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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

μ = is the overall mean

T = is the effect of the different treatments

E = is the experimental error

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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

μ = 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≤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≤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≤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.

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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 Howlider 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.

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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).

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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 (Rutherfurd, *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 phytas 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.

REFERENCES

Abd El-Hakim, A. S. and M. O. Abd El-Samee (2004). Effect of feeding systems and phytase supplementation on the performance of broiler chicks during summer season. World,s Poultry Congress, 8 – 13 June, Istanbull, Turkey.

Aksakal, D.H. and T.Bilal (2002). Effects of microbial phytase and 1, 25-dihydroxycholecalciferol on the Bryden. Influence of microbial phytase on absorption on minerals from mineral broiler chicken diets containing different levels of calcium. Ind. Vet. J., 79: 446-450.

Angel, R., WW Saylor, AD Mitchell, W Powers, and TJ Applegate (2007). Effect of dietary phosphorous, phytase, and D3 on broiler chicken bone mineralization, Nutrient Utilization, and Excreta Quality of Broiler chickens, Poult. Sci. 87: 1200/1211.

A.O.A.C.(1990). Official Methods of Analysis Association of Official Analytical Chemists, 15th Edition, Washington, D.C, USA.

Atia, F. A., P. E. Waibel, I. Hermes, C. W. Carlson and M. M.Walser, (2000). Effect of dietary phosphorus, calcium, and phytase on performance of growing turkeys. Poultry Science., 79:231–239.

Attia, Y. A.; S. A. Abd El-Rahman and E. M. Qota (2001). Effects of microbial phytase without or with cell- wall splitting enzymes on the performance of broiler fed marginal levels of dietary protein and metabolizable energy. Egypt.Poult. Sci. J., 21(II): 521– 547

Augspurger, N. R. and D. H. Baker (2004). High dietary phytase levels maximize phytate-phosphorus utilization but not affect protein utilization in chicks fed phosphorus or amino acid- deficient diets. J. Anim. Sci., 82: 1100 – 1107.

Bozkurt, M., M. Cabuk and A. Alcicek, (2006). The effect of microbial phytase in broiler grower diets containing low phosphorous, energy and protein. J. Poult. Sci., 43: 29/34.

Camden, B.J.,P.C.H. Morel, V. Ravindran and M.R. Bedford, (2001). Effectiveness of exogenous microbial phytase in improving the bioavailability of phosphorus and other nutrients in maize-soybean meal diets for broilers. Br.Anim. Sci., 73: 289 297.

Deaton, J.W. and B.D. Lott (1985). Age and dietary energy effect on broiler abdominal fat deposition. Poult. Sci., 64: 2161-2164.

Downs, K.M.; R.J. Lien; J.B. Hess; S.F. Bilgili and W.A. Dozier III (2006). The effects of photoperiod length, light intensity, and feed energy on growth responses and meat yield of broilers. J. Appl. Poult. Res., 15: 406-416.

El-Deeb, Mariam, A. ; H. Sharara and M. N. Makled (2000). Enhance calcium and Phosphorus utilization by enzyme phytase supplemented to broiler diet containing rice bran.Egypt. Poult. Sci. J., 20: 546 – 566.

El-Ghamry, A. A.; M. A. Al-Harthi and Y.A. Attia (2005). Possibility to improve rice polishing utilization in broiler diets by enzymes or dietary formulation based on digestible amino acids. Archiv. Fur Gelfugelkunde, 69: 49 – 56.

El-Husseiny, O. M.; Abou El-Wafa S. and Shaban M. (2006). Influence of dietary phytase on broilers performance fed low-phosphorus corn/soybean or sunflower diets based on digestible or deficient amino acids. Egypt.Poult. Sci (26): 427-454.

El-mansy, M. M. (2006). Assessment of the effect of L-carnitine supplementation to the diet with different dietary energy on Broiler, high energy, productive performance and carcass characteristics broiler performance. M. Sc.Thesis, Fac. Agric., Tanta Univ., Tanta, Egypt.

