EFFECT OF ENZYME PREPARATION ON PERFORMANCE OF BROILERS FED CORN-SOYBEAN MEAL BASED DIETS

By

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ABSTRACT: *An experiment was conducted to study the effect of adding three enzyme preparations to corn-soybean meal based diets on the performance of broiler chicks. Three commercial enzyme preparations (P_1, P_2 and P_3) were supplemented to experimental diets, at two energy levels: recommended level (control) and Low level. A number of 350 one-day-old 'Hubbard' broiler chicks were fed on 7 experimental diets, for 7 weeks.*

There was no effect ($P>0.05$) of adding enzyme preparations to broiler diets on feed intake allover the experimental period. Average live body weight gain at the end of the experimental period significantly ($P<0.05$) increased by adding enzyme preparations over the control diet. FCR values were better for enzymes treatments than control. Mortality rate and carcass characteristics were not affected by enzymes supplementation.

The data of nutrient digestibility at 49 days of age cleared that adding enzyme preparations improved CP, EE and NFE digestibility, however there were no significant differences among treatments for CF digestibility. Adding enzyme preparations, either over the control diets or with low energy diets significantly ($P<0.05$) increased metabolizability (ME %) values at 49 days of age comparing with control treatment (T_1).

Enzymes supplementations had positive effect on reducing the feed cost/kg BWG as well as the economic efficiency.

It could be concluded that supplementation of enzyme preparations containing amylase, protease, xylanase, lipase and other NSPs degrading enzymes to corn-soybean meal based diets improved broiler performance, besides it allowed a reduction in the energy formulation of the diets. Accordingly, there are two cost-effectively options in enzymes supplementation to broiler diets:

1-over an existing formulation (control) to effectively improves broiler performance.

Or 2-change the feed formulation (reduce dietary energy level) to reduce the cost/ton of feed and though, the addition of enzymes mixture maintains performance similar to the control.

INTRODUCTION

At the end of June 1999, the majority of antibiotic growth promoters used in monogasteric diets were removed within the EU. The consequences of their removal are many.

Feed enzymes are increasingly seen as "environmentally responsible" alternatives to some hormone growth promoters and antibiotics. This is because they currently are seen as "natural products" rather than as chemical additives to providing growth and health benefits (Makled, 1993;Vukic Vranjes and Wenk, 1995 and Sheppy, 2001). All animals use enzymes (produced either by animal itself or by microbes present in the digestive tract) in the digestion of feed. However, the digestive process doesn't reach 100% efficiency. Therefore, supplementation of poultry feeds with enzymes in order to increase the efficiency of digestion can be seen as an extension of animal's own digestive process (Sheppy, 2001).

In many countries, including Egypt, broiler feed is based primarily on corn and soybean meal, which supplies the majority of energy and protein in the diet. The cell wall of the cereals is primarily composed of carbohydrates complexes as non-starch polysaccharides (NSPs). Corn and soybean meal contain NSPs.These NSPs exhibit antinutritional activity that may negatively affect poultry performance (Choct and Annison, 1990). Sheppy (2001) reported that using enzymes in poultry feed increase the availability of starch, proteins and minerals that are enclosed within the fiber-rich cell walls. The beneficial effects of some enzymes for improving the nutrients availability and bird's performance are well established by Bedford and Morgan (1996). They reported that the addition of commercial enzyme preparations containing xylanase, ß-glucanase and side enzymatic activities improved the feed efficiency of maize/ soybean meal diets for poultry. Greenwood *et al.* (2002) reported that supplementing a corn-soybean meal broiler diets with enzyme preparation containing a mixture of protease, amylase and xylanase resulted in improved body weight.

The objective of this study was, therefore, to evaluate the effect of adding some commercial enzyme preparations on the performance of broiler chicks fed corn/soybean meal based diets.

MATERIALS AND METHODS

An experiment was carried out to evaluate the performance of broiler chicks fed diets supplemented with three commercial enzymes preparations:

1-Enzyme preparation-1 (P_1): is a multi enzymes product containing: amylase, xylanase, and protease.

2-Enzyme preparation-2 (P_2): is a multi enzymes product containing protease, lipase, amylase, hemicellulase, cellulase, ß-glucanase, xylanase, α-galactunase, amyloglucanase and pentosanase

3-Enzyme preparation-3 (P_3): is a multi enzymes product containing: cellobio-hydrolases, xylanases, endo-glucanases, ß-glucosidases, laminarinases, xylosidases, arabinofuranosidases and other enzymes such as protease.

