INFLUENCE OF ADDING PHYTASE TO LOW CALCIUM BROILER DIETS ON PERFORMANCE, BONE AND CARCASS CHARACTERISTICS.

By

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Abstract: *Three starter diets contained 1.00, 0.85 and 0.65% Ca, and three corresponding grower diets contained 0.90, 0.75, and 0.55 % Ca were formulated. The nonphytate-P (NPP) content was 0.35% for the starter and 0.26% for the grower diets. Phytase enzyme was added to all diets at two levels, being 0 and 500 U/kg diet. The dietary treatments were fed to 180 one-day old Ross broiler chicks for 35 days. Every dietary treatment was applied to 3 replicates of 10 chicks each (6 treatments x 3 replicate x 10 chicks).Growth performance, bone parameters and some carcass characteristics were measured.*

The results showed that, decreasing dietary Ca level increased (P<0.05) body weight, slightly decreased feed intake and significantly (P<0.05) improved feed conversion ratio. Addition of phytase to different dietary Ca levels increased (P<0.001) weight gain, feed intake (P<0.05) and improved (P<0.05) feed conversion ratio. Birds fed 0.85/0.75 or 0.65/0.55% Ca (starter/grower) diet with phytase addition recorded the highest weight gain and the best feed conversion ratio compared to those fed 1.00/0.90% Ca diet. Decreasing dietary Ca level did not affect tibia length or bone weight but it did increase tibia and toe ash% significantly (P<0.01). Phytase supplementation increased (P<0.01) average tibia length, tibia and toe weights and also increased ash % of tibia and toe (P<0.001). Decreasing dietary Ca level and phytase supplementation significantly increased concentrations of Ca, P% (P<0.001) and Zn mg/Kg (P<0.01) in tibia ash. Decreasing dietary Ca level or added phytase enzyme did not significantly affect carcass weight, dressing % or heart weight (% body weight). Decreasing dietary Ca level significantly decreased abdominal fat, gizzard (P<0.001) and liver (P<0.01) percentages. Addition of phytase significantly (P<0.01) decreased abdominal fat %.

In conclusion, Addition of phytase enzyme to broiler diets of low Ca content significantly improve body weight gain, feed intake and feed conversion ratio. It also improved bone mineralization.

INTRODUCTION

The hydrolysis and absorption of phytate phosphorus (P) by monogasteric animals are complex process that is influenced by many factors. Dietary ingredients and feed processing seem to be the most important factors related to the diet, while age and type of birds could also affect phytate (P) utilization (Reddy *et al.*, 1982; Sebastian *et al.,* 1998 and Attia, *et al.,* 2003). Phytic acid does not only bind P but also minerals, lowering their utilization in monogasteric animals. This possesses a problem to nonruminant animals because they do not produce sufficient amounts of intrinsic phytase necessary to hydrolyze the phytic acid complex. Phytate, also can form various salts with the important minerals such as Ca, Mg, Cu, Zn and Fe, which reducing their solubility (Erdman, 1979). Mineral level of the diet can affect the degree of phytate degradation (Sandberg *et al.,* 1993).

Calcium, which considered the major dietary divalent cation for many species, can progressively precipitate the phytate by forming the extremely insoluble Ca-phytate complex in the intestine (Nelson and Kirby, 1987); consequently, phytate P, as well as Ca itself, is largely unavailable for absorption.

Sebastian *et al.* (1996b) reported that high levels of Ca in broiler diets of poultry decreased the availability of phytate P considerably. High levels of dietary Mg and Ca are known to reduce intestinal phytase activities in chickens (McCuaig *et al.,* 1972).

Generally, supplemental microbial phytase has been shown to increases the availability of phytate P (Simons *et al.*, 1990; Denbow *et al.,* 1995 and Attia *et al.*, 2001 and Attia *et al.* 2003) and of trace minerals such as Cu and Zn (Sebastian *et al.,* 1996a) and improves body weight gain (Broz *et al.,* 1994, Attia, 2003 and El-Ghamry *et al.*, 2005) for poultry fed a commercial corn-soybean meal diet.

Therefore, the objective of this experiment was to determine the effects of phytase supplementation at different levels of calcium on performance, bone measurements and carcass characteristics of broiler chickens fed low-P corn-soybean meal diet.

