EFFECT OF DIETARY METABOLIZABLE ENERGY AND MICROBIAL PHYTASE LEVELS ON BROILER PERFORMANCE, NUTRIENTS DIGESTIBILITY AND MINERALS UTILIZATION

by

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ABSTRACT: *An experiment designed in a 2 x 4 factorial arrangement was conducted to study the effect of using different levels of metabolizable energy (3100 and 2900 kcal/kg starter diets and 3200 and 3000 kcal/kg grower diets) , along with different levels of phytase (0, 500, 750 and 1000 FTU/kg diet) in broiler diets on their growth performance , nutrients digestibility, minerals utilization and economical efficiency . Diets were formulated to be isonitrogenous , being contain 21% and 18% CP during starter and grower periods, respectively . A total number of 240 one-day old Arbor Acres broiler chicks were randomly and equally divided into 8 groups , each in three replicates . The experimental birds were reared under similar managerial and veterinarial conditions and offered feed and water ad libitum up to 42 days of age . At this age , a digestion trial was carried out to study the effect of dietary treatments on nutrients digestibility , blood constituents and tibia analysis*

The obtained data showed that the group of chicks fed high ME diets supplemented with 750 or 1000 FTU/kg recorded heavier live body weight (LBW) and body weight gain (BWG) values than those fed the corresponding low ME diets. However, phytase addition at 750 or 1000 FTU/kg gave similar LBW and BWG values and were higher ($P\leq0.05$) than the control group . Although, the dietary ME combined with phytase additions did not significantly affect the amount of feed intake , however, the group of chicks fed high energy level supplemented with 750 FTU/kg of phytase recorded ($P\leq0.05$) the best feed conversion while those fed the phytase – free low energy diets had recorded the worst value . The interaction between dietary energy level and phytase supplementation significantly affected both ether extract and crude fiber digestibility . In addition, such interaction significantly affected tibia weight and its calcium *content , while tends to decrease (P≥0.05) the activity of alkaline phytase of plasma. As a result to the former findings, the group of chicks fed the high energy diets supplemented with phytase at 750 FTU/kg recorded the lowest feed cost needed to obtain one kilogram of body weight gain compared to the control. Therefore, from the economical and nutritional points of view, it is concluded that phytase addition at 750 FTU/kg to adequate energy diets is more valuable and economical .*

INTRODUCTION

Most of poultry feed ingredients are from plant origin which contains some components that are hardly digested by monogasterics because of the lack of endogenous enzyme secretions . These compounds also decrease the utilization of other dietary nutrients , leading to depress performance . Phytic acid is one of these compounds that may cause various problems due to its mostly presence in cereals , oil seeds and their by-products (Cromwell *et al*., 1993). 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) . As a result , phytase addition to broiler diets can improve body weight and feeutilization

(Waldroup *et al*., 2000 ; Desouky, 2001 ; Lan *et al*., 2002 ; Wu *et al*., 2003 ; Abd El-Hakim and Abd Elsamee,2004 ; El-Ghamry *et al*., 2005 and Ghazalah *et al*., 2006).

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 (Attia *et al*., 2001 ; Shaapan, 2004 and Ramadan, 2005). Studies reported that energy utilization could be improved by phytase addition into broiler diets, that may be attributed to liberation of calcium ions necessary for œ – amylase activity which is involved in starch digestion (Ravindran *et al*., 1999 ; Kies *et al*., 2001 ; Attia, 2003a,b). It has been postulated also that calcium phytate may increase the formation of metallic soaps in the gut lumen , with a corresponding reduction in the utilization of energy from saturated fats(Ravindran *at al*., 2000) .

Due to this confliction and bearing in mind the economic aspects, this study aimed to study the interaction effect of dietary energy and phytase levels in view of broiler performance , nutrients digestibility , blood and tibia analysis .

