FACULTY OF AGRICULTURE

Minia J. of Agric. Res. & Develop.
Vol. (39), No. 2, pp. 271-284, 2019

EFFECT OF USING DIFFERENT SOURCES OF PHYTASE ON SOME PRODUCTIVE PERFORMANCE OF BROILER CHICKS.

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Received: 19 July (2019) Accepted: 22 September (2019)

ABSTRACT

A total number of 240 unsexed, one-day old Arbor Acres broiler chicks were randomly distributed into 6 experimental groups of 40 birds each. Each group contained four replicates of 10 birds each. A factorial design (2×3) was used, two diet densities (control and 10% low) and three enzyme sources (control, bacterial phytase and fungal phytase), Live body weight and feed consumption were recorded and body weight gain and feed conversion were calculated during starting, growing and whole experimental periods. At 6 weeks of age, three birds were randomly taken from each treatment and slaughtered to measure carcass traits. The results revealed that, body weight at 3rd and 6th week and body weight gain during the period from 0-3 and 0-6 weeks of age for birds fed control diet were significantly higher (P≤0.05) than birds fed low density diet. However, feed consumption was not significantly affected by diet density, while feed conversion ratio of birds fed control diet was significantly better (P≤0.05) than birds fed low density diet especially during the starting period from (0-3 weeks).

Body weight and body weight gain of broiler chicks were not significantly affected by phytase sources. Feed consumption of chicks fed diet supplemented with fungal phytase at 3-6 and 0-6 weeks of age was significantly (P≤0.05) higher than the other treatments. However, feed conversion ratio at 3-6 weeks of age for birds fed diet supplemented with fungal phytase was not significantly improved. The birds fed control diet had significantly higher pre-slaughter weight, carcass weight and giblets percentage than the birds fed low density diet. The birds fed diet supplemented with fungal phytase had significantly (P≤0.05) higher pre-slaughter weight and lower giblets percentage than the birds received bacterial phytase.

Key word: bacterial phytase, fungal phytase, broiler chicks, performance.

INTRODUCTION

Due to the increase in price and the non-availability of feed ingredients, the nutritionists have to formulate the diets alternatively with the agro-industrial by- products and non-conventional feed resources. Studies with broilers fed those ingredients have proved that the use of exogenous enzymes individually or in combination improved dietary nutrient utilization, resulting in more uniform animal performance (Cowieson and Adeola, 2005; Francesh & Geraert, 2009 and Lu *et al.,* 2013). Lima (2005) stated that the purpose of adding exogenous enzymes to non-ruminant feeds was to reduce the effects of the anti-nutritional factors of ingredients that are present in greater or lesser amounts in the diet. Enzymes increase, therefore, the availability of nutrients by breaking down specific chemical structures which endogenous digestive enzymes are not capable of breaking them down completely or partially. Choct (2006) found that use of commercial enzymes in poultry feeds has evolved greatly in the last few years, based on the efficacy of the new products and the better understanding of the relationship between enzyme activity and substrates available. A number of studies have shown that inclusion of microbial phytase in broiler diet release the phytate bound P and to improve the utilization of P in plant derived ingredients including energy and amino acids (Ravindran *et al.,* 1995 and Selle *et al.,* 2000). Phytate is a ubiquitous component of plant sourced feed ingredients which encompasses approximately two thirds of total plant P (Hughes *et al.,* 2009). In poultry, phytate P is normally utilized with availability from 0 to 50%, depending on age and metabolic adaptation in critical circumstances. Therefore, to meet the P requirement, generally expensive inorganic P sources are added to poultry diets. This practice leads to non-utilization of a large portion of dietary P from feedstuff and its excretion in faeces (Hughes *et al.,* 2008 and Woyengo *et al.,* 2010) which ultimately pollutes environment. Recently, microbial phytase supplementation in poultry diets has got remarkable attention to reduce negative impact of phytate P on environment and performance of birds (Ceylan *et al.,* 2003 and Francesch and Geraert, 2009). Since phytase efficiency in the digestive tract is influenced by various factors like phytase origin, type of birds and ambient temperature etc. Therefore, each phytase preparation for poultry must be tested on broilers/layers to ensure its efficacy (Hughes *et al.,* 2008 and Onyango *et al.,* 2005).

