D. R. Ledoux[1], J. N. Broomhead[1], and I. Kühn[2]*
[1]University of Missouri, Columbia, Missouri, USA. E-mail: Ledouxd@missouri.edu
[2]AB Enzymes GmbH, Darmstadt, Germany

Abstract

A market weight study (week 1 to week 14) was conducted to determine the efficacy and safety of a novel phytase product. The experimental diets included: (1) an NRC positive control diet (0.60% non phytate P (npP), 1.2% Ca, phase 1; adjusted for each phase according to NRC, 1994); (2) a negative control low P basal diet (60% NRC npP level for each phase; 84% NRC Ca for each phase); (3) as diet 2 plus 125 PPU phytase/kg diet; (4) as diet 2 plus 250 PPU phytase/kg diet; (5) as diet 2 plus 500 PPU phytase/kg diet; and (6) as diet 2 plus 10000 PPU phytase/kg diet. All diets were fed in mash form. The novel phytase was effective in improving phytate P utilization. Phytase up to 10000 PPU was not detrimental to the productivity or health of turkey hens grown to market weight. In fact, birds fed 10000 PPU/kg phytase outperformed birds fed the positive control diet.

Introduction

Approximately two thirds of the P in cereal grains (CG) and oil seed meals (OSM) is present in the form of phytate and is poorly available to poultry (NRC, 1994). One result of the poor availability of phytate P is that a significant amount of P is excreted annually in poultry manure. Poultry manure is often used as fertilizer on pastures and croplands. In areas of intensive poultry production, however, the nutrient content of manure often exceeds plant requirement for crop growth. When this occurs, excess P can pose a significant environmental problem.

It has been conclusively demonstrated that microbial phytase is effective in degrading phytate and improving P availability to poultry fed rations consisting of cereal grains and oilseed meals (Simons *et al.,* 1990; Schöner *et al.,* 1993). Enzyme companies are constantly looking to develop new products, to improve existing products, or to determine dietary conditions for optimizing the efficacy of their products. An important part of the development and evaluation process is product testing for efficacy and safety under industry type conditions. Therefore, the objective of the present study was to determine the efficacy and safety of a novel bacterial phytase product.

Materials and Methods

Seven hundred and fifty week-old female turkey poults were weighed, wing-banded, and randomly assigned to dietary treatments in floor pens. A completely randomized design was used with 6 dietary treatments and five replicate pens of 25 poults allotted randomly to each dietary treatment from day 8 to day 98. The experimental diets included: (1) an NRC positive control diet (0.60% non phytate P (npP), 1.2% Ca, phase 1; adjusted for each phase according to NRC, 1994); (2) a negative control low P basal diet (60% NRC npP level for each phase; 84% NRC Ca for each phase); (3) as diet 2 plus 125 PPU phytase/kg diet; (4) as diet 2 plus 250 PPU phytase/kg diet; (5) as diet 2 plus 500 PPU phytase/kg diet; and (6) as diet 2 plus 10000 PPU phytase/kg diet. All diets were fed in mash form. With the exception of Ca and P, all diets met or exceeded the nutrient requirements of poults (NRC, 1994). The novel phytase is a bacterial 6-phytase. Data were analyzed by analysis of variance using the General Linear Models procedure of SAS (1984). Statistical significance was accepted at $P < 0.05$.

Results and Discussion

Effects of dietary treatments on turkey hen performance are summarized in Table 1. Turkeys fed the negative control treatment consumed less feed and gained less weight ($P < .05$) compared with turkeys fed all other dietary treatments. Turkeys fed 125 to 500 PPU/kg of phytase performed as well ($P > .05$) as turkeys fed the positive control diet, whereas turkeys fed 10000 PPU/kg phytase outperformed ($P <.05$) turkeys fed the positive control diet. The poor growth performance of hens fed the negative control diet indicate that a 60% NRC npP and 84% NRC Ca diet was not adequate for turkey hens fed dietary treatments to 14 weeks of age. The lowest level of npP reported to support performance of turkey hens to market weight (14 weeks), equivalent to that of hens fed a 110% NRC npP diet, is 73% of NRC npP (Atia *et al*. 2000). The addition of the lowest level of supplemental phytase (125 PPU phytase/kg diet) was enough to enable hens to perform as well as those fed the positive control diet. The superior performance of birds fed 10000 PPU phytase/kg diet suggests that this phytase product may have benefits beyond that of improved phytate P utilization. At such a high dietary inclusion rate of phytase, it is possible that enzymatic side activities present came up to effective concentrations in the phytase product that may have contributed to the improved performance. The addition of a cocktail of enzymes to a phytase supplemented corn-soybean meal based diet resulted in improved growth performance and bone mineralization, and increased P and Ca retention by growing turkeys (Zyla *et al.*, 1996).

