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# Citric Acid and Microbial Phytase Inclusion in The Diet to Improve Utilization Phytate Phosporus and Growth of Broiler

**H. A. Sukria[a] & F. Liebert[b]**
[a] Department of Animal Nutrition and Feed Science, Bogor Agricultural University, Jl. Agatis Kampus IPB Darmaga, Fakultas Peternakan, IPB Bogor 16680, Indonesia
[b] Institut for Animal Physiology and Animal Nutrition, Georg-August-University Goettingen, Germany
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## ABSTRAK

Penelitian ini menggunakan anak ayam umur 3 sampai dengan 38 hari (180 ekor) dan 7 sampai dengan 42 hari (180 ekor). Ayam diberi ransum A, B, dan C yang berbahan dasar jagung (CSM) dan ransum E, F, dan G yang berbahan dasar gandum (WSM) yang diberi perlakuan penambahan steam pada suhu 100$^0$C selama 10 menit. Semua ransum ditambah enzim fitase (SP-1002 ct) sebanyak 500 U/kg dan dibuat dalam bentuk pelet. Khusus ransum C dan G ditambah asam sitrat. Kandungan fosfor total ransum adalah 4,5 g/kg dan fosfor tersedia adalah 1,5 g/kg (defisien P). Bobot badan harian adalah 36, 34, dan 45 g/hari untuk ayam yang diberi ransum A, B, dan C dan 54, 46, dan 55 g/hari untuk ransum E, F, dan G. Deposisi fosfor total adalah 5,75; 5,36; dan 6,99 g berturut-turut untuk ransum A, B dan C dan 8,15; 6,90; dan 7,77 g untuk E, F, dan G. Penambahan asam sitrat dalam ransum CSM yang mengandung enzim fitase rendah mampu meningkatkan pertumbuhan dan deposisi fosfor. Pada ransum WSM, perlakuan panas menyebabkan penurunan aktifitas fitase dan penurunan ini tidak dapat digantikan dengan penambahan enzim fitase (*microbial phytase*) akan tetapi dapat digantikan dengan penambahan asam sitrat. Hasil penelitian ini dapat disimpulkan bahwa asam sitrat berpengaruh terhadap efisiensi enzim fitase (*microbial phytase*) dalam mendegradasi senyawa fitat di dalam saluran pencernaan.

*Kata kunci: gandum, jagung, asam sitrat, enzim fitase, asam fitat*

## INTRODUCTION

Improving P-utilization has became increasingly importance, primarily due to phosphorus pollution from animal production. A number of studies shown that microbial phytase is an efficient tool for increasing phytate-P utilization, thereby reducing the amount of supplemental inorganic P in poultry diets. However, possibilities for increasing the efficiency of phytate degradation by supplemented microbial phytase is still a very interesting area of research. Boling *et al.* (2001) reported that addition of citric acid in combination with microbial phytase increased tibia ash content and weight gain of chicken fed corn-soybean diets significantly. The objective of the current study was to investigate the effect of microbial phytase in combination with citric acid in the presence of different native phytase activity. Corn and wheat treated by hydrothermal treatment were used as the grain component of chicken diets to vary the native activity of dietary phytase.

## MATERIAL AND METHODS

As many as 360 day old chicks were used in two experiments with age of 3 to 38 d (180 chicks) and 7 to 42 d (180 chicks) fed corn-soybean meal (CSM) and wheat-soybean meal (WSM) diets. Ten birds per group were located in a cage system as one replication (6 replication per diet), feed and water were supplied ad libitum. Corn and wheat (B, C and E, F) were subjected to hydrothermal treatment with steam addition ($100^0$C for 10 minutes). All diets were applied in pellet form and supplemented with 500 U/kg of a microbial phytase (SP-1002 ct). A mixture of citric acid : Na-citrate (1 : 1, w/w, 30 g/kg diet) was added only to diets C and F. All diets were deficient in available phosphorus (1.5 g/kg), the total phosphorus content of the diets was equal to 4.5 gP/kg. Treatments and experimental diets are summarised in Tables 1 and 2. At the end of the experiments selected animals were sampled and analysed for body composition (DM, N, P). The results are used for calculations of nutrient deposition.

## RESULTS AND DISCUSSION

In the first step of data analysis the result of growth experiments in terms of average daily gain (ADG), feed intake (FI), and feed conversion rate (FCR) as well as nutrient deposition are summarised in Table 3.

