P135 Effect of Sodium Gluconate on Growth Performance and Digestive Tract Development in Broiler Chickens

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Sodium gluconate in broiler chickens

Summary An experiment on day old 120 male broiler chicks (Ross 308) was conducted for 43 days to evaluate the effect of sodium gluconate (SG) on growth performance and the status of the gastrointestinal tract (5 treatments, 12 replication and 2 birds in each replication). Birds received a basal diet with a) no addition (control), or with SG at b) 1, c) 2, d) 3 or e) 4 g/kg. Postmortem measurements included an analysis of the influence of the administered diets on the structure (length, weight) and functional parameters (pH, concentrations of short-chain fatty acids) of particular segments of the gastrointestinal tract. The use of the SG in diets tended to increase BW (P = 0.081) and improve FCR (P = 0.086) and had no effect on feed intake. The used diets had no effect on the weight of the crop, the proventriculus and the ceca, but the weight of the gizzard and the small intestine were varied. The smallest weight of the gizzard was reported in group c (P<0.05). The smallest weight of the small intestine was observed in the experimental group d. In comparison to the control group, the observed difference was highly statistically significant (14.28 vs. 16.79 g/kg BW, P<0.01). The digesta pH of the crop tended to decrease with increasing levels of dietary SG (P = 0.067). In the ceca, SG increased SCFA (P<0.01) and isobutyric acid (P<0.001) concentration.

Key Words: sodium gluconate, performance, digestive tract, broiler chickens

Introduction Microflora of the digestive tract plays a key role in poultry nutrition following the withdrawal of antibiotic growth promoters (Gabriel et al., 2006). Maintaining optimal gut health provides protection against infections thus minimizing the use of antibiotics. The normal microflora of the gastrointestinal tract can be stabilized through the introduction of probiotics and prebiotics (Edens 2003; Verstegen, Williams 2002). The pH of the intestinal contents plays a crucial role in maintaining microbial balance since Clostridia and other pathogenic bacteria responsible for enteric diseases do not grow at low pH levels. Organic acids, known for their strong bacteriostatic properties, are often added to feed and water to inhibit the growth of pathogens such as Salmonella (Van Immerseel et al., 2006). They are also used to acidify the intestinal contents. Organic acids, e.g. gluconic acid, can also modify bacterial growth in the intestines due to their prebiotic effects that result in the production of short-chain fatty acids (SCFAs) from bacteria. Gluconic acid occurs naturally in rice, honey, wine, vinegar, beer, and grape juice. Industrial-scale production of gluconic acid involves starch fermentation. Currently, it is the only organic acid reported to have a bifidogenic or prebiotic response (Kameue et al., 2004). It is of interest to note that microbes can use gluconic acid as substrate for butyric acid production. Therefore, gluconic acid may be further explored as a rather inexpensive source of butyric acid for use in animal nutrition (Biagi et al., 2006).
The objective of this study was to determine the effect of sodium gluconate on performance (feed intake, body weight, feed conversion, survival rates, and production efficiency) and digestive tract development in broiler chickens.

Materials and Methods A 43-day experiment was conducted on 120 day-old male broiler chickens (Ross 308) to determine the effect of sodium gluconate (SG) on the growth performance of birds and the status of their gastrointestinal tracts (5 treatments, 12 replications, 2 birds per replication). The birds received a basal diet without SG (control, a) or diets supplemented with SG at 1 (b), 2 (c), 3 (d) or 4 (e) g/kg. Water and feed were provided ad libitum. Broilers were fed commercial starter, grower and finisher diets. The nutrient content of diets was determined by the Weende method (AOAC 2000). The body weights (BW) of chickens were determined at weekly intervals throughout the experiment. Feed intake and the health status of birds were also analyzed. The data were used to calculate feed conversion ratio (FCR) measured as kg feed intake per kg body weight gain. Fattening efficiency was determined based on the European Efficiency Index (EEI). The effect of the administered diets on the structure and functional parameters of different segments of the gastrointestinal tract was analyzed post mortem, on day 43. The dissected alimentary tract was divided into the following parts: the crop, the gizzard, the proventriculus, the small intestine and the ceca, and the parts were weighed. The lengths of the small intestine and the ceca were measured. Each alimentary organ was cleared of the chyme, and the weights of the organ and the chyme were determined. The chyme collected from the crop, the gizzard, the proventriculus, the small intestine and the ceca was immediately mixed with deionised water (1:1 ratio), and pH was measured using a pH-meter (model 301, Hanna Instruments, Vila do Conde, Portugal). The concentrations of SCFAs were determined by gas chromatography (Shimadzu GC 14A, Shimadzu Co., Kyoto, Japonia). The results were processed statistically by one-way ANOVA and Duncan’s test. Arithmetic means (x), standard errors of the mean (SEM) and significance level (P) were determined. All calculations were performed using STATISTICA 10 software.

Results The inclusion of sodium gluconate in experimental diets tended to increase BW (P = 0.081). On day 43 (the end of fattening), group e birds (SG, 4 g/kg; 3536.3 g) were characterized by the highest body weight. The noted difference reached approximately 0.2 kg compared with control group birds (3327.1 g), but it not statistically significant. Diet supplementation with SG tended to improve FCR (P = 0.086), and it had no effect on feed intake. SG had a positive effect on the value of EEI, which was highest in group e (533.1 vs. 489.1 in the control group, P<0.05). All birds remained in good health throughout the trial.

The experimental diets had no effect on the weights of the crop, the proventriculus and the ceca, whereas the weights of the gizzard and the small intestine varied in response to dietary treatments. The lowest gizzard weight was reported in group c (P<0.05). The lowest weight of the small intestine was observed in group d, and the difference was highly significant relative to the control treatment (14.28 vs. 16.79 g/kg BW, P<0.01). The weight of the chyme and the pH of the crop, the proventriculus, the gizzard, the small intestine and the ceca did not vary among the experimental groups. However, a trend towards increased acidity of the chyme in the crop was observed in broilers that received diets supplemented with SG. Different sodium gluconate levels had a significant (P<0.01) effect on SCFA production. SG increased the production of total SCFAs and isobutyric acid in the ceca. Butyric acid concentrations increased progressively with increasing levels of dietary SG, but the observed differences were not statistically significant.
Conclusions The results of our study indicate that sodium gluconate tended to improve the growth performance of broiler chickens and to increase the concentrations of total SCFAs and butyric acid in their intestines.

References