

## **EFFECT OF MICROBIAL PHYTASE ON ENERGY UTILIZATION IN BROILERS DIETS**

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### **ABSTRACT**

An experiment was carried out to investigate the effect of feeding some different plant diets containing different metabolizable energy (ME) supplemented with an enzyme preparation (Phytase) on growth performance, nutrient digestibility, carcass traits, some bone and blood parameters of broiler chicks. The current study was designed as a 2 x 3 factorial arrangement by using different levels of ME (3000, 2900 and 2800 kcal/kg starter diets and 3100, 3000 and 2900 kcal/kg grower diets and 3200, 3100 and 3000 kcal/kg finisher diets), with two levels of phytase (0 and 750 FTU/kg diet). Diets were formulated to be isonitrogenous, containing 23% and 21% and 19% crude protein during starter, grower and finisher periods, respectively. The obtained data showed that regardless of phytase, decreasing dietary ME level in starter, grower and finisher periods 100 or 200 kcal/kg below control negatively affected economic efficiency and significant reduced percentage of abdominal fat, final live body weight, body weight gain, feed intake, feed conversion ratio, liver percentage, spleen percentage and had no significant effect on all carcass traits and carcass parts or blood parameters of broiler chicks except triglyceride, total lipids, uric acid and GOT and finally length and width of tibia. Phytase supplementation had significant effect on weight gain, tibia ash, tibia Ca, tibia P, plasma P and digestibility of crude fiber, ether extract and ash retention. According to the economical study feeding chicks balanced diets supplemented with microbial phytase at level of 750 FTU/kg is more successful in view of growth and economical evaluation of broiler chicks.

**Keywords:** Phytase, metabolizable energy, broiler performance, carcass traits, and blood parameter,.

### **INTRODUCTION**

Phytic acid is a compound that may cause various problems due to its mostly presence in cereals, oil seeds and their by-products. Therefore, it is well documented that microbial phytase supplementation enhances phytate hydrolysis and increases the availability of nutrients bound to the phytic molecule (Sebastian *et al.*, 1997). Phytase is a much studied enzyme, with the first modern series of studies conducted in the 1960's early research on the application of phytase to poultry diets showed results to improve availability of phytate phosphorus to poultry, particularly in young birds. However, it is not until the 1990's that phytase became economically feasible for use in animal/poultry feed (Remus, 2005). It cannot be secreted by the chicken (Van *et al.*, 1997), requiring thus its addition to the diet in the form of salt. Phytase addition to broiler diets can improve body weight and feed utilization (Abd El-Hakim and Abd Elsamee, 2004; and El-Ghamry *et al.*, 2005). Supplementation of phytase must be done with precaution because an

excess or a deficiency can decrease the availability of minerals (Lonnerdal, 1989). There are two good reasons for supplementing poultry feeds with phytase. The first reason is to reduce the harmful environmental impact of phosphorus from animal manure in areas with intensive livestock production. Several studies have found that optimizing phosphorus intake and digestion with phytase reduces the release of phosphorus in manure by around 30%. The second reason is based on the fact that phytate is capable of forming complexes with proteins and inorganic cations such as calcium, magnesium, and zinc. The use of phytase not only releases the bound phosphorus but also these other essential nutrients which led to higher nutritional value of the diet (Keshavarz, 2003 and Panda *et al.*, 2005).

Dietary energy level appears to be the most important factor affecting feed intake. Change in the energy content of the diet will normally result in an inverse change in the total amount of feed consumed and will therefore influence the intake of essential nutrients (Slagter and Waldroup, 1990). Hunton (1995) found that nutrients intake can be influenced by different levels of energy in diet. Therefore, deficiency of nutrients may occur in poultry by increasing the energy content in the diet. In contrast, feed intake as well as nutrients utilization are increased by low level of energy in the diet. It is well known that poultry tend to eat to satisfy their energy needs, because energy is necessary for providing the body with heat needed for maintenance and doing many physiological functions (Ramadan, 2005). Many studies showed that energy utilization could be improved by phytase addition into broiler diets that may be attributed to liberation of Ca ions necessary for alpha-amylase activity which is involved in starch digestion (Kies *et al.*, 2001). Broiler chickens have traditionally been fed relatively high energy diets to promoting efficient feed utilization, it is also assumed that this type of diet maximizes growth rate (Leeson and Summers, 1991). The higher concentration of energy induced a higher content of abdominal fat (Nahashon *et al.*, 2005). Diet energy dilution had a triple influence on carcass weight or yield of breast meat, although it was lessened the abdominal fat of male broiler chickens, however, the carcass weight and breast meat yield of male broiler were linearly decreased as the diet was diluted for both energy and protein (Lesson *et al.*, 1996).

The current study aimed to examine the effect of different levels of dietary energy with or without enzyme preparation (phytase) on body weight gain, feed consumption, feed conversion and mortality rate.

## **MATERIALS AND METHODS**

The present study was carried out at the Poultry Nutrition Farm, Poultry Production Department, Faculty of Agriculture, Ain Shams University, Egypt, to investigate the effect of enzyme preparation on energy utilization in broiler diets. One hundred eighty chicks divided into six treatments, and birds were reared under similar managerial conditions. Feed was presented in mash form in metallic feeders while an automatic nipple drinkers presented water, both feed and water were provided *ad-libitum*. Birds were vaccinated in

drinking water against Newcastle disease by Hitchner B1 vaccine at 7 days and Lasota vaccine at 17 and 27 day-old and Gumboro disease at 14 day-old.