A total number of 350 one-day-old unsexed "Hubbard" broiler chicks, nearly have similar live body weight, were used. Chicks were allocated in littered floor poultry pens under same management conditions. Water and feed were offered *ad- libitum* and artificial lighting was provided 24 hrs. daily, allover the experimental period which lasted for 7 weeks. All birds were fed a commercial starter diet from 1-6 days of age. At the 7^{th} day of age, all birds were individually weighed to the nearest gram. The birds were divided into 35 groups of 10 birds each in such a way that the mean weights of all groups were approximately equal.

All bird groups were randomly distributed into 7 experimental treatments (T_1, T_2, T_3….T_7) where each treatment had 5 replicates groups. The experiment was divided into 3 periods: Starter period (from 7 to 18 days of age), Growing period (from 19 to 40 days of age) and finishing period (from 41 to 49 days of age) .Seven experimental diets were formulated. Such experimental diets were fed to seven treatment groups as follows:

Treatment group-1 (T_1): birds were fed the control diets (1) containing "Habbard" nutrients recommendations with dietary energy (ME) levels of 3055, 3100 and 3200 Kcal/ Kg diet, for starting, growing and finishing periods, respectively. These diets were formulated to contain no enzyme preparations.

Treatment group-2 (T_2): birds were fed diets (2), which contained the same nutrients content of control diets (1) without any modification and supplemented with 0.1 % enzyme preparation P_1.

Treatment group-3 (T_3): birds were fed diets (3), which contained the same nutrients content of control diets (1) with lower energy (ME) level by 100 Kcal/Kg diet and supplemented with 0.1% enzyme preparation P_1.

Treatment group-4 (T_4): birds were fed diets (4), which contained the same nutrients content of control diets (1) without any modification and supplemented with 0.1% enzyme preparation P_2.

Treatment group -5 (T_5): birds were fed diets (5), which contained the same nutrients content of control diets (1) with lower energy (ME) level by 100 Kcal/Kg diet and supplemented with 0.1% enzyme preparation P_2.

Treatment group-6 (T_6): birds were fed diets (6), which contained the same nutrients content of control diets (1) without any modification and supplemented with 0.005% enzyme preparation P_3.

Treatment group-7 (T_7): birds were fed diets (7), which contained the same nutrients content of control diets (1) with lower energy level by 50 Kcal/Kg diet and supplemented with 0.005% enzyme preparation P_3.

Tables 1, 2 and 3 illustrated the seven experimental diets used in each period.

Throughout the experimental period, feed intake, body weight gain and calculated feed conversion ratio were recorded at the end of each period, while mortality were recorded daily. At the end of each period, a digestion trial was conducted according to method of Abdel-Hamid (1974) to estimate the nutrients digestion coefficients and energy utilization (ME %) of different experimental diets.

Chemical analysis of the experimental diets and excreta were undertaken according to the methods of A.O.A.C (1990). Fecal nitrogen was determined according to Jakobsen *et al.* (1960).

At the end of experimental period, 3 birds as a random sample, from each replicate were fasted for 12 hrs. , weighed, slaughtered and eviscerated to determine the carcass and giblets weight.

The total feed cost (L.E / bird) at the end of the experiment for each treatment, was calculated depending upon the local market prices of the ingredients used in formulating the experimental diets. Also, the total income (L.E / bird) was calculated depending upon the local market prices of 1 kg live body weight. Economic efficiency was determined by comparing the net revenue (L.E / bird) and the total feed cost, for each experimental treatment. It was calculated as follows:

$$\text{Economic efficiency} = \frac{\text{Net revenue (LE / bird)}}{\text{Total feed cost (LE / bird)}}$$

Data were statistically analyzed using the linear model (SX, 1992). A simple one way classification analysis was used followed by Duncan’s new multiple range test (Duncan, 1955) for testing the significance between means.

RESULTS AND DISCUSSION

Feed intake (FI), body weight gain (BWG) and feed conversion ratio (FCR) values throughout the experimental period are shown in Table (4). Average FI values ranged between 606.9 and 630.2 g/bird (from7-18 days of age), 3165.1 and 3298.4 g/bird (from7-40 days of age) and 4337.5 and 4536.8 g/bird (from7-49 days of age). No significant differences ($P>0.05$) were detected between treatments allover the experimental period. These results indicated that there was no effect of adding enzyme preparations to broiler diets on FI. These results are in agreement with those reported by Ghazalah *et al*. (1994), Vukic Vranjes and Wenk (1995), Miles *et al*. (1996), Marsman *et al*. (1997) and Ouhida *et al*. (2000) who found that enzymes supplementations had no significant effects on feed intake.

