

METABOLIC EFFECT OF CITRIC ACID IN BROILER CHICKENS

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ABSTRACT

The aim of the present study was to investigate the effect of citric acid inclusion on selected metabolic parameters (glucose, cholesterol, triglycerides) of broiler chickens. Broiler chickens hybrid Ross 308 (n=120) were divided into 2 groups: control (C) and experimental group (E). From each group 10 chickens were randomly selected. Experimental animals received citric acid *per os* in water in single dose 0.25% for 42 days. Average values of selected parameters of the metabolic profile were determined in blood serum by using an analyser Microlab 300 (Merc, Germany). Significant decrease ($p<0.05$) of serum triglycerides in citric acid group when compared with the control group was recorded. Citric acid had no harmful influence on the parameters of metabolic profile of broiler chickens. The research on the field of organic acid will be worthy of further investigation.

Keywords: citric acid, metabolic parameters, broiler chickens



INTRODUCTION

Organic acids have been used for a long time as food additives and preservatives for preventing food deterioration and extending the shelf life of perishable food ingredients. Specific organic acids have also been used to control microbial contamination and dissemination of food born pathogens in preharvest and postharvest food production and processing (Ricke, 2003). Under the current production systems, broiler chickens are exposed to various pathogenic microorganisms. The problems caused by these pathogenic microorganisms have traditionally been prevented by the use of vaccines and antibiotics. However, new regulations and negative consumer perceptions concerning the use of antibiotics in animal production have led to the development of products that consumers consider "natural." With varying degrees of success, several natural alternatives have been developed as substitutes for antibiotics: prebiotics (Xu *et al.*, 2003), direct fed microbials (probiotics) (Higgins *et al.*, 2010), yeast cell wall derivatives (Benites *et al.*, 2008), organic acids (Chowdhury *et al.*, 2009), and plant oils and extracts (Mitsch *et al.*, 2004). Several studies support the statement that the addition of citric acid to broiler rations improved weight gain (Afsharmanesh and Pourreza, 2005; Nezhad *et al.*, 2007), increased feed consumption (Moghadam *et al.*, 2006), and improved feed efficiency (Abdel-Fattah *et al.*, 2008). Its addition, its use increased retention of phosphorus (Brenes *et al.*, 2003; Liem *et al.*, 2008), tibia ash (Rafacz-Livingston *et al.*, 2005; Martinez-Amezcuca *et al.*, 2006), and toe ash (Atapattu and Nelligawatta, 2005) in broiler chicks. It also decreased pH of cecal digesta, crop and gizzard (Andrys *et al.*, 2003), and intestine (Denli *et al.*, 2003) in broiler chicks and improved immune responses by broilers (Rahmani and Speer, 2005; Abdel-Fattah *et al.*, 2008). Considering the above statements, this study was designed to determine the effect of citric acid on some parameters of metabolic profile in broilers chickens.

MATERIAL AND METHODS

Animals and experimental design

The experiment was conducted on broiler chickens, hybrid Ross 308 (n=120). Each group included 60 chickens. Chickens were divided into two groups (control – C and experimental group E). Experimental chickens received an organic acids inclusion in water in concentration 0.2 % (E group). The group of chickens received feed mixture without organic acid addition served as control.

The feeding period lasted 42 days. Chickens were fed *ad libitum* with complete feed mixture KKZ (Biofeed a.s., Kolarovo, Slovakia) as follows: KKZ HYD-01 (powdery form) from Day 1 till Day 21 and KKZ HYD-02 (granula form) from Day 22 till Day 42. Water was provided *ad libitum*. Ingredients and nutrient composition of diets are shown in Table 1.

Animals were kept in thermoneutral hall (from Day 1 33°C until 21°C at the end). In closed hall thermo aggregate was installed and experimental conditions with defined temperature and humidity were simulated by sensor. Simulated conditions were continually monitored using electronic recorder (Hivus s.r.o., Zilina, Slovak Republic). Animals were stabled in cage technology (MBD). The measurements of the cage were 75x50 cm (0.370 m²).

Chickens were healthy and their condition was judged as good at the commencement of the experiment. Conditions of animal care, manipulations and use corresponded with the instruction of ethical commission. Care and use of animals and experimental devices met the requirement of the certificate of Authorization to Experiment on Living Animals (State Veterinary and Food Institute of Slovak Republic, no. SK PC 30008).

