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EFFECT OF SUPPLEMENTAL PHYTASE ON PERFORMANCE, BONE CHARACTERSTICS AND PROTEIN DIGESTIBILITY OF BROILER CHICKS

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SUMMARY

A basal diet (A) was formulated to contain 23% CP, 3200 Kcal ME/Kg, 0.37 total and 0.15 %, non-phytate P with no inorganic P supplements. Three levels of dicalcium phosphate were added to the basal diet to formulate diets B, C, and D containing 0.52, 0.62 and 0.72 % total and 0.30, 0.40 and 0.50 % available P, respectively. Phytase enzyme (Alltech®) was added to diets A, B and C (1g/Kg diet i.e. 1000 U/kg).

Every dietary treatment was fed to 3 replicates (10 chicks each) of one-day old Arbor Acres broiler chicks for 28-day experimental period. Growth performance, symptoms of leg problems, mortality, bone characteristics and protein digestibility were measured.

Birds fed the lowest P diet with no phytase gained significantly (P<0.05) less weight compared to the other treatments. Phytase addition to such diet markedly (P<0.05) increased weight gain. Increasing the dietary P content resulted in pronounced increases in weight gain. No significant differences were detected among birds fed the different dietary P levels supplemented with phytase. The percent improvement in weight gain due to the addition of phytase decreased with increasing the dietary P level. Feed : gain ratio showed that addition of phytase to the lowest P diet caused a significant (P<0.05) improvement in feed utilization.

Incidence of leg problems (50%) and mortality (40%) of birds fed the lowest P diet declined to the normal levels with increasing the dietary phosphorus content or addition of phytase.

Increasing the dietary P level or added phytase significantly increased bone length (P<0.05) and ash percentages in the femur, tibia and toe (P<0.01).

Neither dietary phosphorus level nor added phytase affected protein digestibility values.

It could be concluded that addition of phytase has a great effect in improving growth performance and bone characteristics of broiler chicks fed low P diets. The largest response to phytase supplementation was obtained at the lowest level of dietary P.

Keywords: *Phytase, broilers, performance, bone, protein digestibilty*

INTRODUCTION

Supplemental phosphate sources are used to balance the feeds to their content of available and total phosphorus. At the present, there are two different concerns about phosphorus supplementation to poultry diets. Firstly, there is the need for rapid growth rate with optimum feed utilization and excellent bone mineralization. Secondly, pollution problems. Environmental concern in fact urges for the need of feed with a decreased total phosphorus content in combination with a high level of its availability. This necessitates using sources of high available phosphorus content or improving phosphorus availability of the traditional feedstuffs of low available phosphorus. In this way, uncontrolled output of phosphorus to the environment is avoided.

The use of phytase in poultry diets as means of releasing the P from phytate, thereby reducing the need for supplemental inorganic P, has recently received considerable attention. Recent studies have indicated that phytase supplementation in phosphorus deficient diets will increase body weight gain and feed intake in broiler chickens (Broz *et al.*, 1994; Denbow *et al.*, 1995; Kornegay *et al.*, 1996; and Sebastian *et al.*, 1998).

Qian *et al.* (1996) and Sohail and Roland (1999) proved that supplemental phytase has a great influence on bone mineral content, bone density and bone-breaking strength.

Other studies showed that phytase supplementation improved nitrogen retention by broiler chickens (Farrell *et al.*, 1993 and Sebastian *et al.*, 1996) and increased digestibility of the dietary amino acids (Sebastian *et al.* 1997; Leske and Coon, 1999 and Ravindran *et al.* 1999).

The objective of the present work was to further study the effect of adding phytase to broiler diets containing graded levels of inorganic phosphorus. Performance, dietary protein digestibility and bone characteristics were measured.

MATERIALS AND METHODS

A growth experiment was designed to study the effect of adding phytase enzyme (Alltech®, 1000U/g) to diets containing different levels of total and available phosphorus on performance and bone characteristics of broiler chicks. A digestibility trial was carried out to evaluate the effect of supplemental phytase on protein digestibility.

A basal diet (A) was formulated to contain 23% CP and 3200 Kcal ME/Kg with no inorganic P supplement. The basal diet was formulated to contain nutrient levels to supply chick requirements (NRC, 1994) except that of P. The calculated total and non-phytate P (considered available P) contents were 0.37 and 0.15 %, respectively. Three levels of commercial dicalcium phosphate (18.2 % P and 22.5 % Ca) were added to the basal diet to formulate diets B, C, and D containing 0.52, 0.62 and 0.72 % total and 0.30, 0.40 and 0.50 % available P, respectively. Limestone was used to keep Ca content of all diets being constant.