MATERIALS AND METHODS

This experiment was conducted to study the effect of using two energy levels being high

(HME) and low (LME) , each with four levels of microbial phytase in 2 x 4 factorial arrangement on growth , feed utilization , nutrients digestibility , tibia analysis and economical efficiency of broiler chicks. Energy levels applied were 3100 and 2900 kcal ME/kg during starter (0 – 3 wks) and 3200 and 3000 kcal ME/kg during grower (4 – 6 wks) periods representing high and low energy levels , respectively. Phytase levels supplemented to each energy level were 0 , 500 , 750 and 1000 FTU/kg . Diets were formulated to contain 21 and 18 % crude protein for the starter and grower periods , respectively, being less than the strain recommendation in order to benefit from phytase addition . The composition and calculated analysis of the experimental diets (without phtase supplementation)are presented in Table (1) . Accordingly , a total number of 240 one-day old Arbor Acres broiler chicks were randomly and equally divided into 8 groups , each in three replicates . The experimental birds were reared under similar managerial and veterinarial conditions and offered feed and water *ad libitum* up to 42 days of age . At this age , a digestion trial was carried out to study the effect of dietary treatments on nutrients digestibility , blood constituents and tibia analysis . The criteria of growth performance in terms of live body weight (LBW) and feed intake (FI) were recorded per period in order to calculate body weight gain (BWG) and feed conversion (FC). Digestibilty of nutrients were carried out using individual three birds from each treatment in which feed intake and excreta voided were recorded along 3 days collection period . The collected excreta were sprayed by 2% boric acid solution to prevent any loss in ammonia, then dried in an oven at 60 ^{o}C for 24 hours, thenafter weighed, finely ground and kept for chemical analysis according to AOAC (1990) methods. Fecal nitrogen was determined in dried excreta according to the method of Jakobsen *et al*. (1960). At the end of the experiment, four birds from each treatment were randomly taken , fasted for about 12 hours and slaughtered . Blood samples were taken from the slaughtered birds and plasma was separated by centrifugation at 3000 r.p.m/15 minutes and assigned for subsequent determination of calcium , phosphorus and alkaline phosphatase activity using Sigma procedures No. 586, 360-UV and 104, respectively, Sigma Diagnostics, St. Louis, Mo., USA. The left tibia was also removed, cleaned from all adhering tissues, fat extracted, dried , weighed and then ashed for determination of calcium (Lehman and Henry, 1984) and phosphorus (Tietz, 1986). Finally, the experimental treatments were economically evaluated based upon the price of local market at the year 2008 , in terms of the feed cost needed to obtain one kilogram of live body weight gain as described by Ghazalah *et al*. (2005).

The obtained data were subjected to analysis of variance using the general model of SAS software (SAS,1990) and treatment means were compared using Duncan's new multiple range test (Duncan,1955).

RESULTS AND DISCUSSION

Growth performance :

Data presented in Table (2) indicate the main effects of either dietary energy level or phytase supplementation on growth performance of broilers. At 6 weeks of age, the results cleared that chicks fed HME diets recorded significantly ($P \leq 0.05$) higher live body weight (LBW) and body weight gain values than those fed LME diets . Although, no significant differences were found in feed intake (FI) between chicks fed HME and those given LME diets , however, the former had recorded significantly ($P \leq 0.01$) better feed conversion (FC) than the other group which fed LME diets. Regarding the phytase level, no significant differences were detected in all previous parameters within treatments (Table 2) . Data of the chicken growth performance in terms of LBW, BWG, FI and FC as affected by the interaction between dietary energy level and phytase supplementation are presented in Table (3). The initial LBW for all treatments was nearly similar (about 49 g) which may create a suitable condition to appraise the effect of dietary treatments during the subsequent period. However, at 42 days of age, significant differences ($P \leq 0.05$) had been observed with regard to LBW and BWG values among treatments. Moreover, supplementing broiler diets with microbial phytase either at 750 or 1000 FTU/kg surpassed those groups which fed diets supplemented with microbial phytase at 500 FTU/kg or without phytase supplementation . At 6 weeks of age, the addition of microbial phytase to the HME diets at 500, 750 and 1000 FTU/kg increased LBW by 2.05, 6.35 and 7.77% and BWG by 2.20, 6.51 and 8.02%, respectively, compared to their corresponding control diet without phytase supplementation. While with LME diets, the improve in LBW and BWG at 6 weeks of age amounted to 2.85, 7.83 and 7.26% for LBW and 2.98, 8.09 and 7.5 % for BWG , respectively compared to the control diet .These findings declared the adequacy of phytase addition to broiler diets up to 750 FTU/kg diet.