Birds fed control diet (T_1) from 7-18 days of age recorded significantly ($P<0.05$) higher value of BWG than T_4 and T_5, while there were no significant differences between T_1 and the other treatments (T_2, T_3, T_6 or T_7). The effect of enzymes supplementation during 19-40 days of age appeared to increase significantly ($P<0.05$) BWG of T_3, T_4, T_6 and T_7. At 49 days old , T_6 recorded higher BWG values (2022 g / bird) than the other treatments, with significant differences ($P<0.05$) compared with control treatment (T_1), T_3 and T_5,while there were no significant differences among T_6, T_2, T_4 and T_7. The data of BWG shows that, adding enzyme preparations from 7-18 days of age didn't add beneficial effect. This could be explained that the effect of enzymes added did not appear in this period because of the short time of treatment. From 7-40 days of age and allover the experimental period, BWG increased significantly ($P<0.05$) by adding enzymes preparations over control treatments diets. It could be observed also that adding enzymes had beneficial effect ($P>0.05$) on chicks fed lower energy diets than control. These results are in agreement with that reported by

Ranad and Rajmane (1992), Zanella *et al*. (1999), Ghazi *et al*. (2002) and Cowieson *et al*. (2003).

Feed conversion ratio (FCR) from 7-18 days of age didn't significantly affected by adding enzymes except for T_4 and T_5, which recorded significantly (P<0.05) the worst values of FCR.. While from 7-40 days of age FCR values were better for enzymes treatments than control. Overall the experimental period, FCR values were also better for enzymes treatments than control and the difference was significant (P<0.05) in T_2, T_4, T_6 and T_7 comparing with control treatment (T_1). This improvement in FCR values, as a result of enzymes supplementation, was reported by Zanella *et al*. (1999) and Mathlouthi *et al*. (2003), who showed a significant improvement in FCR due to enzymes supplementation.

The improvement in BWG and FCR obtained upon feeding the enzymes mixtures may be attributed to the presence of amylase and NSPs degrading enzymes in the enzymes mixtures rather than protease that making the nutrients more available to the bird and improve chick growth performance.

Mortality rate recorded throughout the experimental period (Table 4) ranged between 2% (1 dead bird) and 10% (5 dead birds) with no significant differences between them (P>0.05). These results are in agreement with that found by Vukic Vranjes and Wenk (1995), Tanor and Senel (1996) and Miles *et al*. (1996), who found that the effect of adding enzymes on mortality was not significant.

Dietary treatments had no influence on carcass characteristics; data showed that there were no significant differences between treatments in live body weight (BW), carcass weight and carcass % of BW (Table 5). Giblets weight ranged between 99 and 117.4 (g/bird) for T_6 and T_2, respectively with a significant difference between them, but there were no significant differences between treatments and control. Total edible parts weight ranged between 1573 and 1671 (g/bird) with no significant differences between treatments and also in total edible parts (% of BW). Breast weight ranged between 343 and 312 (g/bird) with no significant difference between treatments. Breast (% of the carcass weight) ranged between 21.0 and 22.5 % with no significant difference between them. These results are in agreement with those of Fayek *et al*. (1990), El-Faham *et al*. (1994) and Ghazalah *et al*. (1994) who found that carcass characteristics were not affected by enzymes addition to the diet.

The digestibility values of dry matter (DM), crude protein (CP), crude fiber (CF) , ether extract (EE) and nitrogen free extract (NFE) % were measured at 18, 41 and 49 days of age. (Tables 6, 7 and 8, respectively).

At 18 days of age (Table 6) the digestibility values ranged between 81.5 and 83 % for organic matter (OM), between 90.5 and 93.2% for CP and between 81.0 and 83.0% for NFE, with no significant differences (P>0.05) between treatments. It appears from Table (6), that CF digestibility ranged between 21.2 and 41.6 % for T1 and T6, respectively. Significant differences (P<0.05) were detected only between T6 and each of T1, T3 and T4. The values of EE digestibility ranged between 73 and 85.7%. Significant differences were detected also between control treatment and each of T3 and T5.

Data of digestibility at 40 days of age (Table 7) had the same trend (P>0.05) regarding the results of OM, CP and NFE digestibility comparing with that recorded in the 1st period (7-18 days of age). Digestibility values of CF improved (P<0.05) with adding enzymes to T2, T4, T5 and T7 comparing with values of T1 and T3. No significant differences (P>0.05) were recorded for EE digestibility values.