Table 1 shows the formulation and nutrient composition of the different experimental diets. Phytase (1g / Kg diet i.e. 1000 U/kg) was added to diets A, B and C. Thus, there was a total of seven experimental diets in the study.

Table 1. Formulation and nutrients composition of the experimental diets

Item	Diet A	Diet B	Diet C	Diet D
Ingredients %:				
Yellow corn	57.69	57.28	56.91	56.60
Soybean meal (46%)	26.00	26.00	26.00	26.00
Corn gluten meal (60%)	10.00	10.00	10.00	10.00
Vegetable oil	3.00	3.10	3.20	3.30
Limestone	2.40	1.95	1.58	1.25
Dicalcium phosphate	-----	0.76	1.40	1.94
Vitamin and Mineral mix.	0.40	0.40	0.40	0.40
Salt	0.30	0.30	0.30	0.30
L-lysine HCl	0.15	0.15	0.15	0.15
DL-Methionine	0.06	0.06	0.06	0.06
Total	100	100	100	100
Calculated Composition* %:				
Crude protein	23.03	23.00	22.96	22.94
ME (Kcal / Kg)	3212	3208	3204	3202
Lysine	1.10	1.10	1.10	1.10
Methionine	0.54	0.54	0.54	0.54
Methionine + Cystine	0.90	0.90	0.90	0.90
Calcium	1.00	1.00	1.00	1.00
Total phosphorus	0.37	0.52	0.62	0.72
Non- phytate phosphorus (NPP)	0.15	0.30	0.40	0.50

(1) Vitamin - mineral mixture supplied per Kg of diet: Vit A, 12000 I.U; Vit D_3, 2200 I.U; Vit E, 10 mg; Vit K_3, 2 mg; Vit B_1, 1mg; Vit B_2, 4mg; Vit B_6, 1.5mg; Vit B_{12}, 10μg; Niacin, 20 mg; Pantothenic acid, 10 mg; Folic acid, 1 mg; Biotin, 50 μg; Choline chloride, 500mg; Copper, 10 mg; Iodine, 1mg; Iron, 30 mg; Manganese, 55 mg; Zinc, 50 Mg and Selenium, 0.1 mg.

*Calculated based on feed composition Tables of NRC (1994)

Two hundreds and ten, one-day old Arbor Acres broiler chicks obtained from a commercial hatchery were used. Every dietary treatment was fed to 3 replicates of 10 chicks each. Replicates were randomly allocated in batteries divided into 21 compartments (3 replicates X 7 dietary treatments). Light was provided 24 hr daily and feed and water were allowed for *ad libitum* consumption throughout the 28-day experimental period. After fasting overnight, birds were individually weighed and feed consumption was recorded per replicate for the whole experimental period. Gain in body weight, feed consumption were recorded and feed efficiency was calculated. The apparent symptoms of leg problems and mortality were also recorded.

Ten birds per treatment were randomly taken, slaughtered and processed for bone characteristics. The right femur, tibia and toe of the slaughtered birds were removed from each bird and frozen for subsequent measurements.

Frozen bones were thawed by leaving them at room temperature for 2 hrs and prepared as described by Potter *et al.* (1995) and Ravindran *et al.* (1995). The toes were obtained by severing the right middle toe at the middle joint (between second and third tarsal from the distal end). The clipped toes were cleaned of any waste material, but were left intact otherwise. No flesh, skin or toe nail was removed. Toes were dried at 105 °C till constant weight and the dry toes were ashed at 600 °C for 4 hrs. Percent ash of the dry toes was calculated. The right tibia and femur were removed and cleaned of all adhering flesh, extracted with ethanol and then with diethyl ether. After recording the overall length of each tibia and femur, bones were oven dried at 105 °C for constant weight. The dried fat free bones were ashed at 600°C for 6 hrs. Tibia and femur ash was expressed as a percentage of the fat free dry weight.