Fisher, C. and Wilson, B. J. (1974). Response to dietary energy concentration by growing chickens. In: Energy Requirements of poultry, pp.151-184.

Greenwood, M.W; Cramer, K. R.; Clark, P.M.; Behnke, K.C. and Beyer, R.S. (2004). Influence of feed on dietary lysine and energy intake and utilization of broiler from 14 to 30 days of age . Inter. J. of Poult. Sci., 3: 189-194.

Hidalgo, M.A., W.A. Dozier III, A.J. Davis and R.W. Gordon (2004). Live performance and meat yield responses of broilers to progressive concentrations of dietary energy at a constant metabolizable energy-to-crude protein ratio. J. Applied Poult., 13: 319-327.

Holsheimer, J.P. and E.W. Ruesink (1993). Effect on performance, carcass composition, yield, and financial return of dietary energy and lysine levels in starter and finisher diets fed to broilers. Poult. Sci., 72: 806–815.

Howlider, M.A.R. and S.P. Rose, 1989. Rearing temperature and the meat yield of broilers. Br. Poult. Sci., 30: 61-67.

Hunton, H. (1995). Poultry production, Ontario, Canada, pp 53 – 118.

Jensen, L. S.; Schumaier, G. W. and Latshaw, J.D. (1970). "Extra caloric" effect of dietary fat for developing turkeys as influenced by calorie-protein ratio. Poult. Sci., 49:1679-1704.

Johnston, S. L. and L. L. Southern (2000). The effect of varying mix uniformty (simulated) of phytase on growth performance, mineral retention and bone mineralization in chicks. Poult. Sci., 79: 1485 – 1490.

Keshavarz, K. (2003). The effect of different levels of nonphytate phosphorus with and without phytase on performance of for strains of laying hens. Poult. Sci., 82 : 71-91.

Kies, A. K.; K. H. F. Van Hemert and W. C. Sauer (2001). Effect of phytase on protein and amino acid digestibility and energy, utilization. World s Poult. Sci., 57: 109 – 125.

Lan, G. Q.; N. Abdallah; S. Jalaludin and Y. W. Ho (2002). Efficacy of supplementation of phytase producing bacterial culture on the performance and nutrient use of broiler chickens fed corn soybean meal diets. Poult. Sci., 81: 1522 – 1532.

Leeson, S. and Summers, J. D. (1991). Broiler diet specifications Page 151 in: Commercial Pout. Nutr. University Books, Guelph, Canada.

Leeson, S.; Caston, L. and Summers, J. D. (1996). Broiler responses to diet energy. Poult. Sci., 75:529–535.

Lonnerdal, A. (1989). Inhibitory effect of phytic acid and other inositol phosphates on zinc absorption in suckling rats. British Newspapers of Nutrition.NE211-214.

Lou-Hong Zing; Wu Jian Liang and Xu Chun (1997).The effect of supplemental phytase on growth performance and phosphorus utilization of broiler chicks. Acta Agriculturae Zhejiangensis, 9: 260-265.

Mondal, M. K., S. Panda and P. Biswas, (2007). Effect of microbial phytase in soybean meal based broiler diets containing low phosphorous. International Journal of Poultry Science., 6 (3): 201-206.

Moshad, M.A. (2001). Use of phytase and carbohydrase enzyme for better utilization of parboild rice-polish based diet in broiler. MSc.Thesis, department of Poult. Sci. Bangladesh Agricultural University,Mymensingh.

Nahashon, S. N.; Adefope, N.; Amenyenu, A. and Wright, D. (2005). Effects of dietary metabolizable energy and crude protein concentrations on growth performance and carcass characteristics of French guinea broilers. Poult. Sci., 84: 337-344.

Naher, B. (2002). Utilization of parboild rice polish-based diet with supplementation of carbohydratase and phytase in growing duckling. M.Sc. Thesis, department of Poult. Sci. Bangladesh Agricultural University, Mymensingh.

NRC; National Research Council (1994). Nutrient Requirements of Poultry. 9th revised edition, National Academy Press, Washington, DC.

