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Effect of enzyme addition on mineral metabolism and nutrient balance in broilers fed with corn-soya based diet

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Abstract
A biological trial in broilers (180 chicks) was conducted for a period of 42 days with six treatments 30 birds each. T_1 as control, T_2: control + 250 g /ton NSP enzyme, T_3: control + 500 g/ton NSP enzyme, T_4:1000 g /ton NSP enzyme, T_5: control + phytase enzyme 300 IU/kg of feed with reduction (14.6%) in available phosphorus, T_6: control + phytase enzyme 600 IU/kg of feed with reduction (30%) in available phosphorus. The phosphorus balance was significantly (p<0.05) increased in T_5 and T_6 than control. No significant difference was observed in calcium balance. Based on the results obtained in this study, it was inferred that the enzyme addition to corn – soya based diet improved the nutrient utilization.

Keywords: Enzyme, mineral balance, broilers, corn-soya based diet

Introduction
The feed ingredients used in the preparation of feed contain 10 to 40 % non starch polysaccharides (NSP) and two thirds of the phosphorus as phytates. The NSPs and phytates are not only indigestible/unavailable but also are known to interfere with the utilization of other nutrients. Phytic acid being a reactive cation can form salts with nutritionally important minerals like Zn $^{2+,}$ Ni^{2+}, Co^{2+}, Mn^{2+}, Ca^{2+}, and Fe^{2+} with decreasing order of stability (Cheryan, 1980) [3] and these complexes appear to be resistant to the digestive process. The net result is that a portion of the dietary mineral pool is unavailable to the animal. (Maenz, 2001). The use of enzyme preparations containing cellulase, hemicellulase, pectinase and phytase was found to be helpful in enhancing the nutritive value of feedstuff containing high NSPs (Friesen *et al.* 1992) and phytate phosphorus (Denbow *et al.* 1995) [5]. Keeping these points in view this study was formulated to evaluate the effect of enzyme addition on mineral metabolism and nutrient balance in broilers fed with corn – soya based diet.

Materials and Methods
A biological trial in broilers (180 chicks) was conducted for a period of 42 days with six treatments 30 birds each. T_1 as control, T_2: control + 250 g /ton NSP enzyme, T_3: control + 500 g/ton NSP enzyme, T_4: 1000 g /ton NSP enzyme, T_5: control + phytase enzyme 300 IU/kg of feed with reduction in available phosphorus (14.6 percent reduction in available phosphorous), T_6: control + phytase enzyme 600 IU/kg (30 percent reduction in available phosphorous).Chicks were given a free choice access to diets and tap water for 42 days. The chicks were fed the experimental diets (Table: 1, 2 and 3) throughout the experimental period. At the end of six week of age, six male birds from each experimental group were selected randomly and left tibial bone from all slaughtered birds were removed, dried over night in a hot air oven at 70 °C and defatted with petroleum ether and analysed for their total ash, calcium and phosphorus contents (AOAC 1990) [1]. The data collected on various parameters were statistically analyzed as per the method of Snedecor and Cochran (1989) [11].

Results and Discussion
1. Mineral metabolism
The influence of enzymes addition on bone mineral metabolism in terms of bone weight (g/kg live weight), tibial bone ash, calcium and phosphorus content are presented in Table 4.

Tibial bone ash: The mean values of tibial bone ash (percent) were 50.38, 53.15, 52.93, 53.23, 52.67 and 53.83 in treatment groups T_1 to T_6 respectively. No significant difference was

observed between enzymes added groups and control group. However, the enzymes added groups had a numerically higher tibial bone ash compared to the control group. These results agree with the earlier finding of Balamurugan (2004) [2], who also reported that supplementation of phytase to corn soya based broiler diet numerically increased the tibial ash content by 0.9–2.8 percent.

Tibial bone calcium: The mean value of tibial bone calcium as percent of total ash in birds fed diets T_1 to T_6 was 26.16, 29.46, 30.06, 29.14, 26.80 and 28.22 respectively. There was no significant difference between the experimental groups. However, the enzymes added groups had numerically higher tibial bone calcium compared with the control group. Similarly Balamurugan (2004) [2] also observed numerical increase in bone calcium content. The mean value of tibial bone phosphorus as percent of total ash for the groups T_1 to T_6 was 12.40, 13.35, 12.67, 12.37, 11.81, and 12.65 respectively.

Tibial bone phosphorus: There was numerical increase in tibial bone phosphorus in T_2, T_3 and T_6. But the results were not significant. But Balamurugan (2004) [2] observed significant increase in bone phosphorus content due to the supplementation of NSP degrading enzymes to corn soya based broiler diet. Some authors have also reported a significant increase in the bone calcium and phosphorus content due to the supplementation of phytase to broiler diet. (Singh and Khatta, 2003; Conte *et al.*, 2004) [10, 4].