A digestibility trial was carried out at the end of the experimental period to study the effect of adding phytase on protein digestibility. Eight birds from each treatment of the growing trial were randomly taken, weighed and divided into 2 replicates of 4 birds each. Replicates were allocated in metabolism cages. The collection period lasted 3 days during which, feed and water were offered *ad libitum.* Excreta were collected daily, dried and allowed to equilibrate with atmosphere moisture. The dried excreta from each replicate for the successive 3 days collection period were weighed, finely ground, well mixed and analyzed for nitrogen content. The method of Terpstra and deHart (1974) was used for distinguishing between urinary nitrogen and fecal nitrogen and the digestibility of protein was calculated.

Data were statistically analyzed for the analysis of variance using the General Linear Model of SAS® (SAS Institute, 1990). Means were compared (P< 0.05) using Duncan's multiple range test (Duncan, 1955).

RESULTS AND DISSCUSION

RESULTS

The effect of dietary phosphorus and the addition of phytase on weight gain, feed intake and feed/gain of 28-day old broiler chicks are shown in Table 2.

Birds fed diet A containing the lowest P level with no added phytase gained significantly (P<0.05) less weight compared to the other treatments. Phytase addition to such diet markedly (P<0.05) increased weight gain.

Increasing the dietary P content (diets B, C and D) resulted in pronounced increases in weight gains. When phytase was added (1g /kg diet, 1000 U), no significant differences were detected among birds fed the different dietary P level supplemented with phytase.

The percent improvement in weight gain due to the addition of phytase decreased with increasing dietary P levels. Adding phytase to diet A containing the lowest P level increased weight gain by about 50%. With higher P level (diet B), the addition of phytase resulted in 10% increase. Addition of phytase to diet C containing more P content increased weight gain by 4% increase only. Birds fed diet D containing the highest P content did not exhibit more gain compared with those fed lower dietary P (diet C) without the addition of phytase.

The relative largest increase in feed intake as a result of phytase supplementation was obtained at the lowest level of dietary phosphorus.

Birds fed the highest dietary P content (diet D) consumed 1130g feed which was comparable with feed consumed by birds fed diets A, B and C supplemented with phytase.

Table 2. Effect of dietary phosphorus level and phytase supplementation on performance (mean±SE) of 28-day old broiler chicks

Dietary treatments	Total-P %	Non-phytate P%	Weight gain (g)	Feed intake (g)	Feed/ Gain
Diet A	0.37	0.15	497^{c}	798^{b}	1.62^{a}
A + phytase			744^{ab}	1117^{a}	1.50^{bc}
Diet B	0.52	0.30	680^{b}	1063^{a}	1.56^{ab}
B + phytase			750^{ab}	1174^{a}	1.56^{ab}
Diet C	0.62	0.40	739^{ab}	1086^{a}	1.47^{c}
C + phytase			769^{a}	1159^{a}	1.51^{bc}
Diet D	0.72	0.50	725^{ab}	1130^{a}	1.56^{ab}
Main effects*					
Phosphorus levels					
A (0.37%total, 0.15%NPP)			620^{b}	958^{b}	1.56^{a}
B (0.52%total, 0.30%NPP)			715^{a}	1119^{a}	1.56^{a}
C (0.62%total, 0.40%NPP)			754^{a}	1123^{a}	1.49^{b}
Phytase (U/kg diet)					
00 U			639^{b}	983^{b}	1.55^{a}
1000 U			754^{a}	1150^{a}	1.52^{a}

a---c Means within a column with no common superscript are significantly different (P<0.05).
* Data was analyzed as a 3x2 factorial arrangement of treatments with 3 levels of P without or with phytase supplementation excluding diet D which was included in one way analysis of variance.

The calculated values of feed conversion ratio (feed/gain) showed that adding phytase to diet A containing the lowest P level caused a significant (P<0.05) improvement in feed utilization. The addition of phytase to diets B or C containing 0.52 and 0.62% P, respectively, did not significantly affect feed conversion ratio.

Nearly 50% of the chicks fed diet A without phytase supplementation developed overt signs of rickets throughout the experimental period. Also, mortality in such treatment exceeded to be 40%. Mortality and incidence of leg problems declined to the normal levels with increasing the dietary phosphorus content or addition of phytase. The high mortality and leg abnormality of chicks fed on diet A was mainly due to the fact that diet A was deficient in P, since phytate-P was not available to their chicks and the requirement of P is much higher than the amount offered.

The statistical analysis demonstrated that dietary P level had significant (P<0.01) effects upon weight gain and feed intake. Also, it significantly affected (P<0.05) feed/gain ratio. Weight gain and feed intake were increased with increasing level of dietary P. No significant differences were detected in weight gain and feed intake between birds fed diets B and C (with and without phytase) and diet D.