Digestibility data at 49 days of age (Table 8) showed that OM digestibility values ranged between 71.5 and 78.0% for T1 and T4, respectively. There were no significant differences (P>0.05) between T1 and the other treatments. Crude protein (CP) digestibility values ranged between 79.5 and 87.5% for T1 and T6, respectively with significant differences (P<0.05) between them. It appeared also from Table (8) that there were significant differences (P<0.05) between T5 and T6 from one side and control treatment (T1) from the other side. It could be concluded from these results that, adding enzyme preparations improved CP digestibility. No significant differences (P>0.05) were detected among treatments for CF digestibility (Table 8). Values of EE digestibility ranged between 63.6 and 83.7% for T1 and T2, respectively with significant differences (P<0.05) between them. The results cleared that adding enzyme preparations improved EE digestibility values. The values of NFE digestibility ranged between 73 and 80 % for T1 and T4, respectively with a significant difference (P<0.05) between them. There were also significant differences (P<0.05) between T4 (80%) and each of T6 (74%) and T7 (72.8%).

No significant differences (P>0.05) were detected among treatments for energy utilization (% ME of energy intake) during starter and grower periods (Tables 6 and 7). While statistical analysis for ME % values at 49 days of age (Table 8) showed that adding enzyme preparations either over the control diet or with low energy diets significantly (P<0.05) increased ME %.

Economics of adding enzyme preparations to corn/soybean meal diets are shown in Table (9). The data showed that enzymes supplementation to broiler diets lowered the feed cost needed to obtain one kg live body weight gain (BWG). The data showed that the highest feed cost/ kg BWG was for control treatment (3.38 LE) with a significant difference with T2 (3.19 LE). All enzymes supplemented diets recorded lower feed cost/Kg BWG relative to control diet. The data showed also that enzymes supplementation to broiler diets resulted in better economic efficiency (Table 9) indicating that enzyme supplementation to broiler diets had positive effect, that from the economic point of view.

The results obtained at the end of this experiment showed that, although there are no statistical differences (P>0.05) between enzymes treatments and control, it was observed that using enzyme preparations P1 and P2 (T2, T3, T4 and T5) led to decrease (P>0.05) feed intake value, while the enzyme preparation P3 led to opposite effect (P>0.05) compared to the control (Table 4). Similar results were observed by Mohamed and Hamza (1991), Ranad and Rajmane (1992) and Ali (1999).

Adding enzyme preparations over the control diets (T2, T4 and T6) seemed to increase BWG at the end of the experimental period (Table 4). Also, treatments T3, T5 and T7 (low energy specifications) maintained the performance with no significant differences with control treatment (T1). These results indicated that adding enzyme preparations improved broilers BWG. These results are in agreement with that found by Zanella et al. (1999) who reported that enzyme supplementation produced a 1.9 % improvement in BWG. They mentioned also that reducing the energy specifications in the diet formulation to account for the advantage of enzymes supplementation did not affect performance.

The improvement of feed utilization as a result of adding enzyme preparations (P1, P2 and P3) either over the control (T2, T4 and T6) or down specification (T3, T5 and T7) reflected on improved FCR comparing with control (T1). The results of Zanella *et al.* (1999) confirmed such findings. They concluded that supplementation of the diets with an enzyme mixture containing amylase, protease and xylanase improved broiler performance and use of this mixture allowed a reduction in the energy formulation of the diets.Mathlouti *et al.* (2003) reported also that the addition of a commercial enzyme preparation containing xylanase, β-glucanase and side enzymatic activities improved the feed efficiency of maize/ soybean meal-based diet. Similar results were obtained by Danicke *et al.* (1999) who found that FCR significantly improved when a multi-enzymes preparation (xylanase, β-glucanase and cellulase) was used in maize-fed birds.

Although corn is considered to be low-viscous grains, an effect of NSPs degrading enzymes in P1, P2 and P3 like xylanase, β-glucanase, glucosidase, and arabinofuranosidase. …etc., in reducing digesta viscosity may be occurred. However, the insoluble components of the NSPs present in corn may be encapsulating nutrients and such could be responsive to exogenous xylanase (Gracia *et al.,* 2003). Pack et al. (1998) explained that the presence of amylase and xylanase are helping to expose the starch more rapidly to small intestine digestion. On the other hand, Odetallah *et al.* (2003) reported that protease enzyme can attack most proteins and will provide more substrates to the enzyme and might allow the liberation of parts of the protein components, making it more available to chicks, which in turn, might be reflected in higher BW.

