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Live performance and environmental impact of broiler chickens fed diets varying in amino acids and phytase☆

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Abstract

This research examined the effects of decreasing dietary amino acid density (AAD) and potential interactions of AAD and phytase on growth and nitrogen (N) and phosphorus (P) excretion of broiler chickens. In experiment 1, diets were formulated to high (H) or moderate (M) AAD during prestarter (1–7 days), starter (8–19 days), and grower (20–35 days) resulting in the following dietary treatments: HHH, HHM, HMM, and MMM. The HHH feeding regimen improved ($P \leq 0.05$) body weight gain (BWG) and feed conversion (FCR) from 1 to 35 days of age, but increased ($P \leq 0.05$) N content of the excreta by 180 g/kg. In Experiment 2, three diets were fed from 36 to 49 days varying in AAD (H, M, and low, L) with (500 units/kg) or without supplemental phytase. Broilers fed a diet formulated to L AAD had high FCR. Increasing AAD increased ($P \leq 0.05$) N excretion by 0.56 and 0.80 g per bird

Abbreviations: AAD, amino acid density; N, nitrogen; H, high; M, moderate; L, low; BWG, body weight gain; FCR, feed conversion; CP, crude protein; AA, amino acid; Exp, experiment; P, phosphorus; TSAA, total sulfur amino acids; FI, feed intake; DM, dry matter

☆ Mention of trade names or commercial products in this publication is solely for the purpose of providing specific information and does not imply recommendation or endorsement by the United States Department of Agriculture.

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compared with M and L AAD, respectively. Phytase supplementation reduced ($P \leq 0.05$) P excretion by 0.18 g per bird, but BWG and FCR were not affected. Dietary phytase and AAD did not interact to reduce N excretion. These results indicate that N excretion could be reduced with dietary manipulation, but effects on FCR should be considered.
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Keywords: Amino acid; Broiler; Nitrogen excretion; Phytase

1. Introduction

Ammonia emissions generated from livestock and poultry confinement operations have stimulated awareness in the USA (National Research Council, 2003). Aerial gas emissions not only cause air quality, odor, and environmental concerns to humans (Lacey et al., 2004) but also adversely affect bird performance and health (Wathes, 1998; Miles et al., 2004). Reducing dietary crude protein (CP) has been a strategy to decrease N excretion and ammonia production, but growth performance can be adversely affected if adequate amounts of dietary amino acids (AA) are not provided (Ferguson et al., 1998a,b; Kidd et al., 2001).

It is well established that the young chick responds to H AAD diets optimizing growth performance and meat yield (Kidd et al., 2004; Corzo et al., 2005; Dozier et al., 2006a), but H AAD diets may not be appropriate as broilers approach market weight. Therefore, decreasing dietary AAD late in development should translate to decreased N excretion and ammonia production of the excreta without negatively influencing production efficiency. In previous research, N excretion and ammonia production were decreased in broilers fed low CP diets, but growth performance was adversely affected (Ferguson et al., 1998a,b). Phytase supplementation has been reported to improve amino acid (AA) utilization (Ravindran et al., 1999; Wu et al., 2003). Therefore, N excretion may be also reduced by supplementing diets with phytase.

Experiment (Exp) 1 evaluated growth performance (1–35 days) and N excretion (33–35 days) of broilers fed diets varying in AAD. In Exp 2, potential interactive effects of dietary AAD and phytase supplementation were examined for broiler live performance from 36 to 47 days of age and N and phosphorus (P) excretion (47–49 days).

2. Materials and methods

2.1. Bird husbandry

Two Exp were conducted. In Exp 1, 240 Ross × Ross 708 (Aviagen, Hunstville, AL, USA) 1-day-old male chicks were obtained from a commercial hatchery and randomly distributed in 48 chick battery cages (Petersime Incubator Company, Gettysbury, OH, USA). There were five chicks per cage until 19 days of age and three birds per cage from 20 to 35 days of age. Each cage contained one feeder trough and a water trough. The number of birds per cage was reduced due to size limitations of the cage during the 20–35 day period. In Exp