2. Nutrient balance

The effect of enzyme addition on nutrient balance of calcium, phosphorus and nitrogen is presented is Table 5.

Calcium balance: The mean (percent) calcium balance in different treatment groups T_1 to T_6 was 41.80, 41.56, 40.98, 41.20, 41.67 and 41.70 respectively. The mean values did not differ significantly among the experimental groups. But, Balamurugan (2004) [2] in his study supplementing NSP degrading enzymes either alone or in combination with phytase to corn soya based broiler diet observed a maximum improvement of 2 percent balance of calcium in the treatment groups when compared with the control.

Phosphorus balance: The mean (percent) phosphorus balance in birds fed diets T_1 to T_6 was 38.60, 38.72, 38.88, 38.99, 40.89 and 41.07 percent respectively. Significantly (p<0.05) increased phosphorus balance was noticed in T_5 and T_6 groups when compared to other treatment groups. In the entire enzymes added groups phosphorus balance was either significantly or numerically higher than the control group. The increase in phosphorus balance could be due to the enhanced break down of phytate phosphorus present in the vegetable feed ingredients by phytase. Similarly, Balamurugan (2004) [2] in his study, supplementing NSP degrading enzymes either alone or in combination with phytase to corn soya based broiler diet observed a maximum improvement of phosphorus balance by 5.8 percent over the control. Many authors have reported a significant increase in the phosphorus retention due to the supplementation of phytase to broiler diet. (Sebastian *et al.*, 1996; Korin *et al.*, 1999; Singh and Khatta, 2003) [9, 7, 10].

Nitrogen balance: The mean value of nitrogen balance in the treatment groups T_1 to T_6 was 11.02, 11.51, 11.02, 12.54, 11.36 and 11.43 percent respectively. Significant difference (p<0.05) was noticed between the enzymes added group (T_4,) when compared to the control group. While in other treatment groups, numerical increase in nitrogen balance was observed over the control group. Similarly Balamurugan (2004) [2] in his study supplementing NSP degrading enzyme either alone or in combination with phytase to corn soya based broiler diet observed a maximum improvement of 30 percent in the retention of nitrogen.

Table 1: Ingredients and nutrient composition of broiler pre starter diet (% DM)

Ingredients (%)	T_1	T_2	T_3	T_4	T_5	T_6
Maize	44.50	44.63	44.63	44.63	45.16	45.69
Soya	41.25	41.22	41.22	41.22	41.08	40.93
Fish meal	6.00	6.00	6.00	6.00	6.00	6.00
Rice bran oil	5.40	5.36	5.36	5.36	5.13	4.90
Dicalcium phosphate	1.25	1.25	1.25	1.25	1.16	0.26
Calcite	0.83	0.83	0.83	0.83	0.76	1.49
Lysine (g/100 kg)	49.29	49.75	49.75	49.75	52.47	55.19
DL methionine (g/100 kg)	230.00	230.00	230.00	230.00	230.00	230.00
Salt (g/100 kg)	258.47	337.00	337.00	337.00	336.76	336.53
Sodium bicarbonate (g/100 kg)	206.73	64.91	64.91	64.91	64.91	64.91
NSP enzyme (g/100 kg)	0.00	25.00	50.00	100.00	0.00	0.00
Phytase (g/100 kg)	0.00	0.00	0.00	0.00	6.50	13.00
Additives and supplements (g/100 kg)	630.00	630.00	630.00	630.00	630.00	630.00
Nutrients (%)	T_1	T_2	T_3	T_4	T_5	T_6
Dry matter	93.08	92.9	93.3	93.56	93.05	93.85
Crude protein	23.01	23.00	23.01	23.01	22.95	22.95
Crude fibre	4.25	4.25	4.25	4.25	4.25	4.25
NDF	10.77	10.5	10.54	11.11	11.27	11.27
ADF	1.92	1.89	1.94	1.87	1.94	1.93
Hemicellulose	8.84	8.64	9.17	8.91	9.26	9.12
Cellulose	1.78	1.82	1.85	1.81	1.85	1.84
Lignin	0.14	0.15	0.14	0.15	0.14	0.14
Ether extract	6.50	6.93	6.92	6.86	6.76	6.29
Total ash	8.51	8.87	8.16	8.92	8.42	8.12
NFE*	57.73	56.9	57.66	56.96	57.62	58.39