Three periodical diets were formulated; starter from 1 to 14 days of age, grower from 15 to 28 days of age and finisher from 29 to 42 days of age. The experiment was conducted to study the effect of using three energy levels being normal (NME), medium (MME) and low (LME) metabolizable energy, each with two levels of microbial phytase in 3 x 2 factorial design. The composition and calculated analysis of the experimental diets (without phytase supplementation) are presented in Table (1). The energy levels applied were 3000, 2900 and 2800 kcal ME/kg during starter and 3100, 3000 and 2900 kcal ME/kg during grower showed in and 3200, 3100 and 3000 kcal ME/kg during finisher periods representing high, medium and low metabolisable energy levels, respectively. Diets were formulated to contain 23, 21 and 19 % CP for the starter, grower and finisher diets, respectively. Phytase levels supplemented to each energy level were 0, and 750 FTU/kg. The microbial phytase used was Natuphos® 500, a commercial preparation of BASF Corporation, Germany, with phytase activity of 500 units/g. The live body weight, weight gain and feed consumption and feed conversion ratio (feed/gain) were calculated weekly. A record of mortality of experimental birds was also maintained during the entire experiment. Five birds from each treatments, having body weight around the average of treatment were selected and sacrificed by severing the carotid artery and the jugular vein. The data on carcass yield and giblets were calculated as percentage of live weight. Also, relative weights of liver, gizzard, spleen, heart, abdominal fat were recorded. In addition breast yield, thigh yield, drumstick yield, and back were recorded. Blood samples were collected simultaneously during slaughtering at 42 days of age. Tibia of left leg were removed, cleaned of flesh and all soft tissue, oven-dried and dry tibia weight, length and breaking strength were determined. The tibiae were ground for procedure of the chemical analysis. At 42 days of age, five chicks from each treatment were selected and housed individually in individual cages that allowed excreta collection. Excreta voided were recorded along three days collection period to study the effect of energy with and/or without adding enzyme phytase in dry matter, crude fiber, crude protein, ether extract, and ash retention.

Overall data were subjected to one way analysis of variance General Linear Model (GLM) procedure of SAS (1998) user's guide according to the following model:

$$Y = \mu + T + E$$

Where: Y = is the effect of the observation

$\mu$  = is the overall mean

T = is the effect of the different treatments

E = is the experimental error



In addition, two-way analysis of variance was used to test the effects of dietary energy levels and effect of phytase.

$$Y = \mu + T + P + T*P + E$$

Where: Y = is the effect of the observation

$\mu$  = is the overall mean

T = is the effect of the treatments (energy level)

P = is the effect of the phytase

T\*P = is the interaction between treatment and phytase

E = is the experimental error.

## **RESULTS AND DISCUSSION**

### **Growth performance:**

Table 2 and 3 summarize growth performance of broiler chicks during all periods. Data showed that initial live body weight (LBW) values have no significant differences among all tested groups. The results cleared that chicks fed (NME) diets recorded significantly ( $P \leq 0.05$ ) higher (LBW) than those fed (MME) and (LME) diets. It was observed that decreasing dietary ME level had significant effect on final LBW, BWG, of broiler chicks, Table 2 indicated that during the whole experimental period, the lowering diet ME at MME 100 and LME 200 Kcal/kg decreased LBW by 6.4 and 14.25% respectively, While with phytase addition, live body weight increased significantly ( $P \leq 0.05$ ) by 2.64% than control negative group (0 FTU).

The effect of the studied factors on FI and FC are summarized in Table 3 the analysis of variance showed that was no significant differences were observed in FI within different experimental groups in starter, grower and finisher periods. Although this was significant during the whole period of the study. Chicks fed medium energy diet (MME) consumed more feed (4359 g) compared with chicks fed (NME) diet (4284 g) and (LME) consumed less feed (4067 g). During the whole period of the study, the results cleared that chicks fed MME diets recorded significantly ( $P \leq 0.05$ ) higher FI values (102%) than those fed NME (100%) and LME (95%) diets. Although, no significant differences were found in feed intake (FI) between chicks fed phytase (0 and 750 FTU/kg) diets.

Values presented in Table 3 showed significant ( $P > 0.01$ ) differences in feed conversion ratio between NME and all tested groups in grower and finisher periods and the whole experimental period. Feed conversion ratio was significantly improved for chicks fed diets with NME. During 6 weeks of age the best FCR was observed for chicks fed NME (1.93) compared with the MME (2.08) and LME (2.14). In addition, the feed conversion ratio did not significantly affected by adding phytase in the experimental diets.

These results agree with the finding of Jensen *et al.* (1970) and (Fisher and Wilson, 1974) who found that an "extra caloric" effect for dietary supplemented fat and suggested that wide caloric/protein ratios in poultry ration can be used for maximum gain and feed efficiency.





Also, other research has established that feeding broilers diets containing high apparent metabolizable energy concentrations improved LBW (Hidalgo *et al.*, 2004). The same conclusion was reached by Greenwood *et al.* (2004) as they found that birds fed 3200 Kcal ME/Kg diet had greater BWG than those fed 3050 Kcal ME/kg diet. During the finishing period, increasing energy level significantly increased LBW and BWG (Elmansy, 2006). In contrast, Saxena and Thakur (1985) concluded that LBW and BWG were not significantly affected by dietary energy levels (2800, 2900 or 3000 Kcal ME/kg diet). Aksakal and Bilal (2002) showed that adding phytase to broiler chicks increased feed intake. In this connection, Johnston and Southern (2000) reported that phytase supplementation into broiler diets did not affect their feed consumption, while improved feed/ gain ratio. These results opposed Attia *et al.*, (2001) who found that phytase addition to high energy broiler diets resulted in the best feed conversion value. Such improvement in feed conversion of corn-soybean meal based diets may be attributed to an increase in absorbed phosphorus (Lan *et al.*, 2002), release of other minerals affecting feed utilization (El-Deeb *et al.*, 2000) and to the increase in nutrients digestibility (Camden *et al.*, 2001) .

Nahashon *et al.* (2005) concluded that broiler fed diets with 3200 Kcal ME/kg diet in finisher diets had the best FI value. Reece *et al.* (1984) concluded that the highest level of ME (3109 Kcal ME/kg diet) improved FCR by 2.2 and 2.6%, respectively. Also, Nahashon *et al.* (2005) showed that FCR significantly improved with increasing energy level (3200 Kcal ME/kg diet) during the finishing period.

**mortality rate** : Under the condition of the present study all birds appeared healthy and the total mortality number was 16 chicks during the whole experimental period. The Mortality number showed no indication that could be related to the experimental diets, most of mortality cases were at the first days of the experimental period. This result coincides with the finding of Moshad (2001) who reported no effect of phytase supplementation on survivability results.

**Carcass traits and carcass parts:**

Table (4) shows that effects of dietary energy were not significant on dressing percentage, gizzard, heart. But dietary energy was significant effect ( $P \leq 0.05$ ) on liver and spleen percentage however, Phytase addition was not significant on all criteria. There was significant difference for abdominal fat among treatments. The highest value of abdominal fat percentage belonged to the treatment NME, which was higher in ME energy. Lowering ME in diets resulted in decrease abdominal fat. On the other hand, phytase supplementation not significantly affecting on abdominal fat percentage.