The mineral-phytate complexes are usually formed at a pH that is above, or at the upper end of the activity spectrum of microbial phytase (Afsharmanesh and Pourreza, 2005). Hence, the prevalent pH in the gut could have a significant effect on the effectiveness of phytase. The bi-phasic pH profile of microbial phytase operation (Simons *et al.*, 1990) indicates that subtle changes in pH of the upper digestive tract by inclusion of organic acids possibly will impress the activity of microbial enzyme.

Information regarding the effects of addition different phytase sources in broiler chicks' diet having low nutrients density is limited. Therefore, current study was designed to evaluate the effect of different sources of phytase supplementation in broiler chicks fed low density diet on growth performance and carcass traits of broiler chicks.

MATERIALS AND METHODS

A total number of 240 unsexed, one day old Arbor Acres broiler chicks obtained from Cairo Poultry Company, were randomly distributed into 6 experimental groups of 40 chicks each. Each group contained four replicates of 10 chicks each. The chicks were housed in an open house in battery cages (1 x 0.4 x 0.6 meter as length, width and height). Feed and water were offered *ad libitum* to the bird's during the experimental periods (0-6 weeks of age).

chicks were randomly distributed into 6 dietary treatments in a factorial arrangement (2 diet densities: control and 10% low density and three sources of phytase enzyme: control, bacterial and fungal phytases). The basal control diet was formulated as recommended by the National Research Council**,** NRC, (2004). The recommended supplementation level of either bacterial or fungal enzymes was 50 gm/ton for each. The dietary treatments were as follows:

1- The basal control diet without enzyme supplementation.
2- The basal control diet + 50 gm bacterial phytase/ton.
3- The basal control diet + 50 gm fungal phytase/ton
4- The 10% low density diet without enzyme supplementation
5- The 10% low density diet + 50 gm bacterial phytase/ton
6- The 10% low density diet + 50 gm fungal phytase/ton

The ingredients and chemical analysis of the experimental diets during starting and growing periods are shown in Table (1)

The live body weight and feed consumption of each replicate were recorded, at 3 and 6 weeks of age. Body weight gains and feed conversion ratio were calculated during starting (0-3 weeks), growing (3-6 weeks) and the whole experimental period (0-6 weeks).

At the end of the experiment (at 6 weeks of age), representative samples of birds (3 birds from each treatment) were randomly taken, starved for about 12 hours, then individually weighed. birds were slaughtered and after complete bleeding, they were scalded and feathers were plucked. heads and shanks were separated, then the carcass were chilled in tap water for about 10 minutes. Eviscerated carcasses were individually weighed and dressing percentage was calculated (weight of carcass + giblets + abdominal fat/pre-slaughter weight ×100).

Table (1). The ingredients and the chemical composition of the experimental diets

Ingredients, %	Starter		Grower	
	Control	Low	Control	Low
Yellow corn	50	56.63	54.3	63.13
Soybean meal, 44% CP	35	25.84	29.35	20.87
Concentration	9.57	10	10	10
Premix	0.2	0.35	0.25	0.25
Wheat bran	0	6.83	0	5.5
Limestone	0	0	0.2	0
Dicalcium phosphate	0	0	0	0
NaCl	0.23	.35	0.25	0.25
Oil	4.82	0	5.65	0
Total	100	100	100	100
Chemical analysis				
Crude protein %	23	20.7	21	18.9
Metabolizable energy (Kcal/kg)	3100	2792	3201	2882
Calcium (C)%	1.0	0.95	1.0	0.9
Phosphorus (P)%	0.4	.36	0.4	.36
Lysine%	1.2	1.1	1.1	0.9
Methionine%	0.8	0.8	0.8	0.79
Crude fiber%	3.7	3.9	3.4	3.6

RESULTS AND DISCUSSION

Body weight (gm):

Data presented in Table (2) showed that body weight at 3 and 6 weeks of age of broiler chicks fed the basal control diet were significantly ($P \leq 0.05$ or $P \leq 0.01$,) heavier than those of chicks fed low density diet. In agreement with these results, EL-Sayed *et al.,* (2001) showed that Gimmizah, Mandara and Silver Montazah chicks fed high CP diet (20 or 19 %) with 2800 to 3000 kcal ME/ kg diet had significantly higher body weight at 8 and 12 wk of age than those fed low CP ration (19, 16, 15 %) with different energy levels, Also, Abd EL–Samee (2002) showed that feeding broiler chicks on diets contained medium level of CP (20 or 18 %) significantly increased body weight compared to those fed low level of CP (18 and 16%) during the growing and finishing periods, respectively.