Acid insoluble ash	2.31	2.4	2.55	2.51	2.15	2.18
Calcium	1.01	1.01	1.01	1.01	1.01	1.01
Available phosphorus	0.50	0.50	0.50	0.50	0.42	0.34
Lysine*	1.30	1.30	1.30	1.30	1.30	1.30
Methionine*	0.58	0.58	0.58	0.58	0.58	0.58
Cystine + Methionine*	0.93	0.94	0.93	0.93	0.93	0.93
Metabolizable energy*(kcal/kg)	3050	3050	3050	3050	3043	3039

Mineral mixture added at the level per kg feed supplied manganese-81 mg, zinc 78 mg, iron-30 mg, iodine- 3 mg, and copper –3 mg and cobalt – 1.5 mg

Vitamin AB_2D_3K added at the level per kg feed supplied vitamin A-16500 IU, B2-10 mg, D3-3200 IU and vitamin K-2 mg.

Vitamin B complex added at the level per kg feed supplied, thiamine 2.8 mg, pyridoxine 5.6 mg, Niacin 42 mg, cyanocobalamine 28 mcg, vitamin E 28 mg, calcium D pantothenate 28 mg and folic acid 2.8 mg, calcium 30.1 mg Coccidiostat added at the level per kg feed supplied 125 mg of Di-nitro-ortho-toluamide.

Antibiotic (Oxy tetracycline) 0.5 g was added per kg of feed.*Calculated values

Table 2: Ingredients and nutrient composition of broiler starter diet (% DM)

Ingredients (%)	**T_1**	**T_2**	**T_3**	**T_4**	**T_5**	**T_6**
Maize (kg)	48.84	48.84	48.84	48.84	49.37	49.90
Soya (kg)	36.60	36.60	36.60	36.60	36.46	36.32
Fish meal (kg)	6.00	6.00	6.00	6.00	6.00	6.00
Rice bran oil (kg)	5.77	5.77	5.77	5.77	5.54	5.31
Dicalcium phosphate (kg)	1.00	1.00	1.00	1.00	0.50	0.00
Calcite (kg)	1.03	1.03	1.03	1.03	1.37	1.70
Lysine (g/100 kg)	118.00	118.00	118.00	118.00	121.56	124.28
DL methionine (g/100 kg)	234.00	234.00	234.00	234.00	234.35	234.04
Salt (g/100 kg)	338.03	338.03	338.03	338.03	337.80	337.57
Sodium bicarbonate (g/100 kg)	38.58	38.58	38.58	38.58	39.00	38.59
NSP enzyme (g/100 kg)	0.00	25.00	50.00	100.00	0.00	0.00
Phytase (g/100 kg)	0.00	0.00	0.00	0.00	6.50	13.00
Additives and supplements (g/100 kg)	630.00	630.00	630.00	630.00	630.00	630.00
Nutrients (%)	T_1	T_2	T_3	T_4	T_5	T_6
Dry matter	92.30	90.80	93.94	93.06	92.65	92.23
Crude protein	21.49	21.50	21.49	21.49	21.5	21.46
Crude fibre	4.05	4.05	4.05	4.05	4.05	4.05
NDF	11.42	11.2	11.02	11.01	11.17	11.03
ADF	1.49	1.57	1.59	1.61	1.54	1.48
Hemicellulose	9.41	9.41	9.69	9.58	9.49	9.58
Cellulose	1.22	1.25	1.27	1.29	1.28	1.28
Lignin	0.24	0.34	0.34	0.34	0.34	0.34
Ether extract	6.96	6.96	6.96	6.96	6.51	6.31
Total ash	8.21	8.63	8.52	8.25	8.31	8.21
NFE*	59.29	58.9	58.98	59.25	59.63	59.97
Acid insoluble ash	2.41	2.41	2.58	2.52	2.12	2.14
Calcium	0.99	1.01	1.01	1.01	1.01	1.01
Available phosphorus	0.45	0.45	0.45	0.45	0.37	0.29
Lysine*	1.25	1.25	1.25	1.25	1.25	1.25
Methionine*	0.56	0.56	0.56	0.56	0.56	0.56
Cystine + Methionine*	0.90	0.90	0.90	0.90	0.90	0.90
Metabolizable energy*(kcal/kg)	3125	3125	3125	3125	3118	3113

Mineral mixture added at the level per kg feed supplied manganese- 81 mg, zinc 78 mg, iron-30 mg, iodine- 3 mg, and copper –3 mg and cobalt – 1.5 mg.

Vitamin AB_2D_3K added at the level per kg feed supplied vitamin A-16500 IU, B2-10 mg, D3-3200 IU and vitamin K-2 mg.

