Microbial Phytase and Phosphorus Utilization by Broiler Chickens

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Abstract

The aim of study was to investigate the mathematical and statistical assesment of the micorbial 6-phytase efficacy on phosphorus utilization at broiler chickens Cobb 500. Broiler chickens fed commercial feed mixtures based on soyabean-maize meal. Each feed mixture was fed ad libitum to chickens in boxes in commercial poultry farm. The trial consited of three groups of broiler chickens, one control group (CG) and two trial groups, in which were broiler chickens fed by feed mixtures with decreased phosphorus content (TG1) and with microbial 6-phytase (TG2). A body weight of chickens at the end of the trial (42 day) was 1900.0 g compared with 1883,0 g (TG1) and 1827.0 g (CG) with not statistically significant differences (P≥0.05). Phosphorus, calcium and magnesium content in blood serum of broiler chickens in every group was not staticstically significant (P≥0.05). Phosphorus content in broiler chickens excreta was most higher in in control group (4.2556 g/kg) in comparison with trial group (2.0911 g/kg) were was microbial 6-phytase added and in trial group (3.1851 g/kg) were was phosphorus content in feed mixtures decreased. In addition we concluded that microbial 6-phytase. Phytase addition into feed mixtures has not negative effect on broiler chickens growth ability and health, and helped to better utilization of phytate phosphorus from feed mixtures in relation to excreted phosphorus.

Keywords: Cobb 500, excreta, microbial phytase, phosphorus

1. Introduction

The nutritional value of diets improved by the addition of exogenous enzymes may be mediated through a reduction in the losses of endogenous compounds from the birds [1]. Several studies reported that phytate increased the excretion of endogenous minerals and amino acids in broiler chickens, while phytase reduced the ileal flows of endogenous [2].The enzyme phytase catalyses the dephosphorylation of phytic acid and its salts, phytates. Supplementation of monogastric animal feed with microbial-derived phytase increases the bioavailability of phytic acid bound phosphate. This facilitates a reduction in the addition of inorganic phosphate to the feed and reduces phosphorus excretion [3]. Dietary factors that influence the amount of phytate P excreted by poultry could alter the solubility of the resultant excreta and impact their potential for P loss once applied to agricultural soils. One factor that could affect the solubility of the P in poultry excreta is the type of grain that they are fed. There is little published data examining phytate P degradation and P characterization of ileal digesta and excreta from birds fed various grains. Therefore, the current experiment was conducted to test the hypothesis that feeding broiler chickens grains, varying in phytate P and intrinsic phytase activities, would influence the utilization of dietary phytate P and the form in which P is excreted [4]. There is a little information about the availability of trace minerals when the broiler diet is supplemented with microbial phytase. Phytate being a strong acid can form various salts with the important minerals such as Ca, Mg, Cu, Zn, Fe and K thus reducing their solubility. Nutritionally

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more important is the fact that maximum binding of Zn-Ca-Cu-phytate as well as Cu-Ca-phytate occurs at pH 6 which is the normal pH of the micorbial 6-phytase efficacy on phosphorus utilization at broiler chickens Cobb 500.

2. Materials and methods

We carried out an experiment with the final fattening type of broiler chickens Cobb 500 and feed mixtures starter, grower finisher. Chickens were housed on commercial poultry farm during the whole experimental period, where the conditions were maintained for the fattening type of broiler chickens. The experiment consisted of three groups: control group and two experimental groups. Feed mixtures of one trial group were enriched with 6-phytase of microbial origin derived by biotechnological methods from *Schizosaccharomyces pombe*. Other groups, control and trial had different content of phosphorus as shown in Table 1.

Table 1. Scheme of the trial

Fattening period	Group	P content in feed mixtures	Phytase
Starter	Control	4.5 g/kg	-
Grower	Trial 1	2.3 g/kg	-
Finisher	Trial 2	2.3 g/kg	0.1%

At the end of experiment, the weight of 42 days old chickens was measured by the scale type Kern ECB 20K20. Blood samples for biochemical analysis were taken from *vena ulnaris cutaneus*. The blood plasma was separated from whole blood by the centrifugation at 3000 rpm for 30 minutes and samples were stored at -18 °C. Selected biochemical parameters in blood plasma calcium (Ca), phosphorus (P), magnesium (Mg) were analyzed using semi-automated clinical chemistry analyzer Microlab 300 (VilatScientific, Dieren, Netherlands). Excrement samples were randomly collected from each group in the end of fattening period. The excrement collections were pooled and dried for nutrient analysis. Phosphorus content was analyzed spectrophotometrically by method AAS on equipment VARIAN 240 FS. Results were calculated on phosphorus content of the original matter. Body weight of broiler chickens and blood parameters were statistically evaluated by program SAS.

3. Results and discussion

Table 2 shows the growth performance of broiler chickens used in our experiment with microbial phytase. Body weight of chicken of the control group was lower (1827.2 g) in comparison with two trial groups (1883.2 g, respetivelly 1900.0 g). This differences between control group and the trial group were was phosphorus content in diet decreased to 2.3 g/kg and trial group were was microbial phytase added were not statistically significant (P>0.05).

Table 2. Body weight of broiler chickens at the end of experiment

	n	Mean	SD	Cv (%)	TG1	TG2 2
CG	100	1827.2	172.90	9.46	-	-
TG1	100	1883.2	226.99	12.05		-
TG2	100	1900.0	242.45	12.76		
F-test		3.13^{-}				

Scheffe's test $P_{0.05}$

Phytase supplementation of adequate amount of P in broiler diets has been shown to generate equivocal growth performance responses that might be mediated by dietary nutrient specifications. Phytase did not influence growth performance of broilers on standard diets but significantly increased weight gain (7.6%) in modified diets. Moreover, there was a significant interaction between diet type and phytase addition in feed efficiency [7,8].