In the present study, the improvement in CP, EE and NFE digestibility and metabolizability (ME%) with enzymes supplementation at the end of the experiment (Table 8) is in agreement with that reported by Lyons and Jacques (1987),Pack *et al.* (1998), Zanella *et al.* (1999), El-Gendi *et al.* (2000) and Gracia *et al.* (2003). Bedford (1996) reported that diet is known to affect digestive function and the action of the enzyme supplementation may have been to improve overall digestion and reduce endogenous amino acids losses. This improvement in digestibility, in turn, would improve the energy efficiency of digestion, leaving more energy available for growth. Also, Lyons and Jacques (1987) and El-Gendi *et al.* (2000) suggested, also, that effectiveness of enzyme supplementation to the basal diet may be attributed to its effect in increasing the dietary energy bioavailability. However, preliminary reports of trials using the commercial enzymes have demonstrated improvements in digestibility and broiler performance. Brown (1996) summarized findings on starch that is resistant to digestion. Incomplete starch digestion at the ileum was completed in the hindgut, suggesting that some of the starch was indeed resistant. The enzymes mixture may have improve digestion of this fraction. The results of digestibility can explain the effects of enzymes supplementation on enhancing broiler performance.

In this study, it could be concluded that there are two cost-effectively options in enzyme supplementation to broiler diets:

1-over an existing formulation to cost effectively improves broiler performance.

Or 2-change the feed formulation (reduce dietary energy level) to reduce the cost/ton of feed and though, the addition of enzymes mixture maintains performance similar to the control.

Table 1: Composition of the experimental diets used from 7-18 days of age (starter).

Ingredients \ Treatments	T_1 (Control)	T_2	T_3	T_4	T_5	T_6	T_7
Corn	55.80	55.80	57.85	55.80	57.85	55.80	57.00
Soybean meal (44%)	29.40	29.40	29.40	29.40	29.40	29.40	29.13
Corn gluten meal (60%)	8.00	8.00	7.70	8.00	7.70	8.00	8.00
DL-Methionine	0,17	0.17	0.17	0.17	0.17	0.17	0.17
L-Lysine HCl	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Di. Cal. Phosphate	1.95	1.95	1.95	1.95	1.95	1.95	1.95
Soy oil	2.40	2.40	0.64	2.40	0.64	2.40	1.47
Salt	0.43	0.43	0.43	0.43	0.43	0.43	0.43
Limestone	1.25	1.25	1.26	1.25	1.26	1.25	1.25
Premix *	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**
P1 %	-	0.1	0.1	-	-	-	-
P2 %	-	-	-	0.1	0.1	-	-
P3 %	-	-	-	-	-	0.005	0.005
Calculated composition **							
CP%	23.02	23.02	23.01	23.02	23.01	23.02	23.01
ME (K.cal/Kg)	3055	3055	2955	3055	2955	3055	3006
Ca%	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Available phosphorus%	0.50	0.50	0.50	0.50	0.50	0.50	0.5
Methionine%	0.57	0.57	0.57	0.57	0.57	0.57	0.57
Methionine +Cystine	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Lysine%	1.25	1.25	1.25	1.25	1.25	1.25	1.25
Na%	0,185	0,185	0.185	0,185	0.185	0,185	0.185
EE%	4.95	4.95	3.27	4.95	3.27	4.95	4.0 7
CF%	3.39	3.39	3.43	3.39	3.43	3.39	3.40
Threonine	0.83	0.83	0.83	0.83	0.83	0.83	0.83
Tryptophan	0.28	0.28	0.28	0.28	0.28	0.28	0.28

* *Vitamin & Mineral mixture supplied per Kg of diet: Vit A, 12000 I.U; Vit D_3, 3100 I.U; Vit E, 30 mg; Vit K_3, 1.65 mg; Vit B_1, 4.4mg; Vit B_2, 5.5mg; Vit B_6, 3.3mg; Vit B_{12}, 15μg; Niacin, 53 mg; Pantothenic acid, 11 mg; Folic acid, 1 mg; Biotin, 200μg; Choline, 715mg; Copper, 9 mg; Iodine, 1.1mg; Iron, 88 mg; Manganese, 66 mg; Zinc, 40 mg, Cobalt, 0.2mg and Selenium, 0.3 mg.*

*** Calculated based on feed composition Tables of NRC (1994)*

- P1: Enzyme preparation (1). P2: Enzyme preparation (2). P3: Enzyme preparation (3).

Table 2: Composition of the experimental diets used from 19-40 days of age (grower).