Orban, J.L., O. Adeola and R. Strashine, (1999). Microbial phytase in finisher diets of white pekin ducks: effect on growth performance, plasma phosphorus concentration and leg bone characteristics. Poult. Sci., 78: 366-377.

Panda, A.K., S.V. Rama Rao, M.V.L.N. Raju, and S.K. Bhanja (2005). Effect of microbial phytase on production performance of white leghorn layers fed on a diet low in non-phytate phosphorus. Britsh Poult. Sci.,46:464-469.

Pillai, P. B., T. O. Conner- Dennie, C. M. Owens and J. L. Emmert. (2006). Efficacy of an E. Coli Phytase in broiler fed adequate or reduced phosphorus diets and its effects on carcass characteristics. Poultry Sci. 85: 1200-1211.

Rabie, M.H. and M. Szilagyi (1998). Effects of L-carnitine supplementation of diets differing in energy levels on performance, abdominal fat content and yield and composition of edible meat of broilers. Br. J. Nutr., 80: 391-400.

Raju, M. V.; Sunder, G. S.; Chawak, M. M and Sadagopan, V. V. (2004). Response of naked neck (Nana) and normal broiler chickens to dietary energy level in a subtropical climate. Br. Poult. Sci., 45: 186-193.

Ramadan, Nehad A. (2005). Broiler performance as affected by dietary energy source and level. Ph.D Thesis, Fac. Agric., Cairo univ.. Egypt.

Reece, F. N.; Lott, B. D. and Deaton, J. W. (1984). The effects of feed form, protein profile, energy level and gender on broiler performance in warm (26.7 C) environments. Poult. Sci., 63:1906–1911.

Remus, J., (2005). Poultry and environment reap the benefits of new-generation phytase. Feedtech (International feed production and applied nutrition),9: 22-25.

Rutherfurd, S. M., T. K. Chung, P. C. H. Morel and P. J. Moughan. (2004). Effect of microbial phytase on ileal digestibility of phytate phosphorus, total phosphorus, and amino Acids in a low-phosphorus diet for broilers. Poultry Science. 83:61–68.

Salem, F. M.; El-Alaily, H. A.; El-Medany, N. M. and Abd El-Galil, K. (2003). Improving phosphorus utilization in broiler chick diets to minimize phosphorus pollution. Egypt. Poult. Sci. J. 23:201-218.

SAS (1998). User's guide: Statistics. SAS Institute Inc., Cary, NC.

Saxena, V. P. and Thakur, R.S. (1985). Performance of starting commercial pullets on different protein and energy levels in Haryana. Haryana Agric. Univ. J.of Res. 15: 1-6.

sebastian, S., S. P. Touchburn, E. R. Chavez, and P. C. Lague. (1996). Efficacy of supplemental microbial phytase at different dietary calcium levels on growth performance and mineral utilization of broiler chickens. Poult. Sci. 75:1516–1523.

Sebastian, S.; S. P. Touchburn, E. R. Chavez and P. C. Lague (1997). Apparent digestibility of protein and amino acids in broiler chickens fed a corn-soybean meal diet supplemented with microbial phytase. Poult. Sci. 76: 1760 –1769.

Shirley, R. B. and H. M. Edwards,Jr. (2003). Graded levels of phytase past industry standards improves broiler performance. Poult. Sci., 82: 671 – 680.

Shrivastav, A. and K. R.Panda (1991). Distribution of fat at different locations as influenced by dietary caloric-protein ratio and energy levels in broilers. Indian Vet. Med. J.,15: 178-184.

Slagter, P.J. and P.W. Waldroup (1990). Calculation and evaluation of energy:amino acid ratios for the egg-production type hen.Poult. Sci., 69:1810-1822.

Van, D. K. J., G.H. Verstee, P.C.M. Simons and A.K. Kies (1997). The efficacy of phytase in corn soybean meal based diets for laying hens. Poult. Sci., 76: 1535-1542

Viveros, V.; A. Bernes; I. Arija and C. Centano (2002). Effect of microbial phytase supplementation on mineral utilization and serum enzyme activities in broiler chicks fed different levels of phosphorus. Poult. Sci., 81: 1172 – 1183.