As was evidenced in Table (3), the interaction between dietary energy and phytase levels did not significantly affect the amount of feed intake, however, the group of chicks fed the HME diets supplemented with 750 FTU/kg recorded ($P \leq 0.01$) the best feed conversion (1.91). In addition, no significant differences in feed conversion values were detected when phytase was supplemented at 1000 FTU/kg either to HME or LME diets , compared to the corresponding control diets, confirming the adequacy of 750 FTU/kg to be used in broiler diets. On the other hand, the worst feed conversion value was obtained by the group of chicks fed the LME diets without phytase supplementation, being 2.1 . 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. Attia *et al*., (2001) found that phytase addition to high energy diets of broilers 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 (Desouky, 2001; Lan *et al*., 2002), release of other minerals affecting feed utilization(El –Deeb *et al*., 2000) and to the increase in nutrients digestibility(Camden,2001) .

It is worthy to note that no mortality due to any of the experimental treatments were observed during the all period of feeding . Therefore, all the experimental chicks were in a good health recording 100% viability.

Nutrients digestibility :

Data of nutrients digestibility of the experimental diets as affected by the interaction between dietary energy and phytase levels are presented in Table (4). It is worthy to note the values of dry matter ratio (dry matter excreta / dry matter fed) were nearly similar and ranged between 0.21 and 0.24 indicating the similarity in feeding value among the dietary treatments. The interaction effect appeared significantly only on ether extract (EE) and crude fiber (CF) 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. Moreover, the positive effect on EE digestibility was in agreement with the findings of Kies and Van Hermert (2000); Attia *et al*., (2001); Lan *et al*., (2002) and 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 periods, respectively.

Blood and Tibia analysis :

The effect of dietary energy and phytase levels on plasma content of calcium , phosphorus and alkaline phosphatase activity at 6 weeks of age are shown in Table(5). Results of plasma calcium and phosphorus content were nearly similar with no significant differences within all the treatments. However, it seems from the data obtained that whatever the dietary energy level (HME or LME) , phytase supplementation tend to decrease significantly the activity of alkaline phosphatase . This can be explained by increasing homeostatic balance between phosphorus and calcium by increasing the absorbed phosphorus in order to elevate plasma phosphorus content , which lead to decrease the activity of alkaline phosphatase in blood. These results are in agreement with the findings of Huff *et al*., (1998) who reported that the decreasing in plasma alkaline phosphatase activity associated with the diets supplemented with microbial phytase might reflect the down regulation of this enzyme resulting from the increasing availability of phosphorus. Similarly, Lan *et al*., (2002) showed that there was no significant effect of using phytase on the average values of plasma calcium , while such addition of phytase may lower the alkaline phosphatase activity.

The effect of interaction between dietary ME and phytase levels on tibia analysis are shown also in Table(5). The obtained data nearly indicated similar values of tibia ash and phosphorus content of tibia among all the dietary treatments. In this respect, Ahmed *et al*., (2000); Lan *et al*., (2002) and El-Medany and El-Afifi (2002) found that phytase supplementation to broiler diets had no effect on tibia ash percent. However, the results showed that when microbial phytase had been added at 750 FTU/kg either to HME or LME broiler diets, both tibia weight and calcium content were significantly increased . This confirmed the effective role of phytase in releasing calcium from phytate complex. In this connection, Viveros *et al*., (2002); Shirley and Edwards (2003); Augspurger and Baker (2004) and Onyango *et al*.,(2004) reported that phytase addition to broiler diets revealed significant increase in tibia ash and minerals content compared to those unsupplemented.