Treatments / Ingredients	T_1 (Control)	T_2	T_3	T_4	T_5	T_6	T_7
Corn	60.00	60.00	62.10	60.00	62.10	60.00	61.10
Soybean meal (44%)	29.90	29.90	29.80	29.90	29.80	29.90	29.82
Corn gluten meal (60%)	2.30	2.30	2.08	2.30	2.08	2.30	2.20
DL-Methionine	0.25	0.25	0.25	0.25	0.25	0.25	0.25
L-Lysine HCl	0.19	0.19	0.19	0.19	0.19	0.19	0.19
Di. Cal. Phosphate	1.86	1.86	1.86	1.86	1.86	1.86	1.85
Soy oil	3.58	3.58	1.80	3.58	1.80	3.58	2.67
Salt	0.42	0.42	0.42	0.42	0.42	0.42	0.42
Limestone	1.20	1.20	1.20	1.20	1.20	1.20	1.20
Premix *	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**
P1	-	0.1	0.1	-	-	-	-
P2	-	-	-	0.1	0.1	-	-
P3	-	-	-	-	-	0.005	0.005
Calculated composition **							
CP%	20.01			20.01		20.01	20.00
ME (K.cal/Kg)	3100	20.01	20.01	3100	20.01	3100	3050
Ca%	0.96	3100	3000	0.96	3000	0.96	0.96
Available phosphorus%	0.48	0.96	0.96	0.48	0.96	0.48	0.48
Methionine%	0.58	0.48	0.48	0.58	0.48	0.58	0.58
Methionine +Cystine	0.90	0.58	0.58	0.90	0.58	0.90	0.90
Lysine%	1.13	0.90	0.90	1.13	0.90	1.13	1.13
Na%	0.18	1.13	1.13	0.18	1.13	0.18	0.18
EE%	6.16	0.18	0.18	6.16	0.18	6.16	5.29
CF%	3.44	6.16	4.45	3.44	4.45	3.44	3.46
Threonine	0.73	3.44	3.48	0.73	3.48	0.73	0.73
Tryptophan	0.27	0.73	0.73	0.27	0.73	0.27	0.27
		0.27	0.27		0.27		

* *Vitamin & Mineral mixture supplied per Kg of diet: Vit A, 12000 I.U; Vit D_3, 3100 I.U; Vit E, 30 mg; Vit K_3, 1.65 mg; Vit B_1, 4.4mg; Vit B_2, 5.5mg; Vit B_6, 3.3mg; Vit B_{12}, 15μg; Niacin, 53 mg; Pantothenic acid, 11 mg; Folic acid, 1 mg; Biotin, 200μg; Choline, 715mg; Copper, 9 mg; Iodine, 1.1mg; Iron, 88 mg; Manganese, 66 mg; Zinc, 40 mg, Cobalt, 0.2mg and Selenium, 0.3 mg.*

** *Calculated based on feed composition Tables of NRC (1994)*

- P1: Enzyme preparation (1). P2: Enzyme preparation (2). P3: Enzyme preparation (3).

Table 3: Composition of the experimental diets used from 41-49 days of age (finisher).

Ingredients \ Treatments	T_1 (Control)	T_2	T_3	T_4	T_5	T_6	T_7
Corn	60.85	60.85	63.16	60.85	63.16	60.85	62.00
Soybean meal (44%)	29.90	29.90	29.45	29.90	29.45	29.90	29.64
DL-Methionine	0.22	0.22	0.21	0.22	0.21	0.22	0.21
L-Lysine HCl	0.05	0.05	0.06	0.05	0.06	0.05	0.07
Di. Cal. Phosphate	1.64	1.64	1.64	1.64	1.64	1.64	1.66
Soy oil	5.39	5.39	3.53	5.39	3.53	5.39	4.47
Salt	0.42	0.42	0.42	0.42	0.42	0.42	0.42
Limestone	1.23	1.23	1.23	1.23	1.23	1.23	1.23
Premix *	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**
P1	-	0.1	0.1	-	-	-	-
P2	-	-	-	0.1	0.1	-	-
P3	-	-	-	-	-	0.005	0.005
Calculated composition **							
CP%	18.5	18.5	18.5	18.5	18.5	18.5	18.5
ME (K.cal/Kg)	3200	3200	3100	3200	3100	3200	3150
Ca%	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Available phosphorus%	0.44	0.44	0.44	0.44	0.44	0.44	0.44
Methionine%	0.51	0.50	0.50	0.51	0.50	0.51	0.50
Methionine +Cystine	0.81	0.81	0.81	0.81	0.81	0.81	0.80
Lysine%	1.00	1.00	1.00	1.00	1.00	1.00	1.01
Na%	0.18	0.18	0.18	0.18	0.18	0.18	0.18
EE%	7.94	7.94	6.17	7.94	6.17	7.94	7.06
CF%	3.43	3.43	3.45	3.43	3.45	3.43	3.44
Threonine	0.69	0.69	0.69	0.69	0.69	0.69	0.69
Tryptophan	0.26	0.26	0.26	0.26	0.26	0.26	0.26

