

# Effect of a new coating on the bioefficacy of a phytase product in broilers fed corn-soybean meal-based diets

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A study evaluated whether a coated (C) bacterially-derived, non-intrinsically thermostable, phytase product showed equivalent bioefficacy compared to the uncoated version of the same product (Phyzyme XP; 6-phytase, EC 3.1.3.26). Male Ross 308 chicks were assigned to three dietary treatments each with 6 cage replicates of 8 birds each. The treatments were: Control (NC), NC + 500 U/kg phytase and NC + 500 U/kg C-phytase. Except for Ca and P, the basal corn-soybean meal diet was formulated to meet NRC (1994) requirement. Calcium and P levels were 0.58 and 0.22%, respectively. Birds were weighed on days 0 and 21, and on day 21 birds were sacrificed for ileal phosphorus digestibility and tibia ash determination. Data were analysed using the GLM procedure of SAS. No significant differences were observed between the two phytase treatments. Supplementation of the NC diet with phytase and C-phytase increased ( $P<0.05$ ) tibia ash from 45.9% to 49.2% and 49.1%, respectively. There were no significant differences between treatments for 21-d body weight ( $P>0.05$ ). Phosphorus digestibility significantly improved by 20.6 and 18.0 percentage units ( $P<0.05$ ) with phytase and C-phytase supplementation, respectively. Addition of the new coating to the phytase resulted in similar bioefficacy to the original uncoated product.

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**Key words:** enzymes, phytase, broiler, coating, phosphorus

## Introduction

It has been well documented that majority of phosphorus in cereal grains and oilseeds exist as phytate phosphorus (P). Phytate has anti-nutritional properties which include reducing nutrient availability (e.g. protein, P, Ca, and other divalent minerals such as Mg and Zn). Phytate may also act as an antinutrient by forming complexes with amino acids and/or by potentially inhibiting the animal's own proteolytic enzymes thus negatively influencing digestibility of dietary amino acids and increasing endogenous amino acid secretions. Hence, there has been a lot of interest in overcoming the effects of phytate in livestock nutrition, especially with regard to non-ruminant animals. Poultry and swine lack adequate amounts of endogenous intestinal phytase activity, which results in poor utilization of phytate bound P. Numerous studies have amply demonstrated that supplementing poultry and swine diets with exogenous phytase enzymes can overcome some of the negative effects of phytate on the utilization of nutrients by the bird through the stepwise removal of phosphate groups from the inositol moiety. Therefore, to improve phytate P digestibility, reduce P excretion and the negative effects of phytate, commercial poultry feeds are supplemented with exogenous microbial phytase (Ravindran et al. 1995; Selle et al., 2006).

The current study evaluated the consequence of a new coating (C) on the bioefficacy of a bacterial-derived phytase product (Phyzyme XP; 6-phytase, EC 3.1.3.26; Danisco Animal Nutrition) in broilers fed corn-soybean meal-based mash diets.

## Materials and Methods

Male day-old Ross 308 broiler chicks were randomly allocated to 3 dietary treatments, with 8 birds per cage and 6 replicate cages per treatment, for a 21-d feeding trial. The experimental diets were: 1. negative control (NC), 2. NC + 500 U/kg phytase, and 3. NC + 500 U/kg C phytase. The corn-soybean meal-based mash diets were reduced by 0.17% non-phytate phosphorus and 0.18% calcium compared to the NRC (1994) requirements (*Table 1*). Titanium dioxide was included in diets as an indigestible marker and feed and water were available to birds at all times.

The experiment was conducted at the University of Manitoba, Winnipeg, Manitoba, Canada. Experimental treatments were applied to cages using a completely randomized design. Prior to the start of the study, animals were assigned to their treatment groups using a recognized randomization technique. Groups of animals were uniquely identified before the start of administration of test article. Similarly the cages of the animals were kept in were uniquely labeled. Room temperature and relative humidity were monitored regularly throughout the trial period, and averaged 25.4°C and 25.6%, respectively. Feed usage was measured between 0 and 21 days and birds were weighed in their cage groups at day 0 and 21. On day 21, all birds were sacrificed using cervical dislocation and the left tibia was removed and dry defatted bone ash content determined. Digesta samples were collected from the midsection of the ileum about 5 cm distal to Meckel's diverticulum and 5 cm proximal to the ileocecal junction. Ileal digestibility of P was calculated using titanium concentration in diet and ileal digesta, as indigestible index. Data were analyzed as a randomized complete block design using the GLM procedure of SAS.

