Animal Feed Science and Technology 150 (2009) 270–282

Contents lists available at ScienceDirect

Animal Feed Science and Technology

journal homepage: www.elsevier.com/locate/anifeedsci

Effects of sodium gluconate and phytase on performance and bone characteristics in broiler chickers

Yanli Guo[a,*], Yanghong Shi[a], Fadi Li[a], Jilan Chen[b], Chen Zhen[a], Zhengli Hao[a]

[a] Faculty of Animal Science and Technology, Gansu Agricultural University, Lanzhou 730070, PR China
[b] Institute of Animal Science, Chinese Academy of Agricultural Sciences, Beijing 100094, PR China

ARTICLE INFO

Article history:
Received 23 April 2008
Received in revised form 5 September 2008
Accepted 29 September 2008

Keywords:
Broiler chickens
Sodium gluconate
Phytase
Performance
Tibia ash

ABSTRACT

An experiment was conducted to evaluate the effects of corn soybean meal diets with added sodium gluconate (0 and 20 g/kg) and phytase (0, 500 and 1000 U/kg) on performance and bone characteristics of broiler chicks. A total of 350 eight-day-old Arbor Acre male chicks were used with a 2 × 3 plus 1 factorial arrangement. A positive control diet, adequate in non-phytate-phosphorus and calcium without sodium gluconate and phytase, was used. Chickens were randomly allocated to seven treatments with each treatment having five replicates. The experiment lasted from 8 to 42 d posthatching. The outcomes of the study indicated that the low-non-phytate-phosphorus diet caused a negative effect ($P<0.05$) on the average daily gain, average daily feed intake, tibia weight and tibia ash of birds compared to the positive control diet. The supplementation of 20 g sodium gluconate/kg increased average daily gain during days 22–42 ($P=0.005$), 8–42 ($P=0.013$) and tibia ash at 21 d ($P=0.002$). Phytase addition improved ($P<0.05$) average daily gain and average daily feed intake during the whole experiment and tibia weight, tibia ash at 21 and 42 d and calcium content in tibia ash at 42 d. Compared with diets supplemented with 500 U phytase/kg, diets supplemented with 1000 U phytase/kg had significantly higher average daily feed intake during the whole experiment and average daily gain during days 22–42 and 8–42 and tibia ash at days 21 and 42. There was a significant interaction between sodium gluconate and phytase for average daily gain ($P=0.027$) from 8 to 21 d and tibia weight ($P=0.020$) at 42 d. These results demonstrated that sodium gluconate and phytase supplementation to low-phosphorus diets

* Corresponding author. Tel.: +86 931 7631225; fax: +86 931 7631239.
E-mail address: phoenix@188.com (Y. Guo).

0377-8401/$ – see front matter
doi:10.1016/j.anifeedsci.2008.09.006

improved performance and phytate-phosphorus utilization by chicks during the whole growing periods.

1. Introduction

Phosphorus is an essential mineral for animals. About two thirds of total phosphorus of plant-derived feedstuffs exists in a phytate-bound form (Viveros et al., 2000). The availability of phytate-bound phosphorus is low in non-ruminant animals (Ravindran et al., 1995). It is therefore necessary to supplement diets with inorganic phosphorus sources, resulting in relatively large amounts of phosphorus in the manure that contribute to environmental pollution. In order to improve phosphorus utilization, several feed additives have been investigated.

It has been well demonstrated that the addition of phytase to phosphorus-inadequate diets enhances performance and tibia ash (Sebastian et al., 1996; Qian et al., 1997; Juanpere and Perez-Vendrell, 2004; Onyango et al., 2005; Angel et al., 2006; Cowieson et al., 2006; Ravindran et al., 2006). However, the optimal level of phytase is unknown because phosphorus equivalency of phytase can be affected by many factors such as dietary concentrations of phytate-phosphorus, calcium and non-phytate-phosphorus, phytase inclusion levels, the source of exterior phytase and the level of endogenous phytase in the ingredients (Selle and Ravindran, 2007).

Organic acids have been evaluated for their efficacy in improving performance in chicks (Patten and Waldroup, 1988; Skinner et al., 1991; Rafacz-Livingston et al., 2005a,b). However, most work has focused on citric acid. Information on the efficacy for improving phytate-phosphorus utilization of other organic acids is limited. Sodium gluconates are commonly used in the human food industry as acidifiers, coagulants, and as a carrier for mineral supplements (Asano et al., 1994). The only study on the effect of sodium gluconate on broilers was reported by Rafacz-Livingston et al. (2005a), where the addition of 15–33.5 g sodium gluconate/kg to low-non-phytate-phosphorus diets increased weight gain and tibia ash of starter broilers (8–22 d). There has been no report about the effect of sodium gluconate on finisher broiler chicks and the effect of sodium gluconate and phytase combination on broilers.

Therefore, the objective of the current experiment was to assess the effect of the addition of sodium gluconate, phytase and their combination to a phosphorus-deficient maize soybean meal diet on the performance and bone characteristics of broiler chicks during starter and finisher periods.

2. Material and methods

2.1. Animal, feed and management

Male Arbor Acres broilers were obtained from a commercial hatchery in Lanzhou, China. The experiment was a 2×3 plus 1 factorial arrangement of the treatments with two sodium gluconate levels (0 and 20 g/kg; Shanhai Qiaqia Food Co., Shanhai, China) and three levels of bacterial-derived phytase (0, 500 U/kg and 1000 U Phyzyme XP ®/kg). A seventh treatment was included as a positive control diet containing adequate non-phytate-phosphorus and calcium without addition of sodium gluconate and phytase. 540-Day-old chicks were housed in thermostatically controlled, electrically heated cages and fed a nutritionally complete maize soybean meal starter diet (NRC, 1994) from day 1 to day 7. On day 8, after overnight feed withdrawal, chicks were weighed, and chicks within a narrow weight range were selected. The selected chicks were then wing-banded and randomly assigned to pens which were randomly allocated to dietary treatments. Each experimental diet was fed to 5 replicate groups of 10 chicks and chicks were fed *ad libitum* with free access to water from day 8 to 42 after hatching. Birds were managed according to guidelines approved by Arbor Acres Farm in Lanzhou, China. The activity of commercial phytase was 5200 U/g analyzed with spectrophotometry (GB/T 18634-2002) prior to diet mixing.