* *Vitamin & Mineral mixture supplied per Kg of diet: Vit A, 12000 I.U; Vit D_3, 3100 I.U; Vit E, 30 mg; Vit K_3, 1.65 mg; Vit B_1, 4.4mg; Vit B_2, 5.5mg; Vit B_6, 3.3mg; Vit B_{12}, 15μg; Niacin, 53 mg; Pantothenic acid, 11 mg; Folic acid, 1 mg; Biotin, 200μg; Choline, 715mg; Copper, 9 mg; Iodine, 1.1mg; Iron, 88 mg; Manganese, 66 mg; Zinc, 40 mg, Cobalt, 0.2mg and Selenium, 0.3 mg.*

*** Calculated based on feed composition Tables of NRC (1994)*

- P1: Enzyme preparation (1). P2: Enzyme preparation (2). P3: Enzyme preparation (3).

Table 4: Effect of enzymes supplementation on broiler performance.

Item \ Treatments	T_1 (Control)	P_1		P_2		P_3		SEM*	P**
		T_2	T_3 (low ME)	T_4	T_5 (low ME)	T_6	T_7 (low ME)		
<u>7-18 days</u>									
Feed intake (gm\bird)	630.2^{a}	606.9^{a}	618.9^{a}	623.7^{a}	614.3^{a}	626^{a}	629.8^{a}	11.020	0.721
Body weight gain (gm\bird)	427.1^{a}	411.6^{abc}	408.4^{abc}	398.4^{bc}	392.4^{c}	409.2^{abc}	416.8^{ab}	6.692	0.025
FCR	1.478^{b}	1.473^{b}	1.516^{ab}	1.566^{a}	1.566^{a}	1.531^{ab}	1.511^{ab}	0.0226	0.032
<u>7-40 days</u>									
Feed intake (gm\bird)	3251.7^{a}	3169.1^{a}	3194^{a}	3165.1^{a}	3178.1^{a}	3298.4^{a}	329206^{a}	65.486	0.582
Body weight gain (gm\bird)	1565.1^{c}	1593^{bc}	1627^{ab}	1630.1^{ab}	1551.1^{c}	1653.4^{a}	1676.4^{a}	20.258	0.001
FCR	2.078^{a}	1.992^{ab}	1.963^{ab}	1.943^{b}	2.049^{ab}	1.996^{ab}	1.965^{ab}	0.0428	0.287
<u>7-49 days</u>									
Feed intake (gm\bird)	4472.7^{a}	4340^{a}	4340.6^{a}	4337.5^{a}	4342.4^{a}	4536.8^{a}	4475^{a}	91.301	0.526
Body weight gain (gm\bird)	1907.6^{bcd}	1982.3^{ab}	1890.7^{cd}	1965.1^{abc}	1846.7^{d}	2022.2^{a}	1991^{ab}	26.750	0.0006
FCR	2.387^{a}	2.190^{c}	2.296^{abc}	2.208^{c}	2.351^{ab}	2.244^{bc}	2.247^{bc}	0.0375	0.007
Mortality %	10^{a}	2^{a}	4^{a}	8^{a}	6^{a}	10^{a}	8^{a}	4.840	-

a, b .... means with different superscript(s)in the same row are significantly different ($P < 0.05$).
** Standard error mean for comparison.*
*** Probability.*

Table 5: Effect of enzymes supplementation on carcass characteristics.

Treatments / Item	T_1 (Control)	P_1		P_2		P_3		SEM*	P**
		T_2	T_3 (low ME)	T_4	T_5 (low ME)	T_6	T_7 (low ME)		
Live body weight (gm)***	2152^{a}	2146^{a}	2051^{a}	2091^{a}	2121^{a}	2020^{a}	2083^{a}	50.25	-
Carcass weight (gm)	1557^{a}	1554^{a}	1474^{a}	1540^{a}	1551^{a}	1474^{a}	1524^{a}	44.40	-
Carcass %	72.4^{a}	72.4^{a}	71.8^{a}	73.3^{a}	73.2^{a}	72.8^{a}	73.1^{a}	0.925	-
Giblets weight (gm)	100.7^{ab}	117.4^{a}	104.2^{ab}	107.2^{ab}	118.4^{a}	99.0^{b}	104.8^{ab}	5.692	0.208
Total edible parts weight (gm)	1657.7^{a}	1671.4^{a}	1578.2^{a}	1647.2^{a}	1669.4^{a}	1573.0^{a}	1628.8^{a}	45.67	-
% Total edible parts	76.7^{a}	77.8^{a}	76.8^{a}	79.1^{a}	78.6^{a}	77.8^{a}	78.0^{a}	0.985	-
Breast weight (gm)	334^{a}	313^{a}	343^{a}	340^{a}	341^{a}	312^{a}	320^{a}	17.50	-
% Breast	21.4^{a}	21.5^{a}	22.5^{a}	22.1^{a}	21.1^{a}	21.1^{a}	21.0^{a}	0.8421	-

a, b .... means with different superscript(s)in the same row are significantly different ($P < 0.05$).