MATERIALS AND METHODS

Three starter diets were formulated to contain1.00, 0.85 or 0.65% Ca (diets 1, 2 and 3, respectively). Corresponding grower diets contained 0.90, 0.75 or 0.55 % Ca. The dietary P level was 0.35% NPP and 0.60% tP in the starter diets and 0.26% NPP and 0.50% total P in grower diets. Two levels of phytase being 0 and 500 U/Kg were adopted in the starting and grower diet. These diets, contained lower available P level than the current **NRC (1994)** recommendation in order to ensure maximum responses with phytase addition. Table 1 shows formulation and nutrient composition of the starter and grower diets.

A number of 180 one-day old Ross broiler chicks were used in this experiment. Every dietary treatment was fed to 3 replicates of 10 chicks each. The average initial live body weights of all replicates were nearly similar. Replicates were randomly allocated in batteries of three-tier system divided into 18 compartments (3 replicates X 6 dietary treatments). Light was provided 23 hr daily throughout the experimental period. Birds were fed starter diets from 1 to 21 days of age and then switched to grower diets to 35 days of age. Feed and water were allowed for *ad libitum* consumption throughout the experimental period.

After fasting overnight, birds were individually weighed and feed consumption was recorded per replicate at 35 days of age. Gain in body weight and feed conversion ratio were calculated. At 35 days of age, six representative chicks with body weight close to the group average were selected from each group and slaughtered for bone measurements and carcass characteristics.

Determination of phosphorus and calcium in tibia ash were carried out based on the Official Methods of Analysis (AOAC, 1990). Zinc content of tibia ash was determined using flame atomic absorption spectrophotometer after ashing with 15 ml HNO_3 and 10 ml $HClO_4$. as described by Scancar *et al.* (2000) based on the described method of Berg *et al.*(2000).

Data obtained from a factorial arrangement (2 phytase levels x 3 Ca levels) were statistically analyzed for analysis of variance using the General Liner Model of SAS (1990). Significant differences among treatment means were separated by Duncan's new multiple rang test (Duncan, 1955) with a 5% level of probability.

RESALTUS AND DISCASION

Performance of Broiler Chicks at 35 days of Age.

The effects of phytase supplementation at different levels of dietary Ca content on growth performance from 1 to 35 days of age of broiler chicks are shown in Table 2. Birds fed 1.00/0.90% (starter/grower) Ca diet without phytase addition gained significantly ($P<0.05$) less weight compared to those fed diets containing 0.65/0.55% or 0.85/0.75% Ca with phytase supplementation. Phytase addition to such diet (1.00/0.90% Ca) numerically increased body weight gain with no significant differences. Birds fed 0.85/0.75% Ca diet with phytase addition recorded the highest weight gain, which was significantly ($P<0.05$) higher than those recorded with birds fed lower (0.65/0.55) or higher (1.00/0.90) dietary Ca content without phytase supplementation. No significant differences were detected in weight gain among birds fed different dietary Ca levels without phytase addition.

The main effects of Ca level and phytase supplementation on weight gain showed that dietary Ca level had significant ($P<0.05$) effects on body weight gain. Weight gain increased with decreasing dietary Ca level. Birds fed 0.85/0.75% Ca gained significantly ($P<0.05$) more weight compared to those fed 1.00/0.90 % Ca diet, but gained statistically similar weight to those fed 0.65/0.55% Ca diet. No significant differences were detected in weight gain between birds fed 0.65/0.55% Ca diet and birds fed 1.00/0.90% Ca diet. Addition of phytase significantly ($P<0.01$) improved weight gain. No significant interaction between dietary Ca level and phytase supplementation on weight gain was detected.

Feed intake increased by the addition of phytase with different dietary Ca levels. The main effects of Ca level and phytase supplementation on feed intake showed that dietary Ca level did not significantly affect feed intake. Feed intake slightly decreased with decreasing dietary Ca level. Addition of phytase enzyme significantly ($P<0.05$) increased feed intake. No significant interaction between dietary Ca level and added phytase on feed intake was detected.

