

Effects of phytase and/or organic acids on broiler performance

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Abstract

An experiment was conducted to study whether the addition of phytase and/or organic acids (citric or ascorbic acids) to a P-deficient maize and soybean meal diet would improve performance of broiler chickens. 288 male broiler chicks of the Ross 308 strain were allocated to 48 Petersime cages to test 8 dietary treatments based on two levels on non-phytate phosphorus (NPP), addition or not of phytase (0, 500 or 5000 U/kg feed), and inclusion or not of organic acids (citric acid at 1% or ascorbic acid at 0.3%) The reduction of NPP in broiler diets produced a decrease of feed consumption ($P < 0.01$) and a reduction of animal growth ($P < 0.001$) that could be overcome by the inclusion of phytase enzyme SP-1002 in these feeds. Similar broiler performance was obtained feeding the animals with diets with 0.45% of available phosphorus or with diets showing only 0.27% of NPP plus 500 U/kg feed of phytase enzyme SP1002. The addition of 5000 U phytase/kg to a P-deficient diet produced even better performance of broilers in comparison to birds fed positive control diet. No effects were found on productive parameters due to the inclusion of citric or ascorbic acids, and no interactions were observed between phytase and these organic acids.

Introduction

Phytase is an enzyme extensively studied in recent years due to its interest in several aspects: nutritional, because phytase supplementation increases the utilization of plant phosphorus, which is mainly in phytate form, and environmentally, because phytase decreases excreted phosphorus, thus reducing environmental eutrophication (Juanpere et al., 2004).

Citric acid has been reported to be a substance that intensifies phytate dephosphorylation in vitro (Zyla et al., 1995), and Boling et al (2000) reported that citric acid is also efficacious in improving P utilization in chickens fed on maize-soybean meal diets containing no supplemental P and reducing the available P requirement by approximately 1g/kg diet.

In in vitro studies using the iron dialyzability method, Porres et al, (2001) reported that the action of phytase on phytate dephosphorylation was enhanced by addition of citric acid and further by ascorbic acid supplementation.

Few studies in vivo have been reported evaluating the combined action of organic acids as enhancers of phytase on poultry feeding (Brenes et al, 2003).

The main objective of the current trial was to evaluate whether the addition of phytase and/or organic acids (citric or ascorbic acids) to a P-deficient maize and soybean meal diet would improve performance of broiler chickens.

Materials and Methods

Two hundred and eighty eight male broiler chicks of the Ross 308 strain were used. The chicks were allocated to 48 cages located in two Petersime battery brooders, in a randomised complete block design, consisting of 6 blocks and 8 dietary treatments, according the description listed below:

Treatment	Non-phytate phosphorus (g/kg)	Phytase enzyme (U/kg)	Organic acid (%)
T-1	4.5	-	-
T-2	2.7	-	-
T-3	2.7	500	-
T-4	2.7	-	Citric acid: 1%
T-5	0.27	500	Citric acid: 1%
T-6	0.27	-	Ascorbic acid: 0.3%
T-7	0.27	500	Ascorbic acid: 0.3%
T-8	0.27	5000	-

Diets were formulated to have 12.5 MJ/kg, 21,5% of crude protein and a ratio Ca:P of 2:1. The enzyme used in P-deficient diets was a microbial phytase (SP-1002). Quality control of feeds was performed determining proximate analysis, total and phytate phosphorus, calcium and phytase activity. Chicks and feed were weighed at the beginning and at the end of the experiment (21 days). At 21 days, excreta samples were taken, freeze-dried and analysed for phosphorus.

Results and Discussion

The reduction of available phosphorus in broiler diets produced a decrease of feed intake and a reduction of animal growth that could be overcome by the inclusion of phytase enzyme SP-1002 in these feeds. Similar broiler performance was obtained feeding the animals with diets with 0.45% of available phosphorus or with diets showing only 0.27% of NPP plus 500 U/kg feed of phytase enzyme SP1002. The addition of 5000 U phytase/kg to a P-deficient diet produced even better performance of broilers in comparison to birds fed positive control diet. No effects were found on productive parameters due to the inclusion of citric or ascorbic acids, and no interactions were observed between phytase and these organic acids.

References

- PORRES, J.M., ETCHEVERRY, P., MILLER, D.D. and LEI, X.G. (2001). Phytase and citric acid supplementation in whole-wheat bread improves phytate-phosphorus release and iron dialyzability. *Journal of Food Science*. 66: 614-619.
- BRENES, A., VIVEROS, A., ARIJA, I., CENTENO, C., PIZARRO, M. AND BRAVO, C. (2003). The effect of citric acid and microbial phytase on mineral utilization in broiler chicks. *Animal Feed Science and Technology*. 110: 201-219.
- BOLING, S.D., WEBEL, D.M., MAVROMICHALIS, I., PARSONS, C.M. and BAKER, D.H. (2000). The effects of citric acid on phytate-phosphorus utilization in young chicks and pigs. *Journal of Animal Science*. 78: 682-689.
- ZYLA, K., LEDOUX, D.R., GARCIA, A. and VEUM, T.L. (1995). An in vitro procedure for studying enzymic dephosphorylation of phytate in maize-soybean feeds for turkey poults. *British Journal of Nutrition*. 74: 7-13.

JUANPERE, J., PÉREZ-VENDRELL, A.M. and BRUFAU, J. (2004). Effects of microbial phytase on broilers fed barley-based diets in the presence or not of endogenous phytase. *Animal Feed Science and Technology*. 115: 265-279.

Table 1: Productive parameters of broilers from 1 to 21 days.

Trt	NPP (%)	Phytase (U/kg)	Organic acids (%)	Final body weight (g)	Average Daily Gain (g/d)	Average Daily Consumption (g/d)	Feed Efficiency (g/g)
T-1	0.45	-	-	696.32 b	31.03 b	42.65 bc	1.375
T-2	0.27	-	-	654.62 b	29.04 b	40.63 c	1.400
T-3	0.27	500	-	692.57 b	30.85 b	43.08 bc	1.399
T-4	0.27	-	Citric: 1%	657.08 b	29.16 b	41.75 bc	1.434
T-5	0.27	500	Citric: 1%	677.70 b	30.14 b	41.90 bc	1.391
T-6	0.27	-	Ascorbic: 0.3%	659.93 b	29.30 b	41.03 bc	1.401
T-7	0.27	500	Ascorbic: 0.3%	690.78 b	30.77 b	43.37 b	1.411
T-8	0.27	5000	-	755.07 a	33.83 a	46.10 a	1.364
St.Err.				14.60	0.69	0.82	0.016
Pr>F				0.0004	0.0004	0.0012	0.1108
Contrastes (Pr>T)							
Nivel P: 0.45% vs 0.27%				0.0501	0.0496	0.0900	0.2722
Citric: 0 vs 1%				0.6733	0.6743	0.9759	0.4119
Ascorbic: 0 vs 0.3%				0.9043	0.9042	0.6760	0.6654
Sin enzima vs. Fitasa				0.0001	0.0001	0.0003	0.1023
Dosis fitasa: 500 ppm vs 5000 ppm				0.0002	0.0002	0.0012	0.0537