Addition of phytase significantly increased weight gain ($P<0.001$) and feed intake ($P<0.01$). Feed /gain was slightly improved (from 1.55 to 1.52) by the addition of phytase but as a result of the simultaneous increase in both body weight gain and feed intake, no significant differences in feed / gain ratio was observed.. These results clearly showed that the addition of phytase to broiler diets significantly improved weight gain. The response was connected with a significant increase in feed consumption. Therefore, it did not affect feed/gain.

Table 3 shows the effect of phosphorus level and phytase supplementation on bone characteristics of chicks. The results indicated that increasing dietary phosphorus level or adding phytase increased length of both femur and tibia. A narrow range of femur length was recorded for birds fed diet A supplemented with phytase, B supplemented with phytase, C with and without phytase and diet D.

Level of dietary phosphorus and phytase supplementation significantly ($P<0.001$) affected length of femur and tibia. Increasing dietary non-phytate phosphorus (NPP) from 0.15% (diet A) to 0.30% (diet B) caused a significant ($P<0.05$) increase in bone length. A non-significant effect was observed when dietary NPP was increased from 0.30% (diet B) to 0.40% (diet C). Addition of phytase caused significant increase ($P<0.001$) in femur and tibia length.

It could be concluded that the length of femur and tibia significantly ($P<0.001$) increased as dietary P increased. The addition of phytase further increased ($P<0.001$) length of femur and tibia.

The minimum ash percentages of femur, tibia and toe were recorded for birds fed the lowest P diet. These values were significantly ($P<0.05$) lower than those recorded for the other dietary treatments. The maximum ash percentages were achieved for birds fed diet D of the highest P level. Birds fed diet B without phytase also showed significantly less ($P<0.05$) bone ash content than birds fed diet B supplemented with phytase or diets C and D (supplemented or unsupplemented with phytase).

The dietary P level significantly ($P<0.001$) affected femur, tibia and toe ash percentages. Also, phytase supplementation significantly increased ash percentages in the femur and tibia ($P<0.001$) and toe ($P<0.01$).

The results of the digestion trial are shown in Table 4. Birds fed on the lowest dietary P level consumed significantly ($p<0.05$) less feed compared to the other treatments. Adding phytase to such diet significantly ($p<0.05$) improved feed intake. When phytase was added to diets B or C, no significant effect was detected in feed intake. The quantity of protein intake (g/day) among birds fed the different dietary treatments followed the same trend as that of feed intake, since protein content of all the experimental diets was almost similar. Values of fecal protein, in general, were associated with the values of protein intake. The results of the digestion trial proved that neither dietary phosphorus level nor added phytase affected protein digestibility values.

Table 3. Effect of phosphorus level and phytase supplementation on bone characteristics of 28-day old broiler chicks

Diets	Length(cm)		Weight (g)*			Ash %		
	Femur	Tibia	Femur	Tibia	Toe	Femur	Tibia	Toe
A(0.37%total,0.15%NPP)	4.20^{d}	5.86^{c}	0.93^{c}	1.46^{d}	0.53^{d}	35.84^{c}	37.00^{c}	7.73^{e}
A+ phytase	5.31^{ab}	7.02^{ab}	1.79^{a}	2.48^{ab}	0.77^{ab}	46.83^{a}	47.43^{a}	10.29^{cd}
B(0.52%total,0.30%NPP)	5.07^{c}	6.89^{b}	1.51^{b}	2.16^{c}	0.66^{c}	42.65^{b}	43.49^{b}	10.00^{d}
B+ phytase	5.36^{a}	7.21^{a}	1.81^{a}	2.49^{ab}	0.72^{bc}	45.58^{a}	46.47^{a}	11.11^{bc}
C(0.62%total,0.40%NPP)	5.27^{ab}	7.13^{a}	1.78^{a}	2.46^{ab}	0.71^{bc}	45.54^{a}	46.57^{a}	11.60^{ab}
C+ phytase	5.34^{ab}	7.24^{a}	1.85^{a}	2.62^{a}	0.82^{a}	46.88^{a}	47.04^{a}	10.24^{cd}
D(0.72%total,0.50%NPP)	5.18^{bc}	7.05^{ab}	1.72^{a}	2.36^{b}	0.67^{c}	47.37^{a}	47.52^{a}	12.16^{a}
Main effects**								
Phosphorus-levels								
A(0.37%total,0.15%NPP)	4.76^{b}	6.44^{b}	1.36^{c}	1.97^{c}	0.65^{b}	41.34^{c}	42.22^{c}	9.01^{b}
B(0.52%total,0.30%NPP)	5.22^{a}	7.05^{a}	1.66^{b}	2.32^{b}	0.69^{b}	44.11^{b}	44.98^{b}	10.56^{a}
C(0.62%total,0.40%NPP)	5.31^{a}	7.19^{a}	1.82^{a}	2.54^{a}	0.76^{a}	46.12^{a}	46.81^{a}	10.92^{a}
Phytase (U/kg diet)								
00 U	4.85^{b}	6.63^{b}	1.41^{b}	2.03^{b}	0.63^{b}	41.35^{b}	42.35^{b}	9.78b
1000 U	5.34^{a}	7.16^{a}	1.82^{a}	2.53^{a}	0.77^{a}	46.43^{a}	46.98^{a}	10.55a