These results opposed those of Naher (2002) who that reported increase carcass yield by addition of phytase enzyme. Dressed weight was a function of live weight. Also these results opposed by Howlinder and Rose (1989). Also, Nahashon *et al.* (2005) who found that carcass yield significantly improved by increasing dietary energy levels. Shrivastav and Panda (1991) confirmed that fat content of whole carcass was significantly increased with increasing energy content of the diet.





The reduction in abdominal fat content of broilers in response to decreasing dietary ME level in the present study agrees with the results reported by Deaton and Lott (1985) and Rabie and Szilagyi (1998) who found that the relative weight of abdominal fat increased as dietary energy level increased. Similarly, Leeson *et al.* (1996) reported significant reductions in abdominal fat pad as percentage of carcass weight in response to decreasing ME contents in broiler diets from 3300 to 2700 kcal/kg. On the other hand, it has been reported that increasing concentrations of dietary ME will not alter abdominal fat percentage if the ratio of calories to CP remains constant (Hidalgo *et al.*, 2004). In this respect, Raju *et al.* (2004) found that the percentage of abdominal fat was significantly increased as the dietary energy level increased.

However, feeding different treatments had no significant effect on carcass parts (percentage of breast, thighs, drumstick, back, and wings) of broiler chicks in this study. These results agrees with previous findings of Angel, *et al.* (2007) but contradicts with those of Pillai, *et al.*, (2006) who showed that phytase supplementation significantly increased percentages of most of carcass merits. Holsheimer and Ruesink (1993) observed that carcass yields were unresponsive to dietary ME level, within a range of 2750 to 3250 kcal of ME/kg of diet. In other study, Hidalgo *et al.*, (2004) reported similar carcass yield responses to increasing ME concentration in the diets of straight-run broilers. In addition, Downs *et al.* (2006) found that dietary energy did not influence carcass characteristics of broiler chicks.

**Nutrients digestibility:**

Data of nutrients digestibility of the experimental diets for 6-week-old broilers as affected by the dietary energy and phytase levels are presented in Table (5). It is worthy to note the values of dry mater ratio (dry mater excreta /dry mater fed) were nearly similar and ranged between 0.210 and 0.242 indicating the similarity in feeding value among the dietary treatments. The phytase effect appeared significantly only on ash, ether extract and crude fiber digestibility. More ever energy had no significant effect on all nutrients digestibility. In this respect, Attia *et al.*, (2001) observed a significant improvement in CF digestibility with phytase addition to broiler diets, which was explained by most of phytic acid located within cell walls. The positive effect on EE digestibility was in agreement with the findings of Shirely and Edwards (2003) who stated that phytase may prevent the formation of insoluble metallic soaps in the gastrointestinal tract, which may improve lipid utilization of the diets. On the other hand, no significant effects were observed among dietary treatments regarding crude protein (CP), nitrogen free extract (NFE) and organic matter (OM) digestibility. This could be explained based upon the experimental diets which were isonitrogenous and their contents of all the nutrients were similar either at starter or grower or finisher diets. On the other hand Phytase applied herein, however, did not affect nutrient digestibility of broiler chicks, with the exception of a slight significant increase in ash, crude fiber and ether extract digestibility of birds fed diets supplemented with 750 FTU/kg compared to those fed negative control (0FTU/kg).



These results can be explained by that phytase enzyme had a positive influence on digestive enzymes of gastrointestinal tract that leads to the increase in ash retention observed in birds. These results are in agreement with previous findings on broiler (Rutherford, *et al.*, 2004; and Mondal, *et al.*, 2007).

**Blood parameters:**

The results in Table (6) showed that the Plasma values of cholesterol, calcium creatinine and GPT had not significant difference among treatments. Chicks fed LME showed lower values for plasma total lipids and triglycerides and higher value for uric acid. The effect of phytase on plasma P was significant ( $P < 0.05$ ). Phytase supplementation insignificantly decreased plasma Ca and increased plasma P. Moreover, addition of phytase releases a large amount of P from phytate-bound P and leads to high blood phosphate levels, which reduce blood Ca as the adverse relationship mentioned above. Concerning the transaminases activity, which is generally used as a sign of liver function, plasma AST (GOT) showed significant ( $P < 0.01$ ) differences within different energy tested groups which reached lower value with the LME. On the contrary, plasma ALT (GPT) values were not significantly affected by different treatments

Total protein (TP), g/dl, albumin and globulin for the studied groups during different periods, not presented in table 6. The Plasma values of total protein, albumin, globulin, and A/G ratio were not significantly affected by different dietary treatments. These values ranged from 4.70 to 4.42, 2.20 to 2.40, and 2.22 to 2.31 g/dl for total protein, albumin and globulin, respectively. This results is contradicts with Sebastian *et al.* (1996) who found that phytase addition in broiler diets reduced plasma Ca. Although Similar results were reported by Lou-Hong Zing *et al.* (1997) who reported that blood P was increased by phytase supplementation to broiler diets. In all treatments, it was noticed addition of phytase increased plasma P level. When phytate is hydrolyzed by microbial phytase, it may release all constituents' minerals, myo-inositol and inorganic phosphate (Wodzinski and Ullah, 1996).

**Bone measurements and composition:**

Values of bone measurements tibia weight, tibia ash, tibia calcium and tibia phosphorus percentage are given in Table 7 At six weeks of age there were no significant differences between the all different treatments in tibia weight. Data of tibia length showed that, birds fed deficient energy LME had significantly lowest ( $P < 0.05$ ) values followed by that fed NME and MME. But phytase had not significantly effect on tibia length. Data of tibia width showed that, birds fed NME diet and birds fed deficient energy MME had significantly highest ( $P < 0.05$ ) values followed by that fed the control LME. However, phytase had not significantly effect on Tibia width. Tibia breaking strength values showed that broiler fed different treatments were not significantly different.