Blood analysis

After 42 days of feeding blood samples were collected (n=10 in each group). The blood serum was separated from whole blood by centrifugation at 3000g for 30 min. The concentrations of serum parameters: glucose, total cholesterol, triglycerides, in blood serum of broiler chickens were analysed. Ecoline kits on automatic analyzer Microlab 300 (Merck, Germany) were used according to manufacturer conditions.

Statistical analysis

SAS software and Sigma Plot 11.0 (Jandel, Corte Madera, USA) were used to conduct statistical analyses. T- test was used to calculate basic statistic characteristics and to determine significant differences among the groups. Data presented are given as mean and standard deviation (SD). Differences were compared for statistical significance at the level $P<0.05$.

Table 1 Diet composition of feed mixture KKZ HYD-01 and HYD-02

Ingredient	KKZ HYD-01	KKZ HYD-02
Dry matter (g.kg ⁻¹)	917.3	913.3
Crude protein (g.kg ⁻¹)	211.3	199.7
Fat (g.kg ⁻¹)	25.5	23.0
Starch (g.kg ⁻¹)	413.0	434.8
Total sugar (g.kg ⁻¹)	49.5	31.7
ME (MJ)	11.689	11.555
Ca (g.kg ⁻¹)	12.121	8.207
P (g.kg ⁻¹)	7.833	6.834

ME – metabolizable energy, Ca - calcium; P - phosphorus

RESULTS AND DISCUSSION

The citric acid is known as effective chelate minerals. **Nezhad et al. (2007)** reported that the addition of citric acid to a broiler diet improved feed efficiency. In the present study consumption of citric acid during 42 days caused significant (P<0.05) decrease in serum triglycerides content. Of the others metabolic parameters (glucose and cholesterol) investigated in this study statistically insignificant (P>0.05) changes were observed. **Islam et al. (2012)** concluded that the addition of 0.75% citric acid to a standard diet is suitable for growth, carcass traits, macromineral digestibility and bone mineral density of broiler chicks. Results of **Menconi et al. (2013)** revealed that 0.2 to 0.8% of this organic acid may reduce pathogens and spoilage organisms and improve food safety properties in poultry. **El-Affifi et al. (2001)** reported no significant effect on serum lipids after citric acid treatment. Decrease in serum triglyceride content and possibly other parameters of lipid profile may be interpreted through influence in decreasing the microbial intracellular pH. The increased growth response observed from 0.5% citric acid in this study is in agreement with the results reported by **Abdel-Fattah et al. (2008)**, who found that the addition of dietary citric acid, acetic acid, or lactic acid improved live BW of broiler chicks as compared with those fed with unsupplemented diets. The citric acid treatment significantly increased tibia ash, indicating improved utilization of phosphorus. This finding is in an agreement with the result of **Liem et al. (2008)**, who reported that the addition of citric, malic, and fumaric acids increased the percentage of tibia ash, but only the effect of citric acid was significant. **Moghadam et al. (2006)** found that the beneficial effects of citric acid on feed consumption of broiler chicks were significant and similar results were found by **Atapattu and Nelligaswatta (2005)**.

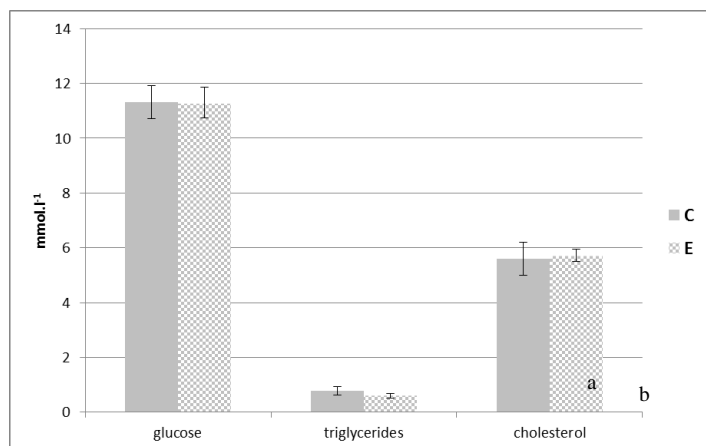


Figure 1 Effect of citric acid on choices parameters of metabolic profile in broiler chickens a-b the dissimilar letters mean significant differences in the rows (P<0.05); C – control group; E - experimental group

CONCLUSION

Reports concerning the effect of organic acids on broiler performance are inconclusive. In the literature, positive effects of different organic acids on feed utilization or dressing percentage have been reported (**Dibner and Buttin, 2002**), but **Rafacz-Livingston et al. (2005)** did not find any positive effects on performance in response to supplementation of different organic acid blends. This study showed that the selected metabolic parameters were not negatively affected by citric acid.

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