* Fat free dry femur and tibia weight and dry toe weight

a---c Means within a column with no common superscript(s) are significantly different ($P<0.05$).

** Data was analyzed as a 3x2 factorial arrangement of treatments with 3 levels of P without or with phytase supplementation excluding diet D which was included in one way analysis of variance.

Table 4. Effect of phosphorus level and added phytase enzyme on dietary protein digestibility

Dietary Treatments	Total P level (%)	Dietary P intake (g/day)	Protein intake (g/day)	Fecal protein (g/day)	Protein Digestibility (%)
Diet A	0.37	77[b]	17.20[c]	2.11[b]	87.73
A + phytase		88[a]	19.66[b]	2.14[b]	89.11
Diet B	0.52	96[a]	21.41[b]	2.42[ab]	88.70
B + phytase		99[a]	22.08[ab]	3.01[a]	86.37
Diet C	0.62	101[a]	22.47[ab]	2.82[ab]	87.45
C + phytase		92[a]	20.70[b]	2.54[ab]	87.59
Diet D	0.72	113[a]	25.11[a]	3.01[a]	88.01

a---c Means within a column with no common superscript are significantly different ($P<0.05$).

Data was statistically analyzed as one way analysis of variance

DISCUSSION

The results clearly indicated that the addition of phytase to broiler diets significantly improved weight gain. The response was connected with a significant increase in feed consumption. Therefore, it did not affect feed/gain ratio.

The magnitude of response to added phytase was related to the level of non-phytate and total P with the greatest response occurring at the lowest P level. Addition of 1 g phytase (1000 U/ g)/ kg diet A resulted in an increase in body weight equal to birds fed 0.40% NPP(diet A + phytase compared to diet C without phytase).

Weight gain and feed intake reported herein are in agreement with the previous findings (Simons *et al.*, 1990; Broz *et al.*, 1994; Denbow *et al.*, 1995; Kornegay *et al.*, 1996; Mitchell and Edwards, 1996; Sebastian *et al.*, 1996; Qian *et al.*, 1997; Sebastian *et al.*, 1998 and Sohail and Roland, 1999) who obtained increases in body weight gain and feed intake when phytase was added to low P broiler diets.

However, the improvements in growth observed in chickens fed on a low phosphorus diet supplemented with phytase may result from one or more of the following: (a) an increase in absorbed phosphorus, (b) the release of other minerals from the phytate mineral complex, (c) the utilization of inositol, (d) an increase in digestibility, or (e) increased availability of amino acids (Simons *et al.*, 1990).

Leg problems and high mortality of birds fed low dietary phosphorus without phytase was also observed in previous studies. Stevens *et al.* (1986) found that when broilers was fed a basal corn-soybean diet (0.14% available phosphorus) without added phosphorus, 57.5% of the birds had severe leg problems and died within 3 weeks. Richter *et al.* (1991) demonstrated that the incidence of leg disorders was limited by phytase supplements. Schoner *et al.* (1993) reported that mortality decreased significantly when P or phytase were supplemented to diets contained low P levels.