Adding phytase enzyme improved feed/gain of different dietary Ca levels. Phytase supplementation to 0.85/0.75% Ca diet improved feed/gain from 1.80 to 1.77. The later value was significantly ($P<0.05$) better than those recorded for birds fed 1.00/0.90% Ca diet with or without phytase and birds fed 0.65/0.55% Ca diet without phytase supplementation. No significant differences were detected among birds fed 0.65/0.55% diet with phytase and those fed 0.85/0.75% Ca diet with or without phytase supplementation. Birds fed 0.65/0.55% Ca diet with phytase showed significant ($P<0.05$) improvement in feed/gain compared to birds fed 1.00/0.90% Ca diet with or without phytase supplementation. The main effects of Ca level and phytase supplementation on feed/gain showed that dietary Ca level had significant ($P<0.01$) effect on feed/gain ratio. Birds fed 0.65/0.55 or 0.85/0.75% Ca diets gave the best feed/gain ratio ($P<0.01$) compared to those fed 1.00/0.90% Ca diet. No significant differences in feed/gain were detected between birds fed 0.85/0.75 or 0.65/0.55% Ca diets. Addition of phytase significantly ($P<0.05$) improved feed/gain ratio. No significant interaction between dietary Ca level and phytase supplementation on feed/gain was detected.

Although, the numerical highest body weight gain and the best feed/gain ratio were obtained with 0.85/0.75% Ca with adding phytase at 35 days of age, these values were not significantly different from the value obtained with 0.65/0.55% Ca with phytase supplementation. Thus, it was concluded that phytase supplementation to diet containing 0.65/0.55% Ca gave chick performance comparable to that of birds fed 0.85/0.75% dietary Ca. Therefore, the level of 0.65/0.55% Ca diet with phytase supplementation seems to be the appropriate level in formulating broiler diets chicks from one to 35 days of age.

These results confirmed that added phytase to a corn-soybean meal diets improved the growth performance of broiler chickens as assessed by increasing body weight and feed intake and improved feed conversion ratio. These findings are in agreement with the previous studies of Simons *et al*. (1990), Broz *et al*. (1994), Kornegay *et al*. (1996), Sebastian *et al*. (1996b) and (1998) and Sohail and Roland (1999) for broiler chickens and Attia (2003) for ducklings.

Phytate P utilization by broiler has been shown to be influenced by both Ca and P levels in the diet (Mohammed *et al.*, 1991) but the effects of dietary Ca are much greater. Previous studies have shown that high levels of Ca in the diets of broiler (Scheideler and Sell, 1987) considerably decreased the availability of phytate P. These observations are in agreement with the results of the present study, which showed that high (1.00/0.90%) dietary Ca level decreased the availability of phytate P as assessed by the reduced body weight gain and worst feed/gain ratio compared to the low dietary Ca content.

The possible explanations for the decreased phytate P availability at the high dietary Ca level, as suggested by **Kornegay *et al.*(1996)**, may be due to: 1) the precipitation of phytate by Ca through the formation of extremely insoluble Ca-phytate complexes that are less accessible to phytase; 2) the direct depression of phytase activity resulting from extra Ca competing for the active sites of phytase and/or 3) increased intestinal pH resulting from increased dietary Ca, which reduces the soluble fraction of minerals, hence limits their availability for absorption.

Bone Measurements at 35-Days of Age..

The effects of dietary Ca level and phytase supplementation on bone measurements of chicks fed the different dietary treatments are shown in Table 3. Added phytase enzyme slightly (P>0.05) increased tibia length. Decreasing dietary Ca levels did not change length of tibia.

The main effect of Ca level and phytase supplementation on tibia length showed that dietary Ca levels did not significantly affect tibia length. However, phytase supplementation significantly ($P<0.01$) increased the average tibia length. No significant interaction between phytase and Ca levels was detected on tibia length.

Length of tibia did not significantly affect by dietary Ca levels. However, phytase addition significantly ($P<0.01$) increased tibia length.

Fat free dry tibia weights and dry toe weight of birds fed the different dietary treatments showed significant ($P<0.05$) differences. No significant differences were observed in weights of tibia and toe among birds fed different dietary Ca levels without phytase supplementation.

The main effects of dietary Ca level and phytase supplementation indicated that bone (tibia and toe) weight was not significantly affected by decreasing dietary Ca level. Phytase supplementation significantly ($P<0.01$) increased tibia and toe weights. No significant interaction between phytase and Ca levels was detected on bone weight. These results indicated that phytase addition significantly ($P<0.01$) increased weights of tibia and toes.