Economical Efficiency :

It is worthy to note that the experimental diets were adjusted to be similar in all nutrients except the ME level. According to guide lines of economical evaluation, the production costs include chicks price, feed cost, medicine and medical care, body weight gain, labor cost, fuel, electricity, depreciation cost for equipments and other miscellaneous items. However, in this study, all the formentioned items are similar per chicl within the different treatments except for the feed cost and the final live body weight that had been affected either positively or negatively by treatments. Therefore, the economical efficiency of the present study could be calculated based mainly upon the total feeding cost and gain in live body weight. Results of the economical evaluation as affected by the dietary treatments are illustrated in Table (6). The group of chicks fed the HME diet supplemented with 750 FTU/kg (T_3) recorded the lowest feed cost needed to obtain one kg of BWG(4.497 L.E), while those fed the LME diet without phytase supplementation (T_5) had gave the worst value(4.912 L.E). Compared to the control group of each energy set, the relative economical value of T_3 (HME + 750FTU/kg) surpassed the other treatments having the HME set. While, the group of chicks of T_7 (LME +750FTU/kg) and T_8 (LME + 1000FTU/kg) surpassed the other treatments of LME set. However, assuming T_1 (HME phytase free) is a general control, the best economical value had been obtained by T_3 (HME + 750 FTU/kg) which is better by 4.0% than the control. However, the all other treatments except T_4 (HME +1000 FTU) gave economically lower values than the control. This means that feeding chicks HME diets with added microbial phytase at 750FTU/kg is more successful in view of growth , feed utilization and economical evaluation of broiler chicks.

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

Ingredients (%)	Starter (0 – 3 weeks)		Grower (4 – 6 weeks)	
Yellow corn	61.66	60.34	68.15	69.09
Soybean meal 44%	24.16	23.00	18.95	24.30
Corn gluten meal 60%	7.80	7.85	5.84	2.00
Vegetable oil	2.01	0.05	2.89	0.59
Wheat bran	0.50	4.90	0.50	0.50
Dicalcium phosphate	1.75	1.75	1.65	1.61
Limestone	1.15	1.13	1.10	1.09
Vit. & Min. mixture[1]	0.30	0.30	0.30	0.30
NaCl	0.35	0.35	0.35	0.35
DL- methionine	0.12	0.12	0.09	0.12
L-lysine HCl	0.20	0.21	0.18	0.05
Total	100	100	100	100
Calculated analysis[2] :				
ME kcal / kg	3100	2900	3200	3000
CP %	21.02	21.12	18.00	18.02
Ca %	0.90	0.90	0.85	0.85
Av. Phos %	0.45	0.45	0.42	0.42
Meth. %	0.49	0.49	0.41	0.42
Meth. + Cyst. %	0.86	0.86	0.74	0.74
Lys. %	1.06	1.06	0.90	0.90

(1) Supplied per kg of diet : Vit.A, 12000 IU; Vit.D_3, 2200IU; Vit.E, 10mg; Vit.K, 2mg; Vit.B_1, 1mg; Vit.B_2, 5mg; Vit.B_6, 1.5mg; Vit.B_{12}, 10µg; Nicotinic acid, 30mg; Folic acid, 1mg; Pantothenic acid, 10mg; Biotin, 50µg; Choline chloride, 250mg; Copper, 10mg; Iron, 30mg; Manganese, 60mg; Zinc, 50mg; Iodine, 1mg; Selenium, 0.1mg and Cobalt, 0.1mg.
(2) According to NRC (1994).

Table (2) : Main effects of dietary energy and phytase supplementation on live body weight (LBW) , body weight gain (BWG) , feed intake (FI) and feed conversion (FC) of broilers.