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The percentage of broilers tibia ash was significantly increased by the addition of dietary phytase and were not affected by deficient ME diets. This agrees with the several studies on broilers (Zyla, et al., 2000 and Mondal, et al., 2007), pekin ducks (Orban, et al., 1999) and turkeys (Atia, et al., 2000). However, it disagrees with those reported by Bozkurt, et al., (2006). In this connection; Augspurger and Baker (2004) reported that phytase addition to broiler diets revealed significant increase in tibia ash and minerals content compared to those unsupplemented.

Phytase supplementation to diets increased the content of Ca and P in the tibia compared to unsupplemented diets. However, phytase had not significantly effect on tibia Ca and P. This is a good indication of increased availability of P from phytase mineral complex by the action of phytase (Sebastian, et al., 1996; Mondal, et al., 2007). This findings are similar to previous work with broilers and ducks, in which dietary phytase increased tibia ash and P percentages. These results are in accordance with those findings of Salem et al., (2003) who reported that addition of phytase to broiler diets increased tibia ash, Ca and P. This might be due to inorganic P release from the phytate molecule due to phytase supplementation and subsequently an increase in P availability and utilization by bones.

Therefore, the beneficial effect of phytase supplementation on tibia can be explained by understanding the negative role of phytic acids forming complexes with different cations; i.e. Ca, Mg, K, Mn, Fe and Zn and reduces their availability. Results of Viveros et al., (2002) and El-Husseiny et al., (2006) explains more by indicating that phytase supplementation diets had increased relative Ca and P retention by broiler chickens when compared to the negative control (0 FTU/kg) diet.

**Economical Efficiency :**

Table (8) showed averages of feed intake, prices of one Kg diet, total feed costs (LE), average weight gain, net revenue, economical efficiency and relative economic efficiency for growing chicks. The economical efficiency of the present study could be calculated based mainly upon the total feeding cost and live body weight gain. Results showed that the group of chicks fed LME diet recorded the lowest feed cost needed to obtain one kg of BWG (2.11 L.E ), while those fed NME diet had the highest value( 2.23 L.E). However, assuming T2 had the best economical value and performance index which is better by 3.0% than the control. At general using phytase increase the relative economic efficacy by 4% than negative control. From This results it can be concluded that feeding chicks with balanced diets supplemented with microbial phytase at level of 750 FTU/kg is more successful in view of growth, feed utilization and economical evaluation of broiler chicks.



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**تأثير انزيم الفيتيز الميكروبي علي الاستفادة من الطاقة في علائق بداري التسمين  
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أجريت هذه الدراسة بمزرعة تغذية الدواجن- كلية الزراعة - جامعة عين شمس لدراسة تأثير مستحضر انزيم الفيتيز مع مستويات مختلفة من الطاقة الممثلة علي الاداء الانتاجي ومعاملات هضم المركبات الغذائية وقوة العظام و خصائص الدم والكفاءة الاقتصادية . استخدم عدد 180 طائر "هيرد" عمر يوم وزعت عشوائيا إلى 6 معاملات ( 30 طائر / معاملة) في خمس مكررات بكل مكررة 6 طيور. وربيت الطيور تحت نفس الظروف البيئية مع تقديم الغذاء والماء بصورة حرة. اجريت التجربة بتصميم احصائي 3X2 حيث استخدمت ثلاث مستويات من الطاقة الممثلة (3000 و 2900 و 2800 كيلو كالوري / كج علف بادئ) ثم (3100 و 3000 و 2900 كيلو كالوري / كج علف نامي) واخيرا (3200 و 3100 و 3000 كيلو كالوري / كج علف ناهي) مع مستويين من انزيم الفاييتيز (صفر و 750 وحد انزيم / كجم علف) مع 23 و 21 و 19 % بروتين خام في مرحلة البادئ والنامي والناهي علي التوالي.

وكانت المعاملات التجريبية كم يلي :

- 1- العليقة المقارنة Control (T1)
- 2- عليقة الكنترول + اضافة انزيم الفايبيز (T2)
- 3- عليقة منخفضة بمقدار 100 كيلو كالوري عن العليقة المقارنة (T3)
- 4- عليقة منخفضة بمقدار 100 كيلو كالوري عن العليقة المقارنة بالاضافة الي انزيم الفايبيز (T4)
- 5- عليقة منخفضة بمقدار 200 كيلو كالوري عن العليقة المقارنة (T5)
- 6- عليقة منخفضة بمقدار 200 كيلو كالوري بالاضافة الي انزيم الفايبيز (T6)

والنتائج المتحصل عليها يمكن تلخيصها كالتالي:

اولا تاثير الطاقة:

- لم يلاحظ أى اختلافات معنوية بين جميع المعاملات في وزن الجسم حتى عمر أسبوعين ، بينما عند عمر 4 و 6 أسابيع كانت الطيور المغذاة على عليقة المقارنة أثقل معنويا من الطيور المغذاة علي علائق منخفضة الطاقة. وكان وزن الجسم المكتسب لعلائق المقارنة كان اعلى من العلائق المنخفضة الطاقة. اما بالنسبة للاستهلاك العلف كان استهلاك الطيور المغذاة علي علائق منخفضة الطاقة 100 كيلو كالوري الاعلى بلية عليقة المقارنة واخيرا المغذاة علي عليقة منخفضة 200 كيلو كالوري. معامل التحويل الغذائي لطيور مجموعة المقارنة أفضل من الأخرى المغذاة على علائق منخفضة الطاقة
- نسبة التصافي للطيور المغذاة على عليقة المقارنة تساوت مع العلائق منخفضة الطاقة.
- تأثر الكبد والطحال ودهون البطن بمستوي الطاقة في العليقة حيث انخفضت النسبة المئوية بانخفاض الطاقة.
- بانخفاض الطاقة انخفض مستوي الدهون الكلية والجليسريدات الثلاثية وانزيم الكبد GOT بينما ارتفعت نسبة حمض اليوريك في الدم .
- النسبة المئوية لطول وعرض عظمة الساق انخفضت بانخفاض الطاقة في العليقة .
- لم يتأثر أي معامل للهضم بالمعاملات الغذائية المدروسة باختلاف مستوي الطاقة في العليقة.
- بانخفاض الطاقة انخفضت تكلفة التغذية والعائد الكلي والكفاءة الاقتصادية.

