Any of the identified beneficial gut bacteria (individually or combined) from this study could be commercialized as probiotic mixtures. This study also provides poultry geneticists with specific gene pool information to aid with the successful genetic breeding of more efficient broiler chickens.

Trial

Five hundred seventy-six eggs from 41-week-old Cobb 500 broiler breeders were incubated in a Chick Master single-stage incubator. On day 18, 288 eggs were randomly selected as the non-injected group;

96 were randomly selected as the in ovo saline group and injected with 0.2 mL of physiological saline, and 192 eggs were randomly selected as the in ovo essential oil group and injected with 0.2 mL of a saline and essential oil blend mixture at a dilution ratio of 2:1. The essential oil utilized in this study is a commercial blend (Probiotech International Inc., St Hyacinthe, QC, Canada) containing the phytonutrients star anise, cinnamon, rosemary, and thyme oil.

Upon hatch, the chicks from the initial non-injection group were randomly allocated into 3 new treatment groups consisting of (A) chicks fed a basal corn-soybean meal-wheat–based diet (negative control treatment, NC), (B) chicks fed NC + 0.05% bacitracin methylene disalicylate (in-feed antibiotics), and (C) chicks supplied the same commercial blend of EOs as earlier described via the water route at the recommended dosage of 250 mL/1000 L of drinking water. The initial in ovo saline and in ovo essential oil groups were placed on the control diet to form treatments (D) and (E) respectively. The last treatment group, (F), consisted of chicks from the in ovo essential oil treatment group also supplied essential oil via the water route. Each treatment group had 48 birds.

On Day 21, 8 birds per treatment were randomly selected, weighed, and euthanized. Samples were taken of the small intestine. On Day 28, 16 birds per treatment were randomly selected, weighed, and euthanized. Digesta content from the ceca was extracted for short chain fatty acid analysis. Liver tissue and DNA was extracted from both small intestine samples. Gut samples were also analyzed for microbiome diversity.

Results

This study revealed that while treatments yielded no difference in bacteria diversity, clear differences were recorded in microbiota distribution and structure in the small intestine. Additionally, while several studies have speculated that antibiotics improve the growth of broiler chickens by modulating the gut composition, this study provides a critical perspective on the "how?" This study reveals that antibiotics increase the proportion of bacteria Eisenbergiella, Lachnoclostridium, and Shuttleworthia, all of which are linked with improved weight gain and feed conversion ratio in broiler chickens. Furthermore, the study provides preliminary evidence that antibiotics and essential oils may act differently in male and female broiler chickens, depending on specific gene sets activated. Antibiotics might be able to improve growth promotion in male broiler chickens by activating genes related to better nutrient transport. Essential oils could also enhance immunity in female broiler chickens by activating immune-related genes.

Researchers and Cooperators

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