Item	Age (wk)	Energy level		Sig.	Phytase level (FTU/kg)				Sig.
		HME	LME		0.0	500	750	1000	
LBW	6	2129[a]	2016[b]	*	1988	2037	2129	2138	NS
BWG	0 – 6	2079[a]	1966[b]	*	1938	1987	2079	2088	NS
FI	0 – 6	4069	4056	NS	3944	4045	4106	4157	NS
FC	0 - 6	1.96[b]	2.07[a]	**	2.04	2.04	1.98	1.99	NS

a...b Means within row with different superscripts are significantly different .
* = significant (P≤0.05) ** = significant (P≤0.01) NS = not significant

Table (3): Effect of ME x phytase interaction on live body weight (LBW), body weight gain (BWG), feed intake (FI) and feed conversion (FC,feed /gain) of broilers.

Tr. No.	ME Kcal/kg	Phytase FTU/kg	LBW , g at day old	LBW , g at 6 weeks	BWG , g 0 - 6 weeks	FI , g 0 – 6 weeks	FC 0 – 6 weeks
T_1	HME	zero	49.4 ± 0.03	2046^{b} ± 34.3	1996^{b} ± 34.4	3942 ± 45.6	1.97^{ab} ±0.01
T_2	HME	500	48.8 ± 0.21	2088^{ab} ± 26.1	2040^{ab} ± 26.3	4030 ± 66.6	1.97^{ab} ±0.01
T_3	HME	750	49.3 ± 0.03	2176^{a} ± 80.1	2126^{a} ± 80.1	4068 ± 83.2	1.91^{a} ± 0.03
T_4	HME	1000	49.3 ± 0.20	2205^{a} ± 61.1	2156^{a} ± 61.3	4236 ± 113.7	1.96^{ab} ±0.01
T_5	LME	zero	49.5 ± 0.05	1929^{c} ± 66.1	1879^{c} ± 66.1	3944 ± 95.8	2.10^{c} ± 0.02
T_6	LME	500	49.2 ± 0.21	1984^{bc} ± 41.4	1935^{bc} ± 41.3	4059 ± 79.6	2.09^{c} ± 0.02
T_7	LME	750	49.1 ± 0.20	2080^{ab} ± 95.3	2031^{ab} ± 95.3	4143 ± 115.6	2.04^{bc}± 0.06
T_8	LME	1000	49.3 ± 0.06	2069^{ab} ± 46.7	2020^{ab} ± 46.6	4078 ± 51.7	2.02^{abc}±0.05
Sign.			NS	*	*	NS	**

a ….c : Means within the same column with different superscripts are significantly different ,
* = significant ($P \leq 0.05$) NS = not significant HME : High metabolizable energy
** = significant ($P \leq 0.01$) LME : Low metabolizable energy .

Table (4):Effect of ME x phytase interaction on nutrients digestibility of the experimental diets.

Treat No.	ME Kcal/kg	Phytase FTU/kg	DMR	Digestibility of nutrients (%)				
				CP	EE	CF	NFE	OM
T_1	HME	zero	0.23	73.37	89.67^{a}	18.33^{c}	89.33	83.33
T_2	HME	500	0.21	71.15	90.33^{a}	19.33^{abc}	89.33	82.67
T_3	HME	750	0.24	74.33	89.67^{a}	26.33^{ab}	87.67	82.00
T_4	HME	1000	0.21	69.87	89.00^{ab}	18.33^{bc}	88.33	81.67
T_5	LME	zero	0.23	67.49	82.67^{c}	25.00^{ab}	88.33	80.67
T_6	LME	500	0.21	69.85	83.33^{c}	27.67^{ab}	89.00	82.00
T_7	LME	750	0.22	72.92	81.33^{c}	29.33^{a}	89.33	83.00
T_8	LME	1000	0.21	72.17	85.33^{bc}	25.00^{ab}	90.33	83.00
Sign.			NS	NS	*	*	NS	NS

a ….c : Means in the same column with different superscripts are significantly different ,
NS = not significant * = significant ($P \leq 0.05$)
HME : High metabolizable energy
LME : Low metabolizable energy
DMR : Dry matter ratio CP : Crude protein EE : Ether extract
CF : Crude fiber NFE : Nitrogen free extract OM : Organic matter

Table (5):Effect of ME x phytase interaction on plasma constituents and tibia analysis of the experimental broilers .