ثانيا تاثير اضافة انزيم الفايبيز:

- اضافة انزيم الفايبيز حسنت من وزن الجسم بصورة معنوية في مرحلة الناهي بينما لم يظهر أي تأثير في أي من المراحل المختلفة. كذلك لم يتأثر استهلاك العلف او كفاءة التحويل الغذائي.
- اضافة الفايبيز ادي الي زيادة نسبة الفوسفور في الدم بينما لم يؤثر علي مستوي الكالسيوم في الدم.
- اضافة الفايبيز ادي الي زيادة في نسبة الكالسيوم والفوسفور والزماد في عظمة الساق. بينما لم يؤثر علي قوة الكسر او وزن عظام الساق.
- حسن الفايبيز من كفاءة هضم الدهون والالياف الخام والرماد المحتجز.
- ادي اضافة الفايبيز الي تحسين الكفاءة الاقتصادية بصفة عامة وعند اضافته الي العليقة المقارنة بصفة خاصة حيث ادت الي زيادة الكفاءة الاقتصادية 4% مقارنة بالعليقة المقارنة.
- من نتائج هذه الدراسة يتضح انه بتغذية كئاكيت التسميت علي علائق متزنة مزودة بالانزيم الفايبيز الميكروبي بمستوي 750 وحدة انزيم لكل كيلو جرام علف ادت الي اداء انتاجي جيد للطيور وكان معدل الاستفادة من العلائق أفضل.
- من الافضل من الناحية الاقتصادية اضافة الفايبيز الي العلائق المتزنة بمستوي 750 وحدة فايبيز وعدم خفض الطاقة وان اضافة الفايبيز الي العلائق منخفضة الطاقة لم يحسن الاداء الانتاجي او الاقتصادي.

قام بتحكيم البحث

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Table (3) : Effect of different dietary treatments on feed intake and feed conversion ratio of broiler chicks

Items Treatments	feed intake (g) during different periods in days				%	feed conversion ratio (g feed: g gain) during different periods in days				%
	(0-14)	(15-28)	(29-42)	(0-42)		FCR (0-14)	FCR (15-28)	FCR (29-42)	FCR (0-42)	
Control T1	297	1415	2545	4277 <sup>b</sup>	100%	1.41	1.60 <sup>b</sup>	2.30 <sup>c</sup>	1.94 <sup>c</sup>	100%
T2	322	1407	2542	4291 <sup>b</sup>	100.31%	1.41	1.60 <sup>b</sup>	2.22 <sup>c</sup>	1.91 <sup>c</sup>	95.96%
T3	310	1443	2583	4356 <sup>a</sup>	101.85%	1.42	1.65 <sup>b</sup>	2.57 <sup>a</sup>	2.09 <sup>a</sup>	108.74%
T4	318	1425	2598	4361 <sup>a</sup>	101.96%	1.40	1.62 <sup>b</sup>	2.51 <sup>a</sup>	2.06 <sup>b</sup>	106.22%
T5	304	1348	2383	4054 <sup>c</sup>	94.79%	1.43	1.75 <sup>a</sup>	2.69 <sup>b</sup>	2.18 <sup>a</sup>	108.72%
T6	311	1299	2450	4080 <sup>c</sup>	95.38%	1.40	1.72 <sup>a</sup>	2.50 <sup>a</sup>	2.10 <sup>bc</sup>	96.27%
Sig.	ns	ns	ns	*		Ns	*	*	*	
<b>Phytase level</b>										
0 FTU/KG	304	1402	2504	4229	100	1.42	1.67	2.50	2.07	100%
750 FTU/KG	317	1377	2539	4244	100.34%	1.40	1.65	2.41	2.02	94.01%
Sig.	ns	ns	ns	ns		Ns	Ns	ns	Ns	
<b>Energy level</b>										
NME	310	1411	2543	4284 <sup>b</sup>	100%	1.42	1.60 <sup>b</sup>	2.26 <sup>b</sup>	1.93 <sup>c</sup>	100
MME	314	1434	2590	4359 <sup>a</sup>	102%	1.41	1.64 <sup>b</sup>	2.54 <sup>a</sup>	2.08 <sup>b</sup>	109.70%
LME	307	1323	2417	4067 <sup>c</sup>	95%	1.42	1.74 <sup>a</sup>	2.60 <sup>a</sup>	2.01 <sup>a</sup>	104.61%
Sig.	ns	ns	ns	*		ns	*	*	**	

a... Means within column in each group with different superscripts are significantly different.  
 \* = significant ( P≤0.05) \*\* = significant ( P≤0.01 ) NS = not significant  
 T2 = control+ enzyme phytase, T3 = (-100) Kcal, T4 = T3+ enzyme phytase, T5= (-200) kcal, T6= T5+ enzyme phytase  
 NME : Normal metabolizable energy MME Medium metabolizable energy LME : Low metabolizable energy