Adding of different phytase sources to broiler chick diets and the interaction between diet density and phytase sources did not significantly affect ($P \geq 0.05$) body weight of chicks at different ages. The previous results are in agreement with the findings of Bahnas *et al.,* (2009). who reported that kemzyme supplementation insignificantly affected live body weight during the period from 10 to 38 days of age in Japanese quails. Also, Rahimian *et al.,* (2013) indicated that phytase had insignificant effect on body weight of broiler chicks from 0 to 49 days.

Table 2. Effect of diet density and source of phytase on body weight (g/bird) of growing chicks

Treatments		Age		
		One day	3 weeks	6 weeks
Diet density:				
Basal control diet		49.29	818.00[a]	2745.93[a]
Low density diet		47.07	735.35[b]	2583.87[b]
±SE		1.52	24.47	32.67
Sig.		NS	*	**
Phytase sources:				
without enzyme		49.43	785.87	2620.42
Bacterial enzyme		45.98	745.90	2692.10
Fungal enzyme		49.12	798.25	2682.18
±SE		1.87	29.97	38.89
Sig.		NS	NS	NS
Diet density x phytase sources:				
Basal control diet	Without E	49.87	817.00	2721.87
	Bacterial E	48.87	821.50	2753.12
	Fungal E	49.12	815.50	2762.81
Low density diet	Without E	49.00	754.75	2518.97
	Bacterial E	43.10	670.31	2631.09
	Fungal E	49.12	781.00	2601.56
±SE		2.64	42.38	56.58
Sig.		NS	NS	NS

*Values within the same column with no common superscripts are significantly different (p<0.05), ±SE = Stander error, NS= Not significant, * Significant (P≤0.05) **highly Significant (P≤0.01)*

Body weight gain (gm/bird/period):

Results presented in Table (3) indicated that body weight gains during the periods from 0-3 and 0-6 weeks of age of broiler chicks fed recommended control diet were significantly (P≤0.05 or P≤0.01) higher than birds fed low density diet. In agreement with the present results, Hassan *et al.,* (2011) indicated that body weight gain of broiler chicks was significantly reduced with decreasing crude protein levels with constant metabolizable energy. Also, Abd EL-Gawad *et al* (2004) showed that feeding broiler chicks on diets containing the optimal level of crude protein in control diet recorded significantly (P <0.05) higher live body weight gain than those fed the low levels of crude protein

The effect of adding different phytase sources to broiler chick diets did not significantly (P≥0.05) affect body gain of birds at different age intervals. Also, the effect of the interaction between diet density and phytase sources on body weight gain at different age intervals was not significant (P≥0.05). Hawever, numerically enhancement (P≥0.05) was noticed in body gain when birds were fed basal diet supplemented with fungal phytase followed by birds fed basal control diet supplemented with bacterial phytase compared with other treatments. The present results are corresponding with Bahnas *et al.,* (2009**)** who showed that kemzyme supplementation insignificantly affected live body weight **gain** during the period from 10 to 38 days of age in Japanese quails. Rahimian *et al.,* (2013) indicated that phytase had insignificant effect on body weight gain of broiler chicks from 0 to 49 days of age.

Feed consumption:

Data presented in Table (4) showed that the effect of diet density on feed consumption of broiler chicks was not significant (P≥0.05) at different age intervals. chicks fed the basal control diet consumed approximately similar feed compared to those fed low density diet during starting, growing and the whole experimental periods.