Wodzinski, R. J. and A. H. J. Ullah. (1996). Phytase. Adv. Appl. Microbiol. 42:263- 302.

Zyla, K., A. Wikiera, J. Koreleski, S. Swiatkiewicz, and D. R. Ledoux (2000). Comparison of the efficacies of a novel Aspergillus niger mycelium with separate and combined effectiveness of phytase, acid phosphatase, and pectinase in dephosphorylation of wheat-based feeds to growing broilers. Poult. Sci. 79:1434-1443.

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 ١٨٠ طائر "هبرد" عمر يوم وزعت عشوائيا إلى ٦ معاملات (٣٠ طائر / معاملة) في خمس مكررات بكل مكررة ٦ طيور. وربيت الطيور تحت نفس الظروف البيئية مع تقديم الغذاء والماء بصورة حرة .اجريت التجربة بتصميم احصائي ٣X٢ حيث استخدمت ثلاث مستويات من الطاقة الممثلة (٣٠٠٠ و٢٩٠٠ و٢٨٠٠ كيلو كالوري / كج علف بادئ) ثم (٣١٠٠ و ٣٠٠٠ و ٢٩٠٠ كيلو كالوري / كج علف نامي) واخيرا (٣٢٠٠ و ٣١٠٠ و ٣٠٠٠ كيلو كالوري / كجم علف ناهي) مع مستويين من انزيم الفايتيز (صفر و ٧٥٠ وحد انزيم / كجم علف) مع ٢٣ و ٢١ و ١٩ % بروتين خام في مرحلة البادئ والنامي والناهي علي التوالي.

وكانت المعاملات التجريبية كم يلي :

١- العليقة المقارنة
Control (T1)
٢- عليقة الكنترول + اضافة انزيم الفايتيز (T2)
٣- عليقة منخفضة بمقدار ١٠٠ كيلو كالوري عن العليقة المقارنة (T3)
٤- عليقة منخفضة بمقدار ١٠٠ كيلو كالوري عن العليقة المقارنة بالاضافة الي انزيم الفايتيز(T4)
٥- عليقة منخفضة بمقدار ٢٠٠ كيلو كالوري عن العليقة المقارنة (T5)
٦- عليقة منخفضة بمقدار ٢٠٠ كيلو كالوري بالاضافة الي انزيم الفايتيز (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 ٤ و ٦ 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 ١٠٠ كيلو كالوري الاعلي يلية عليقة المقارنة واخيرا المغذاة علي عليقة منخفضة ٢٠٠ 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 والجلسريدات 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 الفيتيز:

- اضافة انزيم الفيتيز حسنت من وزن الجسم بصورة معنوية في مرحلة الناهي بينما لم يظهر أي تأثير في أي من المراحل المختلفة. كذلك لم يتاثر استهلاك العلف او كفاءة التحويل الغذائي.
- اضافة الفيتيز ادي الي زيادة نسبة الفوسفور في الدم بينما لم يوثر علي مستوي الكالسيوم في الدم.
- اضافة الفيتيز ادي الي زيادة في نسة الكالسيوم والفوسفور والرماد في عظمة الساق. بينما لم يؤثر علي قوة الكسر او وزن عظام الساق.
- حسن الفيتيز من كفاءة هضم الدهون والالياف الخام والرماد المحتجز.
- ادي اضافة الفيتيز الي تحسين الكفاءة الاقتصادية بصفة عامة وعند اضافته الي العليقة المقارنة بصفة خاصة حيث ادت الي زيادة الكفائة الاقتصادية ٤% مقارنة بالعلقية المقارنة.

من نتائج هذة الدراسة يتضح انة بتغذية كتاكيت التسميت علي علائق متزنة مزودة بالانزيم الفيتيز الميكروبي بمستوي ٧٥٠ وحدة انزيم لكل كيلو جرام علف ادت الي اداء انتاجي جيد للطيور وكان معدل الاستفادة من العلائق أفضل.