** Standard error mean for comparison.*

*** Probability.*

**** Mean of 3 bids (as a random sample).*

Table 6: Effect of enzymes supplementation on nutrients digestibility and energy utilization (ME %) at 18 days of age.

Treatments / Item	T_1 (Control)	P_1		P_2		P_3		SEM*	P**
		T_2	T_3 (low ME)	T_4	T_5 (low ME)	T_6	T_7 (low ME)		
OM %	81.5^{a}	83.2^{a}	82.6^{a}	83.0^{a}	82.4^{a}	83.1^{a}	82.8^{a}	1.357	-
CP %	91.2^{a}	93.2^{a}	92.0^{a}	91.4^{a}	90.5^{a}	91.1^{a}	90.5^{a}	1.100	-
CF %	21.2^{b}	31.3^{ab}	26.7^{b}	25.6^{b}	32.0^{ab}	41.6^{a}	31.2^{ab}	3.676	0.040
EE %	83.0^{a}	85.6^{a}	73.0^{c}	81.4^{ab}	74.7^{bc}	85.7^{a}	78.9^{abc}	2.360	0.010
NFE %	81.0^{a}	82.1^{a}	82.5^{a}	83.0^{a}	82.4^{a}	82.3^{a}	82.9^{a}	1.397	-
ME %	81.9^{a}	84.2^{a}	81.7^{a}	82^{a}	82.7^{a}	84.1^{a}	83.3^{a}	1.381	-

a, b .... means with different superscript(s)in the same row are significantly different (P < 0.05).
** Standard error mean for comparison.*
*** Probability.*

Table 7: Effect of enzymes supplementation on nutrients digestibility and energy utilization (ME %) at 40 days of age.

Treatments / Item	T_1 (Control)	P1		P2		P3		SEM*	P**
		T_2	T_3 (low ME)	T_4	T_5 (low ME)	T_6	T_7 (low ME)		
OM %	75.4 [a]	78.2 [a]	75.5 [a]	75.1 [a]	78.4 [a]	77.4 [a]	78.2 [a]	1.592	-
CP %	88.2 [a]	87.8 [a]	83.9 [a]	88.7 [a]	87.7 [a]	87.8 [a]	90.5 [a]	1.732	-
CF %	19.1 [c]	36.8 [ab]	22.8 [c]	38.5 [ab]	35.0 [ab]	28.3 [bc]	39.1 [a]	3.209	0.002
EE %	79.9 [a]	79.4 [a]	68.0 [a]	75.6 [a]	72.4 [a]	70.5 [a]	69.6 [a]	5.444	-
NFE %	78.5 [a]	78.0 [a]	77.3 [a]	74.2 [a]	78.2 [a]	78.0 [a]	77.7 [a]	1.055	-
ME %	81.3 [a]	80.2 [a]	79.8 [a]	79.9 [a]	81.6 [a]	80.3 [a]	82.4 [a]	0.872	0.321

a, b .... means with different superscript(s)in the same row are significantly different ($P < 0.05$).
** Standard error mean for comparison.*
*** Probability.*

Table 8: Effect of enzymes supplementation on nutrients digestibility and energy utilization (ME %) at 49 days of age.

Treatments / Item	T_1 (Control)	P_1		P_2		P_3		SEM*	P**
		T_2	T_3 (low ME)	T_4	T_5 (low ME)	T_6	T_7 (low ME)		
OM %	71.5 ^{a}	76.5 ^{a}	72.2 ^{a}	78.0 ^{a}	77.2 ^{a}	76.1 ^{a}	72.3 ^{a}	1.913	0.135
CP %	79.5 ^{c}	83.1 ^{abc}	80.8 ^{bc}	83.8 ^{abc}	85.4 ^{ab}	87.5 ^{a}	83.1 ^{abc}	1.422	0.023
CF %	20.2 ^{a}	22.9 ^{a}	23.1 ^{a}	22.0 ^{a}	20.8 ^{a}	20.4 ^{a}	25.1 ^{a}	1.974	-
EE %	63.6 ^{b}	83.7 ^{a}	75.9 ^{ab}	79.4 ^{a}	71.7 ^{ab}	80.8 ^{a}	70.8 ^{ab}	4