**Table (8) : Effect of different dietary treatments on economic efficiency**

Items Treatments	Economic efficiency								
	Average feed intake (Kg)	price/ kg feed <sup>1</sup> (L.E)	Total feed cost (L.E)	Average weight gain (Kg)	Total revenues	Net revenues <sup>2</sup>	Economic efficiency	Relative efficiency	Performance Index
Control T1	4.26 <sup>b</sup>	2.23	9.39 <sup>a</sup>	2.20 <sup>a</sup>	26.88 <sup>b</sup>	11.49 <sup>ab</sup>	186.20 <sup>ab</sup>	100%	115.23 <sup>a</sup>
T2	4.27 <sup>b</sup>	2.23	9.42 <sup>a</sup>	2.25 <sup>a</sup>	27.42 <sup>a</sup>	12.00 <sup>a</sup>	190.97 <sup>a</sup>	103%	119.59 <sup>a</sup>
T3	4.34 <sup>a</sup>	2.14	9.15 <sup>b</sup>	2.08 <sup>ab</sup>	25.44 <sup>c</sup>	10.29 <sup>c</sup>	177.92 <sup>c</sup>	96%	101.23 <sup>b</sup>
T4	4.34 <sup>a</sup>	2.14	9.16 <sup>b</sup>	2.12 <sup>b</sup>	25.92 <sup>c</sup>	10.76 <sup>bc</sup>	182.86 <sup>b</sup>	98%	105.01 <sup>b</sup>
T5	4.03 <sup>c</sup>	2.11	8.41 <sup>c</sup>	1.86 <sup>d</sup>	22.80 <sup>d</sup>	8.39 <sup>d</sup>	171.06 <sup>d</sup>	92%	87.18 <sup>c</sup>
T6	4.06 <sup>c</sup>	2.11	8.45 <sup>c</sup>	1.94 <sup>b</sup>	23.76 <sup>d</sup>	9.31 <sup>d</sup>	181.04 <sup>b</sup>	97%	94.12 <sup>c</sup>
Sig.	*		**	**	*	*	**		**
<b>Phytase level</b>									
0 FTU/KG	4.21	2.16	8.99	2.05 <sup>b</sup>	25.04	10.05 <sup>b</sup>	178.39 <sup>b</sup>	100%	101.21 <sup>b</sup>
750 FTU/KG	4.22	2.16	9.01	2.10 <sup>a</sup>	25.70	10.69 <sup>a</sup>	184.96 <sup>a</sup>	104%	106.24 <sup>a</sup>
Sig.	ns		ns	*	ns	**	**		**
<b>Energy level</b>									
NME	4.26 <sup>b</sup>	2.23	9.41 <sup>a</sup>	2.22 <sup>a</sup>	27.15 <sup>a</sup>	11.74 <sup>a</sup>	188.58 <sup>a</sup>	100%	117.41 <sup>a</sup>
MME	4.34 <sup>a</sup>	2.14	9.16 <sup>a</sup>	2.10 <sup>b</sup>	25.68 <sup>b</sup>	10.52 <sup>b</sup>	180.39 <sup>b</sup>	96%	103.12 <sup>b</sup>
LME	4.05 <sup>c</sup>	2.11	8.43 <sup>b</sup>	1.90 <sup>c</sup>	23.28 <sup>c</sup>	8.85 <sup>c</sup>	176.05 <sup>c</sup>	93%	90.65 <sup>c</sup>
sig.	*		**	**	**	**	*		**
<p>a...d Means within column in each group with different superscripts are significantly different .                      * = significant ( P≤0.05)      ** = significant ( P≤0.01 )      ns = not significant                      T2 = control+ enzyme phytase,      T3 = (-100) Kcal,      T4 = T3+ enzyme phytase,      T5= (-200) kcal,      T6= T5+ enzyme phytase                      NME : Normal metabolizable energy      MME : Medium metabolizable energy      LME : Low metabolizable energy  <sup>1</sup> Based on average price of diets during the experimental time.      <sup>2</sup> Net revenue per unit feed cost .</p>									

**Table (5) : Effect of feeding different dietary treatments on digestibility of nutrients of the experimental diets**

Items Treatments	DMR <sup>1</sup>	Digestibility of nutrients (%)					
		OM	CP	EE	CF	Ash	NFE
Control T1	0.213	83.94	70.25	81.92 <sup>u</sup>	19.54 <sup>c</sup>	41.36 <sup>u</sup>	89.82
T2	0.224	85.62	69.55	83.45 <sup>a</sup>	21.82 <sup>uv</sup>	43.05 <sup>a</sup>	90.00
T3	0.210	84.80	72.42	80.85 <sup>u</sup>	22.45 <sup>u</sup>	39.82 <sup>c</sup>	89.15
T4	0.204	82.39	72.85	82.35 <sup>uv</sup>	19.86 <sup>c</sup>	43.77 <sup>a</sup>	92.45
T5	0.242	84.56	70.86	82.76 <sup>uv</sup>	20.58b <sup>c</sup>	40.14 <sup>u</sup>	91.24
T6	0.231	85.24	71.44	83.85 <sup>a</sup>	25.33 <sup>a</sup>	42.35 <sup>uv</sup>	90.65
Sig.	ns	ns	ns	*	*	*	ns
<b>Phytase level</b>							
0 FTU/KG	0.222	84.43	71.18	81.84 <sup>u</sup>	20.86 <sup>u</sup>	40.44 <sup>u</sup>	90.07
750 FTU/KG	0.220	84.42	71.28	83.22 <sup>a</sup>	22.34 <sup>a</sup>	43.06 <sup>a</sup>	91.03
Sig.	ns	ns	ns	*	*	*	ns
<b>Energy level</b>							
NME	0.218	84.78	69.90	82.69	20.68	42.21	89.91
MME	0.207	83.60	72.64	81.60	21.16	41.80	90.80
LME	0.237	84.90	71.15	83.31	21.96	41.25	90.95
Sig.	ns	ns	ns	ns	ns	ns	ns

a, b and c Means within column in each group with different superscripts are significantly different .  
T2 = control+ enzyme phytase, T3 = (-100) Kcal, T4 = T3+ enzyme phytase, T5= (-200) kcal, T6= T5+ enzyme phytase  
NME=normal metabolizable energy , MME=medium metabolizable energy and LME=Low metabolizable energy  
<sup>1</sup>DMR : Dry matter ratio OM : Organic matter CP : Crude protein EE: Ether extract CF: Crude fiber NFE: Nitrogen free extract

**Table (6) : Effect of feeding different dietary treatments on some blood parameter.**

Items Treatments	Total lipids (mg/dl)	Cholesterol (mg/dl)	Triglycerides (mg/dl)	Ca <sup>1</sup> (mg/dl)	P (mg/dl)	Creatinine (g/dl)	Uric acid (g/dl)	GOT/AST (IU/l)	GPT/ALT (IU/l)
Control T1	592 <sup>a</sup>	134	145.33 <sup>a</sup>	9.85	3.78 <sup>c</sup>	1.48	2.15 <sup>u</sup>	77.20 <sup>a</sup>	16.44
T2	602 <sup>a</sup>	139	144.80 <sup>a</sup>	9.94	3.98 <sup>u</sup>	1.40	2.11 <sup>u</sup>	74.82 <sup>a</sup>	14.84
T3	591 <sup>a</sup>	140	140.91 <sup>u</sup>	8.58	4.01 <sup>uv</sup>	1.42	2.28 <sup>a</sup>	75.50 <sup>a</sup>	16.20
T4	570 <sup>u</sup>	128	145.00 <sup>a</sup>	9.42	4.29 <sup>a</sup>	1.52	2.20 <sup>uv</sup>	72.75 <sup>a</sup>	14.88
T5	553 <sup>c</sup>	121	128.90 <sup>c</sup>	9.35	3.84 <sup>u</sup>	1.46	2.36 <sup>a</sup>	62.43 <sup>u</sup>	15.12
T6	556 <sup>c</sup>	138	133.62 <sup>c</sup>	10.05	4.21 <sup>a</sup>	1.35	2.24 <sup>uv</sup>	66.95 <sup>u</sup>	15.20
Sig.	**	ns	*	ns	*	ns	*	**	ns
<b>Phytase level</b>									
0 FTU/KG	578	132	138.38	9.26	3.88 <sup>u</sup>	1.45	2.20	71.71	15.92
750 FTU/KG	576	135	141.14	9.80	4.16 <sup>a</sup>	1.42	2.18	71.50	14.97
Sig.	ns	ns	ns	ns	*	ns	ns	ns	ns
<b>Energy level</b>									
NME	597 <sup>a</sup>	136	145.07 <sup>a</sup>	9.90	3.88	1.44	2.13 <sup>u</sup>	76.01 <sup>a</sup>	15.64
MME	580 <sup>u</sup>	134	142.96 <sup>u</sup>	9.00	4.15	1.47	2.24 <sup>uv</sup>	74.13 <sup>a</sup>	15.54
LME	554 <sup>c</sup>	130	131.26 <sup>c</sup>	9.70	4.02	1.41	2.30 <sup>a</sup>	64.69 <sup>u</sup>	15.16
Sig.	**	ns	*	ns	ns	ns	**	*	ns