Table (3). Effect of diet density and phytase source on body weight gain (g/bird/period) of broiler chicks

Treatments		Age intervals/ weeks		
		0-3	3-6	0-6
Diet density:				
Basal control diet		768.70[a]	1927.93	2696.64[a]
Low density diet		688.27[b]	1848.52	2536.80[b]
±SE		23.06	40.58	32.94
Sig .		*	NS	**
Phytase sources:				
without enzyme		736.44	1834.54	2570.98
Bacterial enzyme		699.92	1946.20	2646.12
Fungal enzyme		749.12	1883.93	2633.06
±SE		28.24	49.69	40.35
Sig.		NS	NS	NS
Diet density x phytase sources:				
Basal control diet	Without	767.12	1904.87	2672.00
	Bacterial	772.62	1931.62	2704.25
	Fungal	766.37	1947.31	2713.68
Low density diet	Without	705.75	1764.22	2469.97
	Bacterial	627.21	1960.78	2587.99
	Fungal	731.87	1820.56	2552.43
±SE		39.94	70.28	57.06
Sig.		NS	NS	NS

Values within the same column with different superscripts are significantly different ($p<0.05$), ±SE = Stander error, NS= Not significant, * Significant ($P\leq0.05$) ** Significant ($P\leq0.01$)

Feed consumption of broiler chicks fed diet supplemented with fungal phytase was significantly ($P\geq0.05$) higher compared to that of birds fed the control diet or the diet supplemented with bacterial phytase during growing (3-6 weeks) and the whole experimental period (0-6 weeks).

Phytate can form salts with nutritionally important minerals and elements such as P and reduce its availability to chicken that lack the phytase enzyme required to hydrolyze phytate into inorganic P and inositol. It has been well documented that microbial phytase is highly effective in degrading phytate in corn-soybean meal diets, and results in enhancement of chickens performance (Schoner *et al.,* 1991 and Denbow *et al.,* 1995). Classen (1993) concluded that, a wide array of organisms are capable of producing enzymes that can be successfully used by the feed industry. Therefore, selection of enzymes from a specific organism may not be crucial to the success of enzyme use. Based on feed legislation in various countries, some microorganisms are already considered safe as feed ingredients and therefore are most easily used as enzyme sources. Attia *et al.,* (2012) showed that enzyme supplementation significantly decreased feed intake compared to the control group only during days 15-20 of age. Their results showed that chicks fed a diet supplemented with multi-enzyme with phytase consumed significantly less feed than broilers fed a diet supplemented with phytase alone.

The effect of interaction between diet density and phytase sources on feed consumption was not significant during starting, growing and the whole experimental periods (Table 4).

Feed conversion ratio (gm feed/gm gain):

Feed conversion ratio Table (5) of boiler chicks fed the control diet was better ($P\leq0.01$) than that of birds fed low density diet during the starting period (0-3 weeks).

Feed conversion ratio of birds fed diet supplemented with bacterial phytase Table (5) was significantly ($P\leq0.05$) better compared to that of chicks fed diet supplemented with fungal phytase enzyme during growing period (3-6 weeks), while the differences during starting and the whole experimental periods were not significant. The present results are in agree with those of Woyengo *et al.,* (2010) who reported that phytase supplementation to the control diet did not affect feed conversion ratio, while supplementation of phytase together with multi-carbohydrase resulted in improvement in feed conversion ratio compared with the control diet. Furthermore, Hassan *et al.,* (2011) indicated that added dietary phytase enzyme to the basal diet significantly ($P<0.001$) improved feed conversion ratio of broiler chicks at different age intervals and the entire period.

The interaction between diet density and phytase sources addition revealed that birds fed the control diet without enzyme addition recorded the best feed conversion followed by the other groups fed low density diet contained bacterial phytase compared with the other treatments during the period from 3-6 weeks of age. However, this effect on feed conversion during starting and the whole experimental periods was not significant. Attia *et al.*, (2012) showed that there was no significant effect on feed conversion ratio due to the interaction between form of diet and enzyme supplementation during the entire experimental period.

Table (4). Effect of diet density and phytase sources on feed consumption (g/bird/period) of boiler chicks.