من الافضل من الناحية الاقتصادية اضافة الفيتيز الي العلائق المتزنة بمستوي ٧٥٠ وحدة فيتيز وعدم خفض الطاقة وان اضافة الفيتيزالي العلائق منخفضة الطاقة لم يحسن الاداء الانتاجي اوالاقتصادي.

قام بتحكيم البحث

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Table (2): Effect of different dietary treatments on live body weight (LBW) and body weight gain (BWG)

Items / Treatments	Live body weight (g)				body weight gain(g) at different periods in days				%
	1 day	14 days	28 days	42 days	(0-14)	(15-28)	(29-42)	(0-42)	
Control T1	39.80	250.70	1135^{a}	2240^{a}	210.90	884^{a}	1105^{a}	2200^{a}	100%
T2	39.40	260.75	1140^{a}	2285^{a}	221.35	879^{a}	1145^{a}	2246^{a}	102.06%
T3	39.85	240.40	1115^{a}	2120^{b}	200.55	875^{a}	1005^{b}	2080^{b}	94.54%
T4	40.00	245.20	1125^{a}	2160^{b}	205.20	880^{a}	1035^{b}	2120^{b}	96.35%
T5	39.75	245.00	1015^{b}	1900^{c}	205.25	770^{b}	885^{c}	1860^{c}	84.55%
T6	40.70	245.00	1000^{b}	1980^{c}	204.30	755^{b}	980^{c}	1939^{c}	88.14%
Sig.	ns	ns	*	*	Ns	*	**	**	
Phytase level									
0 FTU/KG	39.80	245.37	1088	2087^{b}	205.57	843	998	2047^{b}	100%
750 FTU/KG	40.03	250.32	1088	2142^{a}	210.28	838	1053	2102^{a}	102.68%
Sig.	ns	ns	ns	*	Ns	ns	ns	*	
Energy level									
NME	39.60	255.73	1138^{a}	2263^{a}	216.13	882^{a}	1125^{a}	2223^{a}	100%
MME	39.93	242.80	1120^{a}	2140^{b}	202.88	877^{a}	1020^{b}	2100^{b}	94.47%
LME	40.23	245.00	1008^{b}	1940^{c}	204.78	763^{b}	933^{c}	1900^{c}	85.46%
Sig.	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 (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^{b}	**100%**	1.41	1.60^{b}	2.30^{c}	1.94^{c}	**100%**
T2	322	1407	2542	4291^{b}	**100.31%**	1.41	1.60^{b}	2.22^{c}	1.91^{c}	**95.96%**
T3	310	1443	2583	4356^{a}	**101.85%**	1.42	1.65^{b}	2.57^{a}	2.09^{a}	**108.74%**
T4	318	1425	2598	4361^{a}	**101.96%**	1.40	1.62^{b}	2.51^{a}	2.06^{b}	**106.22%**
T5	304	1348	2383	4054^{c}	**94.79%**	1.43	1.75^{a}	2.69^{b}	2.18^{a}	**108.72%**
T6	311	1299	2450	4080^{c}	**95.38%**	1.40	1.72^{a}	2.50^{a}	2.10^{bc}	**96.27%**
Sig.	**ns**	**ns**	**ns**	*		**Ns**	*	*	*	
Phytase level										
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**	
Energy level										
NME	310	1411	2543	4284^{b}	**100%**	1.42	1.60^{b}	2.26^{b}	1.93 ^{c}	**100**
MME	314	1434	2590	4359^{a}	**102%**	1.41	1.64^{b}	2.54^{a}	2.08^{b}	**109.70%**
LME	307	1323	2417	4067^{c}	**95%**	1.42	1.74^{a}	2.60^{a}	2014^{a}	**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[1] (L.E)	Total feed cost (L.E)	Average weight gain (Kg)	Total revenus	Net revenus[2]	Economic efficiency	Relative efficiency	Performance Index
Control T1	4.26^{b}	2.23	9.39^{a}	2.20^{a}	26.88^{b}	11.49^{ab}	186.20^{ab}	**100%**	115.23^{a}
T2	4.27^{b}	2.23	9.42^{a}	2.25^{a}	27.42^{a}	12.00^{a}	190.97^{a}	**103%**	119.59^{a}
T3	4.34^{a}	2.14	9.15^{b}	2.08^{ab}	25.44^{c}	10.29^{c}	177.92^{c}	**96%**	101.23^{b}
T4	4.34^{a}	2.14	9.16^{b}	2.12^{b}	25.92^{c}	10.76^{bc}	182.86^{b}	**98%**	105.01^{b}
T5	4.03^{c}	2.11	8.41^{c}	1.86^{d}	22.80^{d}	8.39^{d}	171.06^{d}	**92%**	87.18^{c}
T6	4.06^{c}	2.11	8.45^{c}	1.94^{b}	23.76^{d}	9.31^{d}	181.04^{b}	**97%**	94.12^{c}
Sig.	*		**	**	*	*	**		**
									Phytase level
0 FTU/KG	4.21	2.16	8.99	2.05^{b}	25.04	10.05^{b}	178.39^{b}	**100%**	101.21^{b}
750 FTU/KG	4.22	2.16	9.01	2.10^{a}	25.70	10.69^{a}	184.96^{a}	**104%**	106.24^{a}
Sig.	ns		ns	*	ns	**	**		**
									Energy level
NME	4.26^{b}	2.23	9.41^{a}	2.22^{a}	27.15^{a}	11.74^{a}	188.58^{a}	**100%**	117.41^{a}
MME	4.34^{a}	2.14	9.16^{a}	2.10^{b}	25.68^{b}	10.52^{b}	180.39^{b}	**96%**	103.12^{b}
LME	4.05^{c}	2.11	8.43^{b}	1.90^{c}	23.28^{c}	8.85^{c}	176.05^{c}	**93%**	90.65^{c}
sig.	*		**	**	**	**	*		**