Feeding CSM-diet with citric acid improved feed intake and growth ($P < 0.01$), protein deposition and P-deposition ($P < 0.05$) significantly. The effects are more pronounced in comparison to Boling *et al*. (2001), however FCR was not enhanced. Additional effect of citric acid was not observed in chick fed WSM-diets. It is assumed that hydrothermal treatment of wheat changed the solubility of pentosans and the antinutritive effects of increased solubility of pentosans could have overlaped the results. The degradation of native phytase activity by wheat-treatment (Table 2) could be also an influencing factor. Consequently, under these conditions the citrate inclusion seemed to compensate these negative effects but did not express any additional effect on performance, nutrient deposition, and feed conversion. Complexation of calcium by citric acid (Pileggi *et al*., 1956) may also be a factor influencing the results.

Table 1. Experimental treatments

| Groups | Phytase (FTU/kg) | Citric acid : Citrate (1 : 1 w/w; g/kg) |
|---|---|---|
| A | 500 | - |
| B | 500 | - |
| C | 500 | 30 |
| D | 500 | - |
| E | 500 | - |
| F | 500 | 30 |

Table 2. Diet composition

| Ingredients (%) | Corn-soybeanmeal diet | | | Wheat-soybean meal | | |
|---|---|---|---|---|---|---|
| | A | B | C | D | E | F |
| Corn | 53.8 | 53.8 | 53.3 | - | - | - |
| Wheat | - | - | - | 54.9 | 54.9 | 54.1 |
| Soybean meal | 37.0 | 37.0 | 37.0 | 34.5 | 34.5 | 34.5 |
| Soybean oil | 2.0 | 2.0 | 2.8 | 3.5 | 3.5 | 4.5 |
| Wheat starch | 3.6 | 3.6 | 0.6 | 3.6 | 3.6 | 0.6 |
| $CaCO_3$ | 2.2 | 2.2 | 2.2 | 2.2 | 2.2 | 2.2 |
| NaCl | 0.4 | 0.4 | 0.1 | 0.3 | 0.3 | 0.1 |
| Premix | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| Citrate | - | - | 3.0 | - | - | 3.0 |
| **Nutrients** | | | | | | |
| Crude protein, %DM | 21.9 | 21.9 | 21.8 | 22.0 | 22.0 | 21.9 |
| ME, MJ/kg | 13.6 | 13.6 | 13.4 | 13.7 | 13.7 | 13.5 |
| Total P, g/kg | 4.6 | 4.6 | 4.6 | 4.7 | 4.7 | 4.6 |
| Available P, g/kg | 1.7 | 1.7 | 1.6 | 1.7 | 1.8 | 1.8 |
| Phytase activity (U/kg) | 464 | 418 | 571 | 1046 | 431 | 401 |

Table 3. Growth parameters and nutrient deposition after application of the NG, experimental diets over 35 days

| Parameters | Corn-soybeanmeal diet | | | Wheat-soybean meal | | |
|---|---|---|---|---|---|---|
| | A | B | C | D | E | F |
| Protein deposition, g | 224.6[ab] | 215.9[a] | 278.0[c] | 344.0[b] | 296.5[a] | 340.6[ab] |
| P-deposition, g | 5.8[a] | 5.4[a] | 7.0[b] | 8.2[a] | 6.9[b] | 7.8[ab] |
| P-utilization, % | 69.3[a] | 63.4[a] | 68.0[a] | 64.3[a] | 59.9[a] | 60.5[a] |
| ADG, g/d | 36.0[a] | 34.0[b] | 45.0[b] | 54.0[a] | 46.0[b] | 55.0[a] |
| FI, g/d | 61.0 | 61.0 | 77.0 | 99.0 | 89.0 | 101.0 |
| FCR, g/g | 1.7[a] | 1.8[b] | 1.7[a] | 1.8[a] | 1.9[b] | 1.8[a] |

Note: different superscripts indicate significant differences within the diet using Duncan's test

## CONCLUSIONS

Citric acid (30 g/kg) in a corn soybean chicken diet with low native phytase activity and supplementation of microbial phytase increased growth performance, protein, and phosphorus deposition significantly. Further experiments are essential for a more physiological explanation and clarification if citric acid changes the solubility of phytates and affecting the efficiency of supplemented microbial phytase.

## REFERENCES

**Boling, S. D., M. Webel, I. Mavromichlis, C. M. Parsons, & D. H. Baker**. 2001. The effects of citric acid on the calcium and phosphorus requirements of chicks fed corn soybean meal diets. Poult. Sci.80: 783- 788.

**Pileggi, V. J., H. F. De Luca, J. W. Cramer, & H. Steenbock**. 1956. Citrate in the prevention of rickets in rats. Arch. Biochem. Biophy. 60:52-57.