Treatments		Age intervals/ weeks		
		0-3	3-6	0-6
Diet density:				
Basal control diet		1321.46	3797.97	5119.43
Low density diet		1333.46	3728.13	5011.17
±SE		11.23	63.38	70.26
Sig .		NS	NS	NS
Phytase sources:				
Without enzyme		1302.00	3631.95[b]	4933.95[b]
Bacterial enzyme		1330.94	3723.91[ab]	4979.22[b]
Fungal enzyme		1349.44	3933.28[a]	5282.72[a]
±SE		13.75	77.62	86.05
Sig.		NS	*	*
Diet density x phytase sources:				
Basal control diet	Without E	1308.25	3528.28	4836.53
	Bacterial E	1317.00	3783.28	5100.28
	Fungal E	1339.13	4082.34	5421.47
Low density diet	Without E	1295.75	3735.63	5031.38
	Bacterial E	1344.88	3664.53	4858.16
	Fungal E	1359.75	3784.22	5143.97
±SE		19.45	109.78	121.70
Sig.		NS	NS	NS

*Values within the same column with different superscripts are significantly different (p<0.05), ±SE = Stander error, NS= Not significant, * Significant (P≤0.05) ** Significant (P≤0.01)*

Carcass characteristics:

Data presented in Table (6) indicated that broiler chicks fed the basal control diet had significant (p< 0.05 or p< 0.0) higher pre-slaughter weight, carcass weight and giblets percentage than those fed low density diet , however; dressing percentage was not significantly affected. The decline in carcass traits as a result of using low density diet may be due to that the use of low-CP and ME diet was linked with decreasing body weight gain and this depends on chicks' age and magnitude of protein and ME restrictions (Attia *et al.*, 2001). Akyurek *et al* (2005) concluded that broiler chicks fed on high density diet increased the relative weight of gizzard, heart and liver compared to those fed low density diet.

Table (5). Effect of diet density and phytase sources on feed conversion ratio (gm feed/gm gain) of growing chicks.

Treatments		Age intervals/ weeks		
		0-3	3-6	0-6
Diet density:				
Basal control diet		1.72[b]	1.96	1.89
Low diet density		1.87[a]	2.03	1.97
±SE		0.03	0.04	0.03
Sig .		**	NS	NS
Phytase sources:				
Without E		1.78	1.99[ab]	1.93
Bacterial E		1.81	1.92[b]	1.88
Fungal E		1.80	2.09[a]	2.01
±SE		0.03	0.05	0.04
Sig.		NS	*	NS
Interactions:				
Basal control diet	Without E	1.71	1.85	1.81
	Bacterial E	1.71	1.96	1.89
	Fungal E	1.75	2.10	2.00
Low density diet	Without E	1.84	2.12	2.04
	Bacterial E	1.91	1.89	1.88
	Fungal E	1.86	2.08	2.02
±SE		0.05	0.06	0.05
Sig.		NS	*	NS

*Values within the same column with different superscripts are significantly different (p<0.05), ±SE = Stander error, NS= Not significant, * Significant (P≤0.05) ** Significant (P≤0.01)*

Birds fed diet supplemented with fungal phytase had higher pre-slaughter weight and lower giblets percentage compared to chicks fed un-supplemented diet, while the effect on carcass weight and dressing percentage was not significant. Ahmed *et al.,* (2004) showed that there were significant differences (P<0.01) in dressing yield among different levels of phytase, while dietary enzyme had no effect on gizzard weight of broiler chicks. Sousa *et al* (2009) indicated that relative weight of liver and heart were significantly increased in broilers fed the diet with no phytase addition.

The effect of the interaction between diet density and phytase sources on all carcass traits was not significant.

Table 6. Effect of diet density and phytase sources on some carcass characteristics of broiler chicks