Treat No.	ME Kcal/kg	Phytase FTU/kg	Plasma constituents			Tibia analysis		
			Ca (mg/100ml)	P (mg/100ml)	Alk. Phos. (U/L)	Weight (g)	Ash (%)	Ca (%)
T_1	HME	zero	12.69	16.00	3.87^{a}	8.83^{bc}	42.19	39.97^{bc}
T_2	HME	500	13.43	16.99	3.31^{ab}	8.89^{abc}	43.35	40.16^{bc}
T_3	HME	750	13.10	16.52	2.72^{c}	9.12^{a}	44.01	41.97^{a}
T_4	HME	1000	11.23	15.37	2.73^{c}	9.13^{a}	44.02	41.74^{a}
T_5	LME	zero	13.95	14.84	4.09^{a}	8.72^{c}	41.74	39.77^{c}
T_6	LME	500	13.66	16.05	3.01^{b}	8.84^{bc}	42.69	41.14^{ab}
T_7	LME	750	12.44	15.58	2.84^{bc}	9.04^{ab}	43.57	42.09^{a}
T_8	LME	1000	13.30	14.95	2.72^{c}	9.01^{ab}	43.60	41.77^{a}
Sign.			NS	NS	*	*	NS	*

a ….c : Means in the same column with different superscripts are significantly different ,
NS = not significant * = significant ($P \leq 0.05$)
HME : High metabolizable energy
LME : Low metabolizable energy
Ca : Calcium P : Phosphorus Alk. Phos. : Alkaline Phosphatase

Table (6) :Economical evaluation of the experimental treatments (ME x phytase interaction) .

Treat No.	ME Kcal/kg	Phytase FTU/kg	FI / bird Kg / 6 wks	Feed cost L.E / bird	BWG/bird Kg / 6 wks	Feed cost / Kg BWG	Relative feed cost / kg BWG	
T_1	HME	zero	3.942	9.35	1.996	4.680	100[a]	100[aa]
T_2	HME	500	4.030	9.62	2.040	4.720	100.8	100.8
T_3	HME	750	4.068	9.56	2.126	4.497	96.0	96.0
T_4	HME	1000	4.236	9.89	2.156	4.587	98.0	98.0
T_5	LME	zero	3.944	9.23	1.879	4.912	100[b]	104.9
T_6	LME	500	4.059	9.40	1.935	4.858	98.9	103.8
T_7	LME	750	4.143	9.56	2.031	4.707	95.8	100.6
T_8	LME	1000	4.078	9.48	2.020	4.693	95.5	100.3

HME : High metabolizable energy
LME : Low metabolizable energy
FI : Feed intake
BWG: Body weight gain
a : Assuming that T_1 is the control of HME set experimental diets
b : Assuming that T_5 is the control of LME set experimental diets
aa : Considering T_1 as a general control for all the experimental diets

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الملخص العربي

تأثير إستخدام مستويات مختلفة من الطاقة الممثلة وإنزيم الفيتيز الميكروبى على الأداء الإنتاجى لدجاج اللحم و معاملات هضم المركبات الغذائية والإستفادة من العناصر المعدنية