Bone ash data are summarized in Table 2. Hens fed the negative control diet had lower percent tibia ash and lower tibia ash weight ($P < .05$) compared with hens fed all other dietary treatments. Phytase supplementation of the negative control diet increased tibia ash percent to that of the positive control treatment. Tibia ash weight increased ($P < .05$) with increased phytase supplementation, with birds fed the two highest levels of phytase having tibia ash weight equivalent to that of control birds. Bone ash data indicated that supplemental phytase was effective in improving bone mineralization.
Effects of dietary treatments on litter P concentrations are summarized in Table 2. At both 6 and 14 weeks, litter P concentrations were lower ($P < .05$) in hens fed supplemental phytase compared to hens fed the positive control diet. Reductions in litter P at week 6 ranged from 34% at the lowest phytase inclusion level to 41% at the highest inclusion level, whereas at week 14 litter P reductions ranged from 22% to 28%.

An objective of this study was to determine the safety of this novel phytase. To achieve this objective, a phytase treatment was included that contained a phytase level (10000 PPU) that was 10 fold greater than the highest supplementation level recommended commonly for phytases (1000 PPU/kg feed). The performance of turkey hens fed this dietary treatment was superior to birds fed the positive control diet. In addition, a complete gross examination of turkeys from this treatment revealed no gross lesions indicative of potential toxic effects of this level of phytase.

Conclusions

The novel phytase was effective in improving phytate P utilization. Phytase up to 10000 PPU/kg diet was not detrimental to the productivity or health of turkey hens grown to market weight. In fact, birds fed 10000 PPU/kg phytase outperformed birds fed the positive control diet.

References

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Table 1. Effects of a Novel Bacterial Phytase on turkey performance[1]

Dietary ***phytase Level*** (PPU/kg)	Feed ***Intake*** (Kg)	Body Weight ***Gain*** (Kg)	Feed ***Conversion*** (Kg:Kg)
0 (NRC)	17.991[ab]	7.400[b]	2.432
0	14.913[c]	6.167[c]	2.418
125	17.550[b]	7.184[b]	2.444
250	17.357[b]	7.370[b]	2.355
500	18.006[ab]	7.354[b]	2.449
10000	18.661[a]	7.893[a]	2.368
SEM	0.304	0.130	0.034

[1] Data are means of 5 replicates of 25 turkeys each.
[2] Birds were one week old at the start of the study.
[abc] Values within columns with no common superscript differ significantly ($P < .0001$).

Table 2. Effects of a Novel Bacterial Phytase on tibia ash and litter P

Dietary ***Finase Level*** (PPU/kg)	Tibia[3] ***Ash*** (%)	Tibia[3] ***Ash*** (g)	Litter P[4] ***6 wk*** (%)	Litter P[4] ***14 wk*** (%)
0 (NRC)[1]	54.65[a]	13.15[a]	1.501[a]	1.521[a]
0[2]	48.37[b]	9.35[d]	1.086[b]	1.360[ab]
125	53.35[a]	12.27[c]	0.991[bc]	1.180[bc]
250	53.80[a]	12.43[bc]	0.977[bc]	1.154[bc]
500	54.34[a]	12.90[ab]	0.884[c]	1.070[c]
10000	54.34[a]	13.09[a]	0.879[c]	1.092[c]
SEM	0.91	0.21	0.066	0.070

[1]Positive control NRC diet
[2]Negative control low P diet
[3]Data are means of 5 replicates of 6 turkeys each.
[4] Data are means of 5 replicates of 25 turkeys each.
[abc] Values within columns with no common superscript differ significantly ($P < .05$).