The main effects showed that decreasing dietary Ca level from 1.00/0.90 to 0.85/0.75% significantly ($P<0.01$) increased tibia ash percentages, while it did increase toe ash with no significant differences. Phytase supplementation significantly ($P<0.001$) increased ash percentages of tibia and toe.

The results of Table 4 showed that decreasing dietary Ca levels significantly ($P<0.05$) increased concentration of P, Ca (%) and Zn mg/Kg in tibia ash. Birds fed 1.00/0.90% Ca without phytase supplementation recorded significantly ($P<0.05$) lower concentrations of tibia minerals compared to birds fed diets containing 0.85/0.75% or 0.65/0.55% Ca with or without phyatse addition. No significant differences were detected between birds fed 0.65/0.55 or 0.85/0.75% Ca without phytase supplementation in tibia ash concentrations of Ca, P and Zn. Phytase supplementation to 0.85/0.75% Ca diet significantly ($P<0.05$) increased Ca% in tibia ash. The concentration of Zn in tibia ash significantly ($P<0.05$) increased when phytase was supplemented to 1.00/0.90% dietary Ca level.

The main effects of dietary Ca level and phytase addition on tibia ash concentration of Ca, P and Zn showed that decreasing dietary Ca level from 1.00/0.90 to 0.85/0.75 or 0.65/0.55% significantly increased concentration of Ca, P ($P<0.001$) and Zn ($P<0.01$). No significant effect was recorded between birds fed 0.65/0.55 or 0.85/0.75% Ca diet on Ca, P%, and Zn mg/Kg in tibia ash.

Phytase supplementation significantly (P<0.01) increased Ca% and Zn mg/Kg in tibia ash. No significant effect of phytase supplementation on P content was detected. These data clearly indicated that decreasing dietary Ca level to 0.65/0.55% or added phytase enzyme to broiler diets from 1 to 35 days of age significantly (P<0.05) improved bone mineralization.

Tibia ash improved by the addition of phytase regardless of dietary Ca levels. These results of bone measurements are in agreement with previous studies of Broz et al. (1994), Sebastian et al. (1996a). The improvement in bone ash percentage indicates an increase in the availability of minerals liberated by phytase from phytate-mineral complex. Phytase supplementation to low dietary Ca content (0.65/0.55%) increased the ash content compared with the higher dietary Ca content 1.00/0.90%. These results are in agreement with those obtained by Attia et al. (2003).

Qian *et al.* (1997) showed that added phytase levels linearly increased toe ash content, and P and Ca retention of broiler chicks. Sohail and Roland (1999) and Attia et al. (2003) indicated that supplementing phytase in grower diets containing reduced levels of NPP and Ca significantly improved bone strength of broilers.

Carcass Characteristics at 35 Days of Age.

The effects of dietary Ca level and phytase supplementation on carcass characteristics are shown in Table 5. The results indicated that decreasing dietary Ca level or adding phytase enzyme did not significantly affect carcass weight, dressing % or heart %. Birds fed 0.65/0.55% Ca diet with phytase recorded significantly (P<0.05) lower abdominal fat % compared to the other treatments. Birds fed 1.00/0.90% Ca diet with or without phytase supplementation recorded the highest abdominal fat, liver and gizzard % of body weight. No significant differences on liver and gizzard weights were observed between birds fed 0.65/0.55% and birds fed 0.85/0.75% Ca with or without phytase supplementation.

The main effect of dietary Ca level and phytase supplementation on carcass characteristics showed that dietary Ca level or added phytase did not significantly affect carcass weight, dressing % or heart weight. Decreasing dietary Ca level from 1.00/0.90 to 0.85/0.75 or 0.65/0.55% significantly decreased abdominal fat (P<0.001), liver (P<0.01) and gizzard (P<0.001) weights. Addition of phytase significantly (P<0.01) decreased abdominal fat % only. Significant interaction between Ca level and phytase supplementation was detected in abdominal fat (P<0.001) while no significant interaction was observed on other carcass characteristics.

Therefore, it could be mentioned that as the dietary Ca decreased or adding phytase the abdominal fat % significantly ($P<0.001$) decrease.