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أجريت تجربة بتصميم إحصائى 2 × 4 لدراسة تأثير إستخدام مستويات مختلفة من الطاقة الممثلة (3100 ، 2900 ك.كالورى / كجم من علائق البادئ) و (3200 ، 3000 ك.كالورى / كجم من علائق النامى) كل مع أربع مستويات من إنزيم الفيتيز الميكروبى (صفر ، 500 ، 750 ، 1000 وحدة إنزيم / كجم عليقة) على الأداء الإنتاجى ، معاملات هضم المركبات الغذائية ، الإستفادة من العناصر المعدنية والكفاءة الإقتصادية لكتاكيت اللحم . تكونت علائق التجربة بحيث تحتوى على 21% ، 18% من البروتين الخام فى مرحلتى البادئ (عمر يوم – 3 أسبوع) والنامى (4 – 6 أسبوع) على الترتيب وهى أقل قليلا من إحتياجات السلالة وذلك للإستفادة من إضافة إنزيم الفيتيز . أستخدم فى التجربة عدد 240 كتكوت أربور إيكرز عمر يوم قسمت عشوائيا وبالتساوى إلى 8 معاملات كل منها فى 3 مكررات . ربيت الكتاكيت تحت نفس ظروف الرعاية مع تقديم الغذاء والماء بصورة حرة حتى عمر 42 يوم . وفى نهاية التجربة أجريت تجربة هضم لدراسة تأثير المعاملات الغذائية على معاملات هضم المركبات الغذائية وبعض مكونات بلازما الدم وتحليل عظمة الساق . تم وزن الكتاكيت والغذاء المستهلك أسبوعيا لحساب الزيادة فى الوزن والكفاءة التحويلية للغذاء .

أظهرت النتائج المتحصل عليها أن الطيور المغذاة على العلائق العالية فى مستوى الطاقة الممثلة مع إضافة إنزيم الفيتيز الميكروبى بمستويات 750 أو 1000 وحدة إنزيم / كجم قد سجلت قيما أعلى لكل من وزن الجسم الحى والزيادة فى وزن الجسم مقارنة بالطيور التى غذيت على العلائق المقابلة المحتوية على مستوى الطاقة المنخفض ، ومع ذلك فقد أعطى الفيتيز بمستويات 750 ، 1000 وحدة إنزيم / كجم قيما متشابهة ولكنها أعلى (غير معنويا) من الكنترول. لم يكن

لمستوى الطاقة الممثلة مصحوبا بإضافة إنزيم الفيتيز أى تأثير معنوى على الغذاء المستهلك ورغم ذلك عندما أضيف الفيتيز الميكروبى بمستوى 750 وحدة إنزيم / كجم من العليقة المحتوية على المستوى العالى من الطاقة الممثلة سجلت الطيور معنويا أفضل كفاءة تحويلية للغذاء ، بينما سجلت اقل كفاءة تحويلية للغذاء بواسطة الطيور المغذاة على العلائق ذات المستوى المنخفض من الطاقة الممثلة بدون إضافة الفيتيز . كان للتداخل بين مستوى الطاقة وإضافة الفيتيز تأثيرا معنويا على معامل هضم كل من الألياف الخام ومستخلص الإثير ، وزن عظمة الساق ومحتواها من الكالسيوم بينما أدى هذا التداخل إلى خفض نشاط إنزيم الفوسفاتيز القلوى فى بلازما الدم . وتبعا للنتائج السابقة فقد سجلت الكتاكيت المغذاة على العلائق المرتفعة فى مستوى الطاقة الممثلة مضافا إليها الفيتيز الميكروبى بمستوى 750 وحدة إنزيم / كجم عليقة أقل تكلفة للغذاء اللازم للحصول على كيلوجرام من الزيادة فى وزن الجسم الحى . و من هذه الدراسة يتضح من الناحية الإقتصادية أنه لا جدوى من إضافة الفيتيز الميكروبى لعلائق كتاكيت التسمين المنخفضة فى محتواها من الطاقة الممثلة ومن الأفضل غذائيا وإقتصاديا إضافة الفيتيز الميكروبى للعلائق المتزنة فى محتواها من الطاقة .