Vitamin B complex added at the level per kg feed supplied, thiamine 2.8 mg, pyridoxine 5.6 mg, Niacin 42 mg, cyanocobalamine 28 mcg, vitamin E 28 mg, calcium D pantothenate 28 mg and folic acid 2.8 mg, calcium 30.1 mg.

Coccidiostat added at the level per kg feed supplied 125 mg of Di-nitro-ortho-toluamide.

Antibiotic (Oxy tetracycline) 0.5 g was added per kg of feed. * Calculated values

Table 3: Ingredients and nutrient composition of broiler finisher diet (% DM)

Ingredients (%)	T_1	T_2	T_3	T_4	T_5	T_6
Maize	51.31	51.08	51.08	51.08	51.84	52.36
Soya	32.68	32.73	32.73	32.73	32.53	32.39
Fish meal	6.00	6.00	6.00	6.00	6.00	6.00
Rice bran oil	7.37	7.45	7.45	7.45	7.14	6.91
Dicalcium phosphate	1.05	1.37	1.37	1.37	0.60	0.05
Calcite	1.03	0.81	0.81	0.81	1.36	1.69
Lysine (g/100 kg)	76.85	76.07	76.00	76.07	79.56	82.27
DL methionine (g/100 kg)	91.16	91.42	91.42	91.42	90.85	90.54
Salt (g/100 kg)	318.04	318.56	318.56	318.56	315.92	313.81
Sodium bicarbonate (g/100 kg)	51.46	50.71	50.71	50.71	54.87	58.29
NSP enzyme (g/100 kg)	0.00	25.00	50.00	100.00	0.00	0.00
Phytase (g/100 kg)	0.00	0.00	0.00	0.00	6.50	13.00
Additives and supplements (g/100 kg)	630.00	630	630	630	630	630
Nutrients (%)	T_1	T_2	T_3	T_4	T_5	T_6
Dry matter	93.01	93.40	93.17	93.6	93.78	93.24
Crude protein	20.00	20.00	20.00	20.0	19.96	19.98
Crude fibre	3.85	3.85	3.85	3.85	3.85	3.85
NDF	10.32	10.41	10.42	10.52	12.04	12.09
ADF	1.61	1.72	1.74	1.82	1.76	1.89
Hemicellulose	9.51	9.55	9.75	9.95	10.05	9.95
Cellulose	1.84	1.85	1.94	1.95	2.13	2.01
Lignin	0.42	0.42	0.45	0.41	0.51	0.51
Ether extract	9.18	9.75	9.68	9.12	8.74	8.32
Total ash	8.34	8.62	8.51	8.74	8.46	8.21
NFE*	58.63	57.8	57.96	58.29	58.99	59.64
Acid insoluble ash	2.51	2.5	2.61	2.54	2.15	2.15
Calcium	0.99	0.99	0.99	0.99	1.02	1.01
Available phosphorus	0.45	0.45	0.45	0.45	0.37	0.30
Lysine*	1.12	1.12	1.12	1.12	1.12	1.12
Methionine*	0.40	0.41	0.40	0.40	0.40	0.40
Cystine + Methionine*	0.72	0.72	0.72	0.72	0.72	0.72
Metabolizable energy*(kcal/kg)	3250	3250	3250	3250	3238	3239

Mineral mixture added at the level per kg feed supplied manganese-81 mg, zinc 78 mg, iron-30 mg, iodine- 3 mg, and copper –3 mg and cobalt – 1.5 mg

Vitamin AB_2D_3K added at the level per kg feed supplied vitamin A-16500 IU, B2-10 mg, D3-3200 IU and vitamin K-2 mg.

Vitamin B complex added at the level per kg feed supplied, thiamine 2.8 mg, pyridoxine 5.6 mg, Niacin 42 mg, cyanocobalamine 28 mcg, vitamin E 28 mg, calcium D pantothenate 28 mg and folic acid 2.8 mg, calcium 30.1 mg

Coccidiostat added at the level added per kg feed supplied 125 mg of Di-nitro-ortho-toluamide.

Antibiotic (Oxy tetracycline) 0.5 g was added per kg of feed. *Calculated values

Table 4: Effect of different levels of enzymes addition on tibial bone weight, tibial bone ash, calcium and phosphorus in broiler chickens

Treatments	Bone wt (g)/kg live weight*	Tibial ash (%)	Tibial ash	
			Calcium (%)	Phosphorus (%)
T_1	$2.51^{b} \pm 0.27$	50.38 ± 2.56	26.16 ± 1.19	12.40 ± 0.76
T_2	$2.58^{b} \pm 0.11$	53.15 ± 2.58	29.46 ± 1.36	13.35 ± 0.08
T_3	$2.53^{b} \pm 0.18$	52.93 ± 2.88	30.06 ± 1.10	12.67 ± 0.54
T_4	$2.64^{b} \pm 0.23$	53.23 ± 2.31	29.14 ± 1.71	12.37 ± 0.14
T_5	$2.77^{ab} \pm 0.24$	52.67 ± 2.24	26.80 ± 1.49	11.81 ± 0.55
T_6	$3.31^{a} \pm 0.21$	53.83 ± 2.33	28.22 ± 1.49	12.65 ± 0.37

Each value is a mean of six observations.