a, b and c Means within column in each group with different superscripts are significantly different .  
\* = significant ( P≤0.05) \*\* = significant ( P≤0.01 ) NS = not significant  
T2 = control+ enzyme phytase, T3 = (-100) Kcal, T4 = T3+ enzyme phytase, T5= (-200) kcal, T6= T5+ enzyme phytase  
NME : Normal metabolizable energy MME Medium metabolizable energy LME : Low metabolizable energy  
<sup>1</sup>Ca : Calcium P : Phosphorus



**Table (7) : Effect of dietary treatments on some bone measurements and composition.**

Dietary Treatments	Bone measurements						
	Tibia Weight (g)	Tibia Length (Cm)	Tibia Width (mm)	Tibia Breaking Force (Kg/cm <sup>2</sup> )	Tibia Ash %	Tibia Ca %	Tibia P %
<b>Control T1</b>	6.81	9.48 <sup>a</sup>	9.03 <sup>a</sup>	28.69	40.66 <sup>ab</sup>	14.02 <sup>b</sup>	7.27 <sup>b</sup>
<b>T2</b>	6.85	9.28 <sup>a</sup>	9.85 <sup>a</sup>	29.50	42.46 <sup>a</sup>	15.17 <sup>a</sup>	8.51 <sup>a</sup>
<b>T3</b>	6.18	8.03 <sup>bc</sup>	8.63 <sup>b</sup>	28.28	38.68 <sup>c</sup>	13.85 <sup>b</sup>	7.44 <sup>b</sup>
<b>T4</b>	6.45	8.76 <sup>b</sup>	9.26 <sup>a</sup>	28.91	41.34 <sup>a</sup>	14.76 <sup>a</sup>	7.94 <sup>ab</sup>
<b>T5</b>	6.98	8.33 <sup>b</sup>	7.76 <sup>c</sup>	27.41	38.57 <sup>c</sup>	14.07 <sup>b</sup>	7.14 <sup>b</sup>
<b>T6</b>	5.98	7.76 <sup>c</sup>	7.37 <sup>c</sup>	27.02	39.87 <sup>b</sup>	14.14 <sup>b</sup>	7.68 <sup>b</sup>
<b>Sig.</b>	ns	*	*	ns	*	*	*
<b>Phytase level</b>							
<b>0 FTU/KG</b>	6.65	8.62	8.47	28.13	39.30 <sup>b</sup>	13.98 <sup>b</sup>	7.29 <sup>b</sup>
<b>750 FTU/KG</b>	6.43	8.60	8.83	28.48	41.22 <sup>a</sup>	14.69 <sup>a</sup>	8.04 <sup>a</sup>
<b>Sig.</b>	ns	ns	ns	ns	*	*	*
<b>Energy level</b>							
<b>NME</b>	6.83	9.38 <sup>a</sup>	9.44 <sup>a</sup>	29.09	41.56	14.59	7.89
<b>MME</b>	6.31	8.40 <sup>b</sup>	8.94 <sup>b</sup>	28.59	40.01	14.31	7.69
<b>LME</b>	6.48	8.05 <sup>b</sup>	7.56 <sup>c</sup>	27.21	39.22	14.11	7.41
<b>Sig.</b>	ns	*	*	ns	ns	ns	ns

a, b and c Means within columns with no common superscripts differ significantly  
 \* = significant ( P≤0.05) \*\* = significant ( P≤0.01 ) NS = not significant  
 T2 = control+ enzyme phytase, T3 = (-100) Kcal, T4 = T3+ enzyme phytase, T5= (-200) kcal, T6= T5+ enzyme phytase  
 NME=normal metabolizable energy , MME=medium metabolizable energy and LME=Low metabolizable energy