The effects of low calcium concentrations, microbial phytase supplementation on blood phosphorus contents are summarized in Table 3. Although, some small differences in blood serum Ca was observed on 42 days of age of broiler chickens in the observation, phytase and different levels of NNP had no significant effect on Ca concentration [6].

Statistical analysis of data showed that decreasing of anorganic phosphorus level in the diet was not statistically significant (P>0.05).

Table 3. Calcium content in broiler chickens' blood plasma

	n	Mean	SD	Cv (%)	TG1	TG2 2
CG	6	2.57	0.55	21.30	-	-
TG1	6	2.59	0.10	3.78		-
TG2	6	2.25	0.19	8.29		
F-test		0.53^{-}				

Scheffe's test $P_{0.05}$

The average phosphorus content in the blood plasma of broiler chickens was 1.23 mmol/l with the share of 0.01% microbial phytase and low-phytate content, 1.31 mmol/l within microbial phytase and lopw-phytate content. The average phosphorus content in control group was 1.39 mmol/l. Differences between groups were not statistically significant (P>0.05) (Table 4). Results shown that microbial phytase supplementation did not affect the phosphorus content in blood serum. The other studies indicated that phytase supplementation into feeds for broiler chickens did not significantly increase the phosphorus concentration in blood serum of birds [8, 9, 10].

Table 4. Phosphorus content in broiler chickens' blood plasma

	n	Mean	SD	Cv (%)	TG1	TG2 2
CG	6	1.39	0.28	19.82	-	-
TG1	6	1.40	0.08	5.84		-
TG2	6	1.23	0.22	18.11		
F-test		0.33^{-}				

Scheffe's test $P_{0.05}$

As shown in the Table 5 the magnesium content in the blood plasma of chickens was not statistically significant (P>0.05) affected by low phytate phosphorus concentrations and by using phytase. The average content of magnesium content in the blood plasma of the broiler chickens was 1.11 mmol/l with the share of 0.1% microbial phytase and low-phytate content, 0.98 mmol/l within microbial phytase and low-phytate content. In the control group was measured 1.02 mmol/l of magnesium in the blood plasma of broiler chickens.

Table 5. Magnesium content in broiler chickens' blood plasma

	n	Mean	SD	Cv (%)	TG1	TG2 2
CG	6	1.02	0.39	37.78	-	-
TG1	6	0.98	0.19	18.82		-
TG2	6	1.11	0.23	20.61		
F-test		0.44^{-}				

Scheffe's test $P_{0.05}$

During the fattening period broiler chickens fed diets with different composition. Figure 1 shows content of phosphorus content in excreted broiler chickens' manure. The lowest value (2.0911 g per kg) was reported in the second trial group, compared to the first trial group (3.1851 g per kg). In the control group was recorded the highest content of phosphorus (4.2556 g per kg) in excreta, which may result in higher phosphorus. In addition we concluded, that phytase addition to the feed mixtures helped to better utilization of phytate phosphorus from feed mixtures. In addition, phytase supplementation to poultry feeds has been shown to increase P availability from 35% to around 60% and reduced excreted P by 42% [11]. Based on the main effect of phytase

with respect to % excreta retention of total phosphorus, it can be concluded that the diets with higher content of phosphorus would cause a decrease in % total phosphorus retention form the excreta compared to the diets with lower content of phosphorus [12].

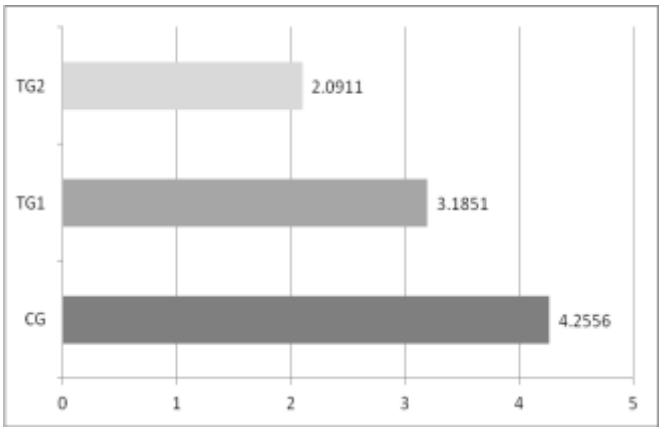

Figure 1. Phosphorus content in broiler chickens's excreta (g per kg)

4. Conclusions

Biotechnology in animal nutrition has an important application in the improving of food safety and quality of animal origin. The one of the area is the enzyme production designed for animals by biotechnological processes. Microbial phytase was developed primarily as an environmental enzyme to reduce phosphorus excretion by the body of animals into environment. In summary, the presence of phytase in feed mixtures did not significantly ($P>0.05$) affect the body weight gain of broiler chickens. We also researched if phytase influenced the Ca, P, Mg concentration in blood serum of birds. Our results have been shown not statistically significant ($P>0.05$) differences between groups.
Phytase supplementation affected the phosphorus content in broiler chickens excreta. The lowest P concentration in broiler chickens excreta in group were was phytase added. This results indicate the importance of phytase using in diets for chickens for decreasing the enivornment pollution affected by intensive animal production.

Acknowledgements

This work was supported by Scientific Grant Agency funding no. VEGA 1/0646/10

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