* Means with atleast one common superscript in a column do not differ significantly ($p<0.05$)

Table 5: Effect of different levels of enzymes addition on nutrient balance in broiler chickens

Treatment groups	Calcium (%)	Phosphorus* (%)	Nitrogen* (%)
T_1	41.80 ± 0.83	$38.60^{b} \pm 0.87$	$11.02^{c} \pm 0.60$
T_2	41.56 ± 1.10	$38.72^{b} \pm 0.57$	$11.51^{bc} \pm 0.24$
T_3	40.98 ± 3.72	$38.88^{b} \pm 0.50$	$11.02^{c} \pm 0.42$
T_4	41.20 ± 3.09	$38.99^{b} \pm 0.59$	$12.54^{a} \pm 0.17$
T_5	41.67 ± 2.39	$40.89^{a} \pm 0.06$	$11.36^{bc} \pm 0.12$
T_6	41.70 ± 2.23	$41.07^{a} \pm 0.04$	$11.43^{bc} \pm 0.11$

Each value is a mean of four observations. ***** Means with atleast one common superscript in a column do not differ significantly ($p<0.05$)

Conclusion

The results of the current study showed that supplementation of NSP degrading enzyme and Phytase improved the nutrient balance, very particularly nitrogen balance was significantly (p<0.05) improved in the enzyme topped control group (1000 g/ton). The phosphorus balance was significantly (p<0.05) increased in phytase than the control. No significant difference was observed in calcium balance. Thus it can be concluded that supplementation of NSP enzyme and phytase improved the nutrient balance.

References

1. AOAC. Official Methods of Analysis, Association of Official Analytical Chemists, 15th edn. Washington, D.C; c1990.
2. Balamurugan R. Performance and intestinal response of broiler chickens fed on multi enzyme supplemented diet. M.V.Sc., thesis, submitted to Tamil Nadu Veterinary and Animal Sciences University, Chennai; 2004.
3. Cheryan M. Phytic acid interactions in food systems. CRC Critical Reviews in Food Science and Nutrition. 13: 297-335. In. Enzymes in farm animal nutrition. CABI publishing, CAB International, Wallingford, UK; c1980. p. 149.
4. Conte AJ, Teixeira AS, Fialho ET, Schoulten NA, Bertechini AG. Effect of phytase and xylanase on the performance and bone characteristics of broiler chicks fed diets with rice bran. Revista Brasileira de Zootecnia. 2003;32:1147-1156. (Nutr. Abstr. 2004;74:3556.
5. Denbow DM, Ravindran V, Kornegay ET, Yim Z, Hulet RM. Improving phosphorus availability in soybean meal for broilers by their interactions on α-amylase activity. J Food Sci. 1995;49:516-519.
6. Friesen OD, Guenter W, Marquardt RR, Rotter BA. The effect of enzyme supplementation on the apparent metabolizable energy and nutrient digestibility of wheat, barley, oats and rye for the young broiler chick. Poult. Sci. 1992;71:1710-1721.
7. Korin L Leske, Craig N Coon. A bioassay to determine the effect of phytase on phytate phosphorus hydrolysis and total phosphorus retention of feed ingredients as determined with broilers and laying hens. Poult. Sci. 1999;78:1151-1157.
8. Maenz DD. Enzymatic characteristics of phytases as they relate to their use in animal feeds. In. Enzymes in farm animal nutrition. CABI publishing, CAB International, Wallingford, UK; c2001. p. 61-84.
9. Sebastian S, Touchburn SP, Chavez ER, Lague PC. The effects of supplemental microbial phytase on the performance and utilization of dietary calcium, phosphorus, copper, and zinc in broiler chickens and corn-soybean diets. Poult. Sci. 1996;75:729-736.
10. Singh PK, Khatta VK. Effect of phytase supplementation on the performance of broiler chickens fed wheat based diets. Indian Journal of Animal Nutrition. 2003;20:57-62.
11. Snedecor GW, Cochran WG. Statistical Methods, 8th edn. Iowa State University Press, Ames, Iowa; c1989.