**Table (4) : Effect of dietary treatments on carcass traits and carcass parts of broiler chicks**

Items Treatments	carcass traits								carcass parts%				
	Body weight	Carcass weight	Dressing (%)	Liver (%)	Gizzard (%)	Heart (%)	Spleen (%)	Ab. Fat (%)	Breast	Wing	Thigh	Drumstick	Back
Control T1	2219	1651 <sup>a</sup>	74	2.82 <sup>a</sup>	1.70	0.63	0.130 <sup>a</sup>	2.90 <sup>a</sup>	44.28	8.86	22.18	12.34	4.90
T2	2264	1676 <sup>a</sup>	74	2.79 <sup>a</sup>	1.69	0.62	0.110 <sup>a</sup>	2.98 <sup>a</sup>	44.30	8.78	22.50	13.04	3.76
T3	2099	1596 <sup>a</sup>	76	2.41 <sup>b</sup>	1.69	0.60	0.093 <sup>b</sup>	1.80 <sup>b</sup>	44.44	8.74	22.50	12.68	4.12
T4	2134	1629 <sup>a</sup>	76	2.43 <sup>b</sup>	1.76	0.62	0.092 <sup>b</sup>	1.88 <sup>b</sup>	44.34	8.84	22.16	12.72	4.23
T5	1874	1358 <sup>b</sup>	72	2.17 <sup>c</sup>	1.73	0.65	0.084 <sup>c</sup>	1.01 <sup>c</sup>	43.56	8.96	22.60	12.86	3.60
T6	1954	1445 <sup>b</sup>	74	2.18 <sup>c</sup>	1.68	0.63	0.084 <sup>c</sup>	0.99 <sup>c</sup>	44.36	8.86	22.24	12.96	4.53
Sig.	**	*	ns	*	ns	ns	*	**	ns	ns	ns	Ns	ns
<b>Phytase level</b>													
0 FTU/KG	2064 <sup>b</sup>	1535	74	2.47	1.70	0.63	0.10	1.90	44.09	8.85	22.43	12.63	4.21
750 FTU/KG	2117 <sup>a</sup>	1584	75	2.47	1.71	0.62	0.10	1.95	44.33	8.83	22.30	12.91	4.17
Sig.	*	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	Ns	ns
<b>Energy level</b>													
NME	2242 <sup>a</sup>	1664 <sup>a</sup>	74	2.81 <sup>a</sup>	1.69	0.63	0.12 <sup>a</sup>	2.94 <sup>a</sup>	44.29	8.82	22.34	12.69	4.33
MME	2117 <sup>b</sup>	1612 <sup>a</sup>	76	2.42 <sup>b</sup>	1.72	0.61	0.09 <sup>b</sup>	1.84 <sup>b</sup>	44.39	8.79	22.33	12.70	4.18
LME	1914 <sup>c</sup>	1402 <sup>b</sup>	0.73	2.18 <sup>c</sup>	1.70	0.64	0.08 <sup>c</sup>	1.00 <sup>c</sup>	43.96	8.91	22.42	12.91	4.07
Sig.	**	*	ns	**	ns	ns	*	**	ns	ns	ns	Ns	ns

a...c Means within column in each group with different superscripts are significantly different .  
 \* = significant ( P≤0.05) \*\* = significant ( P≤0.01 ) NS = not significant  
 T2 = control+ enzyme phytase, T3 = (-100) Kcal, T4 = T3+ enzyme phytase, T5= (-200) kcal, T6= T5+ enzyme phytase  
 NME : Normal metabolizable energy MME Medium metabolizable energy LME : Low metabolizable energy

**Table (1) : Composition and calculated analysis of the experimental diets**

Ingredient	Starter (0-14 d)			Grower (15-28 d)			Finisher (29-42 d)		
	Control T1, T2	T3, T4	T5, T6	Control T1, T2	T3, T4	T5, T6	Control T1, T2	T3, T4	T5, T6
	%								
Yellow Corn	55.99	54.92	53.90	59.89	60.25	60.56	66.35	66.64	67.00
Soybean meal (44%)	28.79	33.65	38.80	26.29	28.85	31.53	17.20	19.80	22.40
Corn Gluten 60%	8.99	5.70	2.20	7.01	5.14	3.20	9.34	7.48	5.55
Soybean oil	1.50	1.00	0.50	2.50	1.50	0.50	2.50	1.50	0.50
Ca Carbonate	1.60	1.60	1.60	1.46	1.44	1.43	1.50	1.50	1.50
Mono Ca Ph	1.85	1.82	1.80	1.64	1.64	1.63	1.66	1.66	1.64
L-lysine HCl	0.39	0.39	0.25	0.32	0.27	0.22	0.52	0.47	0.45
DL-methionine	0.29	0.32	0.35	0.29	0.31	0.33	0.33	0.35	0.36
Salt	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Premix*	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Total	<b>100.00</b>	<b>100.00</b>	<b>100.00</b>	<b>100.00</b>	<b>100.00</b>	<b>100.00</b>	<b>100.00</b>	<b>100.00</b>	<b>100.00</b>
<b>Calculated analysis**</b>									
ME, kcal/kg	3000	2900	2800	3100	3000	2900	3200	3100	3000
Crude protein %	23.00	23.00	23.00	21.00	21.00	21.00	19.00	19.00	19.00
ME:CP ratio	130.43	126.09	121.74	147.62	142.86	138.10	168.42	163.16	157.89
Calcium %	1.00	1.00	1.00	0.91	0.91	0.91	0.91	0.91	0.91
Av. Phosphorus	0.51	0.50	0.51	0.46	0.46	0.46	0.45	0.45	0.45
DL-Methionine %	0.66	0.28	0.31	0.62	0.63	0.63	0.65	0.66	0.65
Meth. + Cyst. %.	1.05	1.05	0.69	0.98	0.98	0.98	0.98	0.98	0.98
Lys. %	1.40	1.50	1.46	1.62	1.62	1.62	1.25	1.25	1.26
<b>Determined values</b>									
Dry matter,%	91.08	91.12	91.40	90.45	89.45	90.23	91.66	90.75	91.28
Crude protein %	23.10	23.05	22.92	21.20	21.14	20.88	19.14	18.92	19.24
Ether extract, %	3.43	3.12	2.85	5.45	5.02	4.77	6.06	5.89	5.68
Crude fiber, %	2.85	2.77	3.07	3.58	3.36	3.28	4.22	3.84	3.72
Crude ash, %	4.52	4.04	3.95	6.89	5.78	5.52	4.82	4.85	4.41
* Composition of vitamin and minerals premix. Each 3 kg of premix containing: 15000000 I.U VIT. A, 50 g. VIT. E, 3000 mg. VIT. K3, 3000 mg. VIT. B1, 8000 mg. VIT. B2, 4000 mg. VIT. B6, 20 mg. VIT. B12, 15000 mg. Pantothenic acid, 60000 mg. Niacin, 1500 mg. Folic acid, 200 mg. Biotin, 200000 mg vitC, 700 gm. Choline chloride, 80 gm. Mn, 80 gm. Zn, 60 gm. Iron, 10 gm. Cu, 1 gm. Iodine , and 0.2 gm. Selenium , where CaCo3 was taken as a carrier up to 3kg, the inclusion rate was 3kg premix / Ton feed.** Calculated analysis of the experimental diets were done according to (NRC, 1994).									
T2 = control T1+ enzyme phytase, T3 = (-100) Kcal, T4 = T3+ enzyme phytase, T5= (-200) kcal, T6= T5+ enzyme phytase									