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
[1] Based on average price of diets during the experiment al time. [2] Net revenue per unit feed cost .

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

Items / Treatments	DMR[1]	Digestibility of nutrients (%)					
		OM	CP	EE	CF	Ash	NFE
Control T1	0.213	83.94	70.25	81.92^{b}	19.54^{c}	41.36^{b}	89.82
T2	0.224	85.62	69.55	83.45^{a}	21.82^{bc}	43.05^{a}	90.00
T3	0.210	84.80	72.42	80.85^{b}	22.45^{b}	39.82^{c}	89.15
T4	0.204	82.39	72.85	82.35^{ab}	19.86^{c}	43.77^{a}	92.45
T5	0.242	84.56	70.86	82.76^{ab}	20.58b^{c}	40.14^{b}	91.24
T6	0.231	85.24	71.44	83.85^{a}	25.33^{a}	42.35^{ab}	90.65
Sig.	ns	ns	ns	*	*	*	ns
Phytase level							
0 FTU/KG	0.222	84.43	71.18	81.84^{b}	20.86^{b}	40.44^{b}	90.07
750 FTU/KG	0.220	84.42	71.28	83.22^{a}	22.34^{a}	43.06^{a}	91.03
Sig.	ns	ns	ns	*	*	*	ns
Energy level							
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
[1]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[1] (mg/dl)	P (mg/dl)	Creatinine (g/dl)	Uric acid (g/dl)	GOT/AST (IU/l)	GPT/ALT (IU/l)
Control T1	592^{a}	134	145.33^{a}	9.85	3.78^{c}	1.48	2.15^{b}	77.20^{a}	16.44
T2	602^{a}	139	144.80^{a}	9.94	3.98^{b}	1.40	2.11^{b}	74.82^{a}	14.84
T3	591^{a}	140	140.91^{b}	8.58	4.01^{ab}	1.42	2.28^{a}	75.50^{a}	16.20
T4	570^{b}	128	145.00^{a}	9.42	4.29^{a}	1.52	2.20^{ab}	72.75^{a}	14.88
T5	553^{c}	121	128.90^{c}	9.35	3.84^{b}	1.46	2.36^{a}	62.43^{b}	15.12
T6	556^{c}	138	133.62^{c}	10.05	4.21^{a}	1.35	2.24^{ab}	66.95^{b}	15.20
Sig.	**	ns	*	ns	*	ns	*	**	ns
Phytase level									
0 FTU/KG	578	132	138.38	9.26	3.88^{b}	1.45	2.20	71.71	15.92
750 FTU/KG	576	135	141.14	9.80	4.16^{a}	1.42	2.18	71.50	14.97
Sig.	ns	ns	ns	ns	*	ns	ns	ns	ns
Energy level									
NME	597^{a}	136	145.07^{a}	9.90	3.88	1.44	2.13^{b}	76.01^{a}	15.64
MME	580^{b}	134	142.96^{b}	9.00	4.15	1.47	2.24^{ab}	74.13^{a}	15.54
LME	554^{c}	130	131.26^{c}	9.70	4.02	1.41	2.30^{a}	64.69^{b}	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
[1]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^2)	Tibia Ash %	Tibia Ca %	Tibia P %