Toffaletti (1996) and Rosol and Capen (1997) discussed the clinical symptoms and metabolic disorders observed in hypophosphatemia which could lead to ATP depletion and affect energy metabolism. Severity of such conditions resulted in increase mortality rate. Also, Woo and Henry (1996) reported that dietary phosphorus inadequacy is one of the most important contributory factors caused bone atrophy. Bone atrophy is applied to decrease bone mass which expressed the imbalance between bone resorption (osteoclasts) and bone formation (osteoblasts) related to bone marrow.

The results of bone characteristics are in agreement with those reported in many studies. Nelson *et al.* (1990) found that increasing the dietary available P content to 0.43% increased ($P<0.05$) bone weight of broiler chicks. Qian *et al.* (1996) observed linear increase ($P<0.01$) in tibia length as dietary non-phytate P increased. Addition of 800 U phytase/ kg diet containing 0.20% non-phytate phosphorus further increased ($P<0.01$) length of the tibia from 6.18 to 7.53 cm.

A positive relation between phytase supplementation and bone ash was reported by Biehl *et al.* (1995), Kornegay *et al.* (1996), Mitchell and Edwards (1996), Qian *et al.* (1996) and Sebastian *et al.* (1996). Sohail and Roland (1999) reported that supplementing phytase in growing broiler diets containing reduced levels of non phytate P and Ca significantly improved performance and bone strength.

Performance and bone characteristics of birds fed diet A (0.37% total P) supplemented with phytase are comparable to those of birds fed diet C (0.62% total P). This proved that addition of 1 g phytase (1000 U) was equivalent to about 2.5 g P as dicalcium phosphate.

The equivalency value of phytase has been studied (Schoner *et al.*, 1993; Denbow *et al.*, 1995 and Mitchell and Edwards, 1996). Schoner *et al.* (1993) reported that the P equivalency of phytase at 14 days of age was 1 g P from monocalcium phosphate = 570 U of phytase for body weight gain and 1 g P = 1050 U of phytase for P retention.

The results of Denbow *et al.* (1995) strongly suggested that the P equivalency value of phytase could be influenced by the dietary non-phytate phosphorus level.

From the results of the present study and the previous reported data, it could be concluded that supplemental phytase is effective in improving the availability of phytate-bound P in the experimental diets (contained no supplemental P) for growth and bone mineralization of broiler chicks. Dietary addition of phytase to the diet improved weight gain, bone length and bone ash percentages.

The possible effect of phytase on protein and amino acid utilization needs to be confirmed since the published results are not consistent and are contradicting. The present study showed that increasing dietary phosphorus or addition of phytase did not affect the digestibility of protein. These results confirmed the previous studies of Simons *et al.* (1990) and Biehl *et al.* (1995) that found no improvement on protein and/or amino acid utilization when phytase was added to poultry diets. However, Farrell *et al.* (1993) and Sebastian *et al.* (1996) showed that phytase supplementation improved nitrogen retention in broiler chicks. A significant improvement in the apparent ileal digestibility of amino acids and nitrogen was detected when phytase was added to diets for growing turkey poults (Officer and Batterham, 1993).

It has been shown that addition of phytase not only improve dietary p utilization but also influence protein and amino acid digestibility (Sebastian *et al.* 1997; Leske and Coon, 1999 and Ravindran *et al.* 1999).

Sebastian *et al.* (1997) found that phytase supplementation increased growth performance in male and female broilers, increased apparent ileal digestibility and apparent fecal digestibility of most of the amino acids, particularly in female chickens. The optimum growth performance and amino acid digestibilities were obtained with the lowest input of resources in the low P-low Ca diet supplemented with microbial phytase.

The results of Ravindran *et al.* (1999) showed that phytase supplementation (1,200 U/kg) improved ($P<.001$ to 0.10) the digestibilities of protein and amino acids in all feedstuffs. The magnitude of response varied depending on the feedstuff and the amino acid considered.

It could be concluded that, the addition of phytase to the diets has a great effect in increasing the body weight gain and feed intake of broiler chicks. The largest response to phytase supplementation was obtained at the lowest level of P. The amount of supplemental phosphorus may be significantly reduced when adding dietary phytase.

However, further studies are recommended with various non-phytate P levels in different types of diets, especially commercial broiler diets, to estimate the equivalency value of phytase for inorganic P.