Treatments		Pre-slaughter weight	Carcass weight	Dressing percentage	Giblets percentage
Diet density:					
Basal control diet		2963.33[a]	2287.91[a]	76.31	3.92[a]
Low diet density		2546.66[b]	1961.25[b]	76.65	3.73[b]
±SE		62.69	57.89	0.44	0.06
Sig .		**	**	NS	*
Phytase sources:					
Without enzyme		2601.25[b]	2046.25	75.81	3.99[a]
Bacterial E		2780.62[ab]	2142.50	77.10	3.81[ab]
Fungal E		2883.12[a]	2185.00	76.52	3.67[b]
±SE		76.78	70.91	0.54	0.08
Sig.		*	NS	NS	*
Diet density x phytase sources:					
Basal control diet	Without E	2840.00	2248.75	76.37	3.93
	Bacterial E	2992.50	2280.00	76.18	3.90
	Fungal E	3057.50	2335.00	76.38	3.93
Low density diet	Without E	2362.50	1843.75	75.26	4.05
	Bacterial E	2568.75	2005.00	78.02	3.72
	Fungal E	2708.75	2035.00	76.66	3.42
±SE		108.59	100.28	0.76	0.56
Sig.		NS	NS	NS	NS

*Values within the same column with different superscripts are significantly different (p<0.05), ±SE = Stander error, NS= Not significant, * Significant (P≤0.05) ** highly Significant (P≤0.01)*

CONCLUSION:

From this study, it could be concluded that, adding either bacterial or fungal phytase enzymes to control or low-density diet may improve growth performance and increased digestibility of nutrients. However, adding of phtyase enzyme types was only economically when birds were fed low density diet.

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تأثير استخدام مصادر مختلفة من انزيم الفيتيز الميكروبي على بعض الصفات الإنتاجية في كتاكيت التسمين

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تم استخدام 240 كتكوت أربور ايكرز غير مجنسه عمر يوم تم توزيعها عشوائيا الى 6 معاملات بكل معامله 4 مكررات فى كل مكره 10طيور. تم استخدام التصميم (2 × 3) اثنين من العليقة (العليقة الاساسية والعليقة المنخفضة 10 ٪ في البروتين الخام والطاقة والفسفور)، وثلاثة معاملات من الانزيم (بدون اضافات , فيتيز بكتيرى , فيتيز فطرى).

وقد تم تسجيل متوسط وزن الجسم الحي وكمية العليقة المستهلكة وحساب الزيادة في وزن الجسم ومعدل تحويل الغذاء عند خلال مرحلة البادى والنامى وفترة التجربه كلها. فى نهاية الاسبوع السادس من العمر تم اخذ (3) طيور عشوائية من كل معامله وتم ذبح الطيور (3 طيور × 6 مجموعات = 18 الطيور) لقياس الصفات الذبيحة. وأوضحت النتائج ان الطيور التي تغذت على العليقة الكنترول حققت أعلى وزن جسم عند عمر 3 و6 أسابيع وأفضل زيادة في الوزن عند 0–3 و0–6 أسابيع مقارنة بالطيور التى تغذت على العليقة المنخفضة، معدل استهلاك الغذاء لم يتأثر معنويا بكثافة الغذاء بينما سجلت الكتاكيت التى تغذت على عليقة الكنترول أفضل معنويا معدل تحويل غذائى خلال الفترة البادئ 0–3 أسابيع.

وزن الجسم والزيادة فى الوزن لم يتأثر معنويا بإضافة انزيم الفايتيز الفطرى او البكتيرى الى علائق كتاكيت التسمين. ادى إضافة الانزيم الفطري الى زيادة استهلاك العلف عند عمر 3–6 و0–6 أسابيع بينما معدل التحويل الغذائى لم يتحسن معنويا نتيجة إضافة الإنزيم عند عمر 3–6 أسابيع. سجلت الكتاكيت التي تغذت على عليقة الكنترول أعلى وزن عند الذبح ووزن ذبيحة ونسبة الأعضاء الداخلية المأكولة. مقارنة بالكتاكيت التى تغذت على العليقة المنخفضة. كما أن الكتاكيت التى تغذت على عليقة مضاف اليها فيتيز فطرى سجلت أعلى وزن عند الذبح وأقل نسبة للأعضاء الداخلية المأكولة.

استنتاج:

من هذه الدراسة ، يمكن أن نخلص إلى أن إضافة إنزيمات الفيتيز البكتيري أو الفطري الى العليقه الكنترول او العليقه المنخفضه قد يحسن أداء النمو ويزيد من هضم المواد الغذائية. ومع ذلك ، فإن إضافة جميع أنواع إنزيم الفيتز كان اقتصاديًا فقط عندما تتغذى الطيور على نظام غذائي منخفض الكثافة.