It could be concluded therefore that, phytase enzyme proved to be of beneficial effects when added to corn-soybean meal broiler diets. Performance and bone mineralization were improved when such enzyme was added to low NPP and low Ca diets. It also increases the utilization of dietary Ca, P and Zn content.

Table 1: Formulation and nutrient composition of the starter and grower diets.

Item	Starter Diets					Grower Diets
	1 1.00% Ca 0.35% NPP	2 0.85% Ca 0.35% NPP	3 0.65% Ca 0.35% NPP	1 0.90% Ca 0.26% NPP	2 0.75% Ca 0.26% NPP	3 0.55% Ca 0.26% NPP
Ingredients %			52.45			
Yellow corn	51.01	51.62	32.00	60.73	61.35	62.20
Soybean meal (44%)	32.00	32.00	7.80	26.00	26.00	26.00
Corn gluten meal (60%)	7.80	7.80	4.96	6.00	6.00	6.00
Vegetable oil	5.48	5.26	0.78	4.11	3.88	3.55
Limestone	1.70	1.31	1.13	1.70	1.31	0.79
Dicalcium phosphate	1.13	1.13	0.40	0.73	0.73	0.73
Premix(1)	0.40	0.40	0.35	0.25	0.25	0.25
Salt	0.35	0.35	0.03	0.35	0.35	0.35
L-Lysine HCl	0.03	0.03	0.10	0.10	0.10	0.10
DL-Methionine	0.10	0.10		0.03	0.03	0.03
Composition (2) %						
Crude Protein	22.93	22.99	23.04	19.99	20.03	20.09
ME (Kcal/Kg)	3199	3200	3199	3199	3199	3199
Lysine	1.10	1.10	1.10	1.00	1.00	1.00
Methionine	0.54	0.54	0.54	0.39	0.39	0.39
Methionine + Cystine	0.90	0.90	0.90	0.75	0.75	0.75
Calcium	1.00	0.85	0.65	0.90	0.75	0.55
Total phosphorus	0.60	0.60	0.60	0.50	0.50	0.50
Nonphytate P	0.35	0.35	0.35	0.26	0.26	0.26

(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 , Selenium, 0.1 mg and cobalt 0.25mg.
(2) Calculated values based on feed composition Tables of NRC (1994)

Table 2: Effect of dietary calcium level and phytase supplementation on performance of 35 days old broiler chicks.

Item		Body weight gain (g)	Feed Intake (g)	Feed/gain
Dietary treatments				
Ca [#] %	**Phytase U/Kg**			
1.00/0.90	0	1362 [c]	2584	1.90 [a]
1.00/0.90	500	1427 [abc]	2657	1.86 [ab]
0.85/0.75	0	1411 [bc]	2538	1.80 [cd]
0.85/0.75	500	1484 [a]	2625	1.77 [d]
0.65/0.55	0	1381 [c]	2541	1.84 [bc]
0.65/0.55	500	1454 [ab]	2590	1.78 [cd]
SE of means		12.34	16.79	0.01
Main effects				
Ca %				
1.00/0.90		1394 [b]	2620	1.88 [a]
0.85/0.75		1447 [a]	2582	1.78 [b]
0.65/0.55		1418 [ab]	2566	1.81 [b]
Phytase U/Kg				
0		1384 [b]	2554 [b]	1.85 [a]
500		1455 [a]	2624 [a]	1.80 [b]
Significances				
Source of variation				
Ca effect		*	NS	**
Phytase effect		**	*	*
Ca X Phytase		NS	NS	NS

[a-d] Means within each column for each effect with no common superscript are significantly different (P< 0.05).
[#] Calcium levels: starter (1-21d) / grower (21-35d)
*P<0.05 **P<0.01 NS: not significant (P>0.05)

Table 3: Effect of dietary calcium level and phytase supplementation on bone measurements of 35-days old broiler chicks.