Control T1	6.81	9.48^{a}	9.03^{a}	28.69	40.66^{ab}	14.02^{b}	7.27^{b}
T2	6.85	9.28^{a}	9.85^{a}	29.50	42.46^{a}	15.17^{a}	8.51^{a}
T3	6.18	8.03^{bc}	8.63^{b}	28.28	38.68^{c}	13.85^{b}	7.44^{b}
T4	6.45	8.76^{b}	9.26^{a}	28.91	41.34^{a}	14.76^{a}	7.94^{ab}
T5	6.98	8.33^{b}	7.76^{c}	27.41	38.57^{c}	14.07^{b}	7.14^{b}
T6	5.98	7.76^{c}	7.37^{c}	27.02	39.87^{b}	14.14^{b}	7.68^{b}
Sig.	**ns**	*****	*****	**ns**	*****	*****	*****
Phytase level							
0 FTU/KG	6.65	8.62	8.47	28.13	39.30^{b}	13.98^{b}	7.29^{b}
750 FTU/KG	6.43	8.60	8.83	28.48	41.22^{a}	14.69^{a}	8.04^{a}
Sig.	**ns**	**ns**	**ns**	**ns**	*****	*****	*****
Energy level							
NME	6.83	9.38^{a}	9.44^{a}	29.09	41.56	14.59	7.89
MME	6.31	8.40^{b}	8.94^{b}	28.59	40.01	14.31	7.69
LME	6.48	8.05^{b}	7.56^{c}	27.21	39.22	14.11	7.41
Sig.	**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[a]	74	2.82[a]	1.70	0.63	0.130[a]	2.90[a]	44.28	8.86	22.18	12.34	4.90
T2	2264	1676[a]	74	2.79[a]	1.69	0.62	0.110[a]	2.98[a]	44.30	8.78	22.50	13.04	3.76
T3	2099	1596[a]	76	2.41[b]	1.69	0.60	0.093[b]	1.80[b]	44.44	8.74	22.50	12.68	4.12
T4	2134	1629[a]	76	2.43[b]	1.76	0.62	0.092[b]	1.88[b]	44.34	8.84	22.16	12.72	4.23
T5	1874	1358[b]	72	2.17[c]	1.73	0.65	0.084[c]	1.01[c]	43.56	8.96	22.60	12.86	3.60
T6	1954	1445[b]	74	2.18[c]	1.68	0.63	0.084[c]	0.99[c]	44.36	8.86	22.24	12.96	4.53
Sig.	**	*	ns	*	ns	ns	*	**	ns	ns	ns	Ns	ns
Phytase level													
0 FTU/KG	2064[b]	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[a]	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
Energy level													
NME	2242[a]	1664[a]	74	2.81[a]	1.69	0.63	0.12[a]	2.94[a]	44.29	8.82	22.34	12.69	4.33
MME	2117[b]	1612[a]	76	2.42[b]	1.72	0.61	0.09[b]	1.84[b]	44.39	8.79	22.33	12.70	4.18
LME	1914[c]	1402[b]	0.73	2.18[c]	1.70	0.64	0.08[c]	1.00[c]	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	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Calculated analysis**									
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
Determined values									
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