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تأثير إضافة إنزيم الفيتيز علي الآداء الإنتاجي وصفات العظام وهضم البروتين فى دجاج اللحم

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تم تكوين عليقة أساسية تحتوى على ٢٣% بروتين خام، ٣٢٠٠ كيلو كالورى طاقة ممثلة / كجم، ٣٧ر.% فوسفور كلى و ٠,١٥% فوسفور متاح. أضيف الفوسفور (فوسفات ثنائى الكالسيوم) بمستويات لتكوين علائق محتواها من الفوسفور الكلى ٠,٥٢ ، ٠,٦٢، و ٠,٧٢% والفوسفور المتاح ٠,٣٠، ٠,٤٠، ٠,٥٠% . اختبرت العلائق الثلاثة الأولى بدون إضافة أو بإضافة إنزيم الفيتيز (١٠٠٠وحدة /كجم عليقة) بينما اختبرت العليقة الرابعة بدون إضافة الإنزيم . قدمت هذه المعاملات لعدد ٢١٠كتكوت (٧معاملات x ٣ مكررات x ١٠ كتاكيت) من عمر يوم وحتى عمر ٢٨ يوم و تم دراسة تأثير هذه المعاملات على أداء الكتاكيت ومعامل هضم البروتين و بعض صفات العظام.

أعطت الكتاكيت التى غذيت على العليقة الأساسية المنخفضة فى محتواها من الفوسفور بدون إضافة الإنزيم أقل وزن عند مستوى معنوية أقل من مقارنة بباقى المعاملات وأدت إضافة الإنزيم لهذه العليقة إلى زيادة معنوية فى الوزن.

أدت زيادة محتوى العليقة من الفوسفور إلى زيادة واضحة فى وزن الكتاكيت. ولم تتضح أى اختلافات معنوية بين الطيور المغذاة على مستويات مختلفة من الفوسفور المضاف مع إضافة الإنزيم . انخفضت نسبة التحسن فى زيادة الوزن والراجعة إلى إضافة الإنزيم بارتفاع مستوى الفوسفور فى العلائق .

تلازمت نتائج كمية الغذاء المأكول مع النتائج التى شوهدت فى الزيادة فى الوزن.

ظهرت أعراض الكساح ومشاكل الأرجل على ٥٠% تقريبا من الكتاكيت المغذاة على العليقة المنخفضة فى محتواها من الفوسفور وبدون إضافة الإنزيم خلال فترة التجربة كما بلغت نسبة النفوق فى هذه المعاملة ٤٠% واختفت أعراض الكساح وعادت نسبة النفوق إلى المستوى الطبيعي مع زيادة مستوى الفوسفور فى الغذاء أو إضافة الإنزيم .

أوضحت نتائج تجربة الهضم أن قيم البروتين المهضوم لم تتأثر بمستويات الفوسفور أو بإضافة الإنزيم .

أدت زيادة مستوى الفوسفور فى العلائق أو إضافة الإنزيم إلى زيادة فى طول كل من عظمة الفخذ وعظمة الساق . أظهر أرتفاع مستوى الفوسفور المتاح وإضافة الإنزيم تأثير معنوى بالزيادة فى وزن عظام الفخذ والساق والإصبع وكذا زيادة نسبة الرماد فى العظام.

يدل التحسن فى أداء الكتاكيت وصفات العظام كمقاييس الاستجابة لإضافة الإنزيم إلى العليقة المحتوية على مستوى منخفض من الفوسفور على أن ١ جم (١٠٠٠ وحدة) إنزيم تماثل إضافة ٢,٥ جم فوسفور من فوسفات ثنائي الكالسيوم حيث تماثل أداء وصفات العظام للكتاكيت التى غذيت على العليقة المحتوية على ٠,٣٧ % فوسفور كلى مع إضافة الإنزيم بأداء وصفات عظام الكتاكيت التى غذيت على العليقة المحتوية على ٠,٦٢% فوسفور كلى.

تبرهن النتائج المتحصل عليها من هذه الدراسة على أن إضافة إنزيم الفيتيز يؤدى إلى زيادة كمية الفوسفور المتاح أي تحسين الاستفادة من فوسفور العليقة لكتاكيت اللحم . يمكن استنتاج أن إضافة إنزيم الفيتيز إلى علائق كتاكيت اللحم المكونة أساسا من الذرة وكسب فول الصويا يحقق أقصى استفادة للكتاكيت من الفوسفور العضوى. وربما تصبح إضافة الفوسفور غير العضوى غير ضرورية أو يضاف بكميات أقل إذا اقتضت الضرورة. الأمر الذى يعود بالفائدة اقتصاديا ويحد من التلوث البيئي.