**Table 1 Composition of basal control diet**

| <b>Ingredient, %</b>          | <b>Basal Control</b> |
|-------------------------------|----------------------|
| Corn                          | 53.22                |
| Soybean meal, 48%             | 38.03                |
| NaHCO <sub>3</sub>            | 0.20                 |
| Vegetable oil                 | 4.00                 |
| Dicalcium phosphate           | 0.62                 |
| Limestone                     | 1.47                 |
| NaCl                          | 0.30                 |
| Lysine                        | 0.12                 |
| Methionine                    | 0.24                 |
| Enzyme premix                 | 1.00                 |
| TiO <sub>2</sub>              | 0.30                 |
| Premix <sup>1</sup>           | 0.50                 |
| <b>Nutrients composition</b>  |                      |
| Metabolisable energy, Kcal/kg | 3053.20              |
| Crude Protein, %              | 22.78                |
| Calcium, %                    | 0.58                 |
| Phosphorus, %                 | 0.53                 |
| Available Phosphorus, %       | 0.22                 |

<sup>1</sup>Supplied per kilogram of diet: vitamin A, 8255 IU; vitamin D<sub>3</sub>, 3000, IU; vitamin E, 30 IU; vitamin K, 2 mg; Thiamine (vitamin B<sub>1</sub>), 4 mg; riboflavin (vitamin B<sub>2</sub>), 6 mg; niacin, 41.2 mg; folic acid, 1 mg; biotin, 0.25 mg; pyridoxine, 4 mg; choline, 1301; Pantothenic acid, 11 mg; vitamin B<sub>12</sub>, 0.013 mg Mn, 70 mg; Zn, 80 mg; Fe, 80 mg; Cu, 10 mg; and Na, 1.7 g

## Results and discussion

There were no significant differences between treatments for 21-d body weight and no significant differences were observed between the two phytase treatments (*Table 2*;  $P > 0.05$ ). Supplementation of the control with phytase and C-phytase significantly increased tibia ash from 45.9% to 49.2% and 49.1%, respectively (*Table 3*;  $P < 0.05$ ). Phosphorus digestibility was significantly improved by 20.6 and 18.0 percentage units (*Table 3*;  $P < 0.05$ ) by supplementation of the basal diet with phytase and C phytase, respectively.

The current observations confirm the potential for including phytase in poultry diets with reduced nutrient specification without compromising growth performance (Selle et al., 2003). Phosphorus digestibility and Tibia ash content were lowest ( $P < 0.05$ ) for birds fed the basal control diet compared to the phytase (phytase and C phytase) supplemented diets. As shown in *Table 3*, birds fed uncoated and coated phytase-supplemented diets had similar ( $P > 0.05$ ) phosphorus digestibility and tibia ash content. Tibia ash is considered to be the most sensitive criterion for assessing response to P availability in poultry (Onyango et al., 2003; 2005). Phytase supplementation to P-reduced control diets has been shown repeatedly to improve tibia ash; a response often attributed to improved P digestibility due to phytase supplementation (Simon et al., 1990; Zyla et al., 2000). Supplementing the NC diet with phytase in the present study significantly improved tibia ash and apparent ileal digestibility of P, which is consistent with results of the above mentioned studies and shows that the phytases tested were effective in hydrolyzing phytate to liberate P for utilization (Liu et al., 1998). The current results showing that performance of birds fed the NC diet was poorer than those fed the diets supplemented with both phytases indicates that P was indeed limiting in the NC diet as planned.

**Table 2 Effect of dietary treatments on bodyweight gain and feed intake**

| Dietary treatment                    | Bodyweight gain, (g/bird/day) | Feed intake (g/bird/day) |
|--------------------------------------|-------------------------------|--------------------------|
| Negative control (NC), mash          | 821                           | 47.6                     |
| NC + 500 U/kg Phyzyme® XP, mash      | 862                           | 49.9                     |
| NC + 500 U/kg C-coated phytase, mash | 825                           | 47.2                     |
| S.E.M.                               | 22.6                          | 1.21                     |
| P value                              | 0.3777                        | 0.2708                   |

**Table 3 Effect of dietary treatments on phosphorus digestibility and tibia ash content**

| Dietary treatment                    | Phosphorus digestibility, (%) | Tibia ash, (%)    |
|--------------------------------------|-------------------------------|-------------------|
| Negative control (NC), mash          | 41.3 <sup>b</sup>             | 45.9 <sup>b</sup> |
| NC + 500 U/kg Phyzyme® XP, mash      | 61.9 <sup>a</sup>             | 49.2 <sup>a</sup> |
| NC + 500 U/kg C-coated phytase, mash | 59.3 <sup>a</sup>             | 48.6 <sup>a</sup> |
| S.E.M.                               | 1.71                          | 0.64              |
| P value                              | <0.0001                       | 0.0050            |

<sup>ab</sup>Differing superscripts in the same column indicate significant difference.

From the results reported herein, it can be deduced that both phytases (uncoated and C phytase) were equally as effective in improving the utilization of phytate P as evidenced by similar improvements in AID P and bone mineralization. In conclusion, applying a new coating to a phytase product (Phyzyme XP; 6-phytase, EC 3.1.3.26) did not result in loss of bioefficacy of the phytase enzyme in broilers fed corn-soybean meal-based mash diets

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