Item		Tibia length (cm)	Weight (g)		Ash %	
			Tibia [(1)]	Toe [(2)]	Tibia	Toe
Dietary treatments						
Ca %	**Phytase U/Kg**					
1.00/0.90	0	8.50	4.36 ^{ab}	0.99 ^{c}	38.17 ^{d}	9.02 ^{c}
1.00/0.90	500	8.70	4.79 ^{ab}	1.25 ^{a}	40.13 ^{b}	10.24 ^{ab}
0.85/0.75	0	8.50	4.31 ^{ab}	1.01 ^{bc}	39.32 ^{bc}	
0.85/0.75	500	8.70	4.81 ^{a}	1.13 ^{ab}	41.28 ^{a}	9.66 ^{bc}
0.65/0.55	0	8.50	4.22 ^{b}	1.05 ^{bc}	38.82 ^{cd}	10.45 ^{a}
0.65/0.55	500	8.76	4.65 ^{ab}	1.19 ^{a}	40.16 ^{b}	9.32 ^{c}
						10.21 ^{ab}
SE of means		0.03	0.08	0.03	0.26	0.15
Main effects						
Ca %						
1.00/0.90		8.60	4.58	1.12	39.15 ^{b}	9.63
0.85/0.75		8.60	4.56	1.07	40.30 ^{a}	10.06
0.65/0.55		8.58	4.43	1.12	39.49 ^{b}	9.76
Phytase U/Kg						
0		8.50 ^{b}	4.30 ^{b}	1.02 ^{b}	38.77 ^{b}	9.33 ^{b}
500		8.69 ^{a}	4.75 ^{a}	1.19 ^{a}	40.52 ^{a}	10.30 ^{a}
Significances						
Source of variation						
Ca effect		NS	NS	NS	**	NS
Phytase effect		**	**	**	***	***
Ca X Phytase		NS	NS	NS	NS	NS

$^{a-d}$ Means within each column for each effect with no common superscript are significantly different (P< 0.05).
** P<0.01 *** P<0.001 NS: not significant (P>0.05)
(1) Fat free dry weight (2) Dry weight

Table 4: Effect of dietary calcium level and phytase supplementation on tibia minerals of 35-days old broiler chicks.

Item		Tibia ash minerals		
		P %	Ca %	Zn mg/Kg
Dietary treatments				
Ca[#] %	Phytase U/Kg			
1.00/0.90	0	19.53[b]	39.35[c]	342[c]
1.00/0.90	500	19.73[ab]	39.52[c]	364[b]
0.85/0.75	0	19.90[a]	39.73[b]	367[b]
0.85/0.75	500	19.94[a]	39.97[a]	383[ab]
0.65/0.55	0	20.06[a]	39.90[ab]	379[ab]
0.65/0.55	500	20.08[a]	39.97[a]	392[a]
SE of means		0.06	0.06	4.61
Main effects				
Ca [#] %				
1.00/0.90		19.63[b]	39.44[b]	353[b]
0.85/0.75		19.92[a]	39.85[a]	375[a]
0.65/0.55		20.07[a]	39.94[a]	386[a]
Phytase U/Kg				
0		19.83	39.66[b]	362[b]
500		19.92	39.82[a]	380[a]
Significances				
Source of variation				
Ca effect		***	***	**
Phytase effect		NS	**	**
Ca X Phytase		NS	NS	NS

[a-c] Means within each column for each effect with no common superscript are significantly different (P< 0.05).
[#] Calcium levels: starter (1-21d) / grower (21-35d)
**P<0.01 *** P< 0.001 NS: not significant (P>0.05)

Table 5: Effect of dietary calcium level and phytase supplementation on carcass characteristics (as percentages of body weight) of 35-days old broiler chicks.

Item		Carcass weight (g)	Dress-ing %	Abdo-minal fat %	Giblets %		
					Liver	Heart	Gizzard
Dietary treatments							
Ca [#] %	**Phytase U/Kg**						
1.00/0.90	0	1020	70	1.79 [a]	2.16 [a]	0.51	1.72 [a]
1.00/0.90	500	1073	69	1.81 [a]	2.15 [a]	0.51	1.72 [a]
0.85/0.75	0	1044	70	1.62 [b]	2.09 [ab]	0.50	1.64[b]
0.85/0.75	500	1080	70	1.67 [b]	2.04 [b]	0.52	1.66 [ab]
0.65/0.55	0	1058	69	1.77 [a]	2.04 [b]	0.51	1.69 [ab]
0.65/0.55	500	1048	69	1.50 [c]	2.10 [ab]	0.51	1.64[b]
SE of means		14.06	0.17	0.03	0.01	0.01	0.01
Main effects							
Ca %							
1.00/0.90		1047	70	1.80 [a]	2.16 [a]	0.51	1.72 [a]
0.85/0.75		1062	70	1.65 [b]	2.07 [b]	0.51	1.65 [b]
0.65/0.55		1053	69	1.64 [b]	2.07 [b]	0.51	1.66 [b]
Phytase U/Kg							
0		1041	70	1.73 [a]	2.09	0.51	1.68
500		1067	69	1.66 [b]	2.10	0.51	1.67
Significances							
Source of variation							
Ca effect		NS	NS	***	**	NS	***
Phytase effect		NS	NS	**	NS	NS	NS
Ca X Phytase		NS	NS	***	NS	NS	NS

[a-c] Means within each column for each effect with no common superscript are significantly different (P<0.05).
[#] Calcium levels: (starter/ grower)
**P<0.01 *** P< 0.001 NS: not significant (P>0.05)

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الملخص العربي

تأثير إضافة أنزيم الفايتيز إلى علائق بداري اللحم المغذاة على مستويات منخفضة من الكالسيوم على الأداء الإنتاجى و العظام وصفات الذبيحة

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استهدفت هذه التجربة دراسة تأثير إضافة إنزيم الفيتيز إلى علائق كتاكيت اللحم (ROSS) المحتوية على مستويات مختلفة من الكالسيوم على الأداء وبعض صفات العظام والذبيحة. تم تكوين ثلاثة علائق احتوت على ١،٠٠ , ٠،٨٥ , ٠،٦٥ %و ٠،٩٠ , ٠،٧٥ , ٠،٥٥% كالسيوم خلال الفترة من ١-٢١ يوم ومن ٢١-٣٥ يوم من عمر الكتاكيت على الترتيب. أضيف إنزيم الفيتيز إلى كل العلائق بمعدل (صفر، ٥٠٠ وحدة /كجم علف). قدمت هذه المعاملات لعدد ١٨٠ كتكوت (٦معاملات X ٣ مكررات X ١٠ كتاكيت) و تم دراسة تأثير هذه المعاملات على أداء الكتاكيت وبعض صفات العظام والذبيحة.

أوضحت النتائج أن انخفاض مستوى الكالسيوم فى العليقة أدى إلى زيادة معنوية فى الوزن مع أنخفاض بسيط فى كمية الغذاء المأكول و تحسن معنوي فى كفاءة تحويل الغذاء. إضافة إنزيم الفيتيز إلى المستويات المختلفة من الكالسيوم أدى إلى زيادة معنوية فى الوزن و فى كمية الغذاء المأكول و تحسن معنوي فى كفاءة تحويل الغذاء. أعطت الكتاكيت التي غذيت على المستوى ٠,٧٥/٠,٨٥ أو ٠,٥٥/٠,٦٥% كالسيوم مع إضافة أنزيم الفيتيز أعلي معدل نمو وأفضل معامل تحويل غذائي مقارنة بالتي غذيت على المستوى ٠,٩٠/١,٠% كالسيوم. لم يؤثر أنخفاض مستوى الكالسيوم فى العليقة على طول عظمة الساق أو وزن العظام و لكن أدت إلى زيادة معنوية فى نسبة الرماد فى كل من عظمة الساق و الإصبع. إضافة أنزيم الفيتيز إلى العليقة أدت إلى زيادة معنوية فى متوسط طول عظمة الساق و وزن عظمة الساق و الإصبع مع زيادة معنوية فى نسبة الرماد فيهما. كما أدى أنخفاض نسبة الكالسيوم فى العليقة أو إضافة إنزيم الفيتيز إلى زيادة معنوية فى محتوى رماد عظمة الساق من الكالسيوم و الفوسفور و الزنك. أنخفاض نسبة الكالسيوم فى العليقة أو إضافة إنزيم الفيتيز لم يؤثر على وزن الذبيحة و نسبة التصافي ووزن القلب (كنسبة مئوية من وزن الجسم) كما أدى إلى انخفاض نسبة الدهن و وزن القونصة والكبد. إضافة إنزيم الفيتيز أدى إلى نقص فى نسبة الدهن.