Final Report Summary

PRJ-010220: Critical amino acids to improve gut health of chickens fed reduced protein

In recent times there has been an increased focus with in the chicken meat industry to reduce the use of antibiotics in poultry production as well as an increasing interest in adopting reduced protein (RP) diets through the use of crystalline amino acids. This has presented the industry with the opportunity to reduce environmental impacts from chicken production, improve chicken health and welfare, and reduce the industry’s reliance on imported soybean meal.

Supporting evidence has emerged around some amino acids such as Gln and Gly that their inclusion in poultry diets may have positive effects. Their inclusion in poultry diets may not be economically or practically feasible without reducing the protein content of the diets. However, reduced protein diets could potentially result in negative implications for bird performance and intestinal function.

This project aimed to investigate the role of selected amino acids and the reduction of dietary protein on intestinal health in meat chickens, with particular emphasis on gut barrier function and permeability.

Objectives

This project aimed to determine the impact of reduced protein diets, and subsequent crystalline amino acid supplementation, on meat chicken intestinal function and health and to identify which amino acids were of most importance.

The specific objectives were:

1. To evaluate the impact of reduced protein and amino acid concentration on intestinal barrier function.

2. To investigate the role of Threonine (Thr), Arginine (Arg), Glutamine (Gln) and Glycine (Gly) in relation to their specific effect on intestinal function with reduced protein content.

3. To evaluate interrelationships between three critical amino acids for intestinal permeability.

4. To evaluate the impact of experimental treatments on gut health by looking at selected biomarkers related to gut barrier function and intestinal permeability.

Reduced protein diets could potentially result in negative implications for bird performance and intestinal function.

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In summary

Three feeding trials were conducted, which included the assessment of dexamethasone (DEX), a synthetic glucocorticoid, to develop a ‘leaky gut’ model to assess the impact of various treatments on the permeability of the meat chicken gut by inducing gut stress.

Experiment 1 – Reduced protein versus Standard Commercial Diet

This experiment investigated how a reduced protein diet, or an increased concentration of crystalline amino acids impacted performance and intestinal barrier function of meat chickens compared to a standard commercial diet.

Experiment 2 – The effect of selected Amino Acids and impact on Gut Barrier Function.

The second experiment tested the hypothesis that additional Arg, Gln and Gly may benefit gut barrier function and performance of meat chickens fed RP diets.

Experiment 3 – Testing Amino Acid Combinations

Based on the results of the first two experiments, the effect of Arg and Thr and their combination in meat chickens fed RP diets was investigated.

A subset of birds was used in each experiment to assess the impact of DEX on inducing gut stress.

Gene expression of selected proteins involved in intestinal inflammation, nutrient transportation and gut barrier biomarkers from ileal and jejunal tissues were also assayed using quantitative PCR.

Outcomes

This project found that the gut barrier function of chickens fed reduced protein diets was maintained in comparison to those fed diets with a standard level of protein inclusion. Birds which were fed reduced protein diets had inferior gut function compared to those fed a high protein diet that was supplemented with an increased concentration of amino acids.

The response to amino acids was found to be dependent on multiple factors, including:

- The extent of protein reduction
- The source of protein
- Basal diet composition
- Bird health and the presence of various stressors

The performance of meat chickens fed reduced protein diets appeared to be optimised by increasing dietary arginine.

Reccomendations

It is recommended that when nutritionists formulate reduced protein diets, they take into consideration all essential amino acids and major non-essential amino acids. Despite general perceptions that the gut health of meat chickens is improved with RP diets, in this study, a high protein diet supplemented with amino acids was superior in terms of performance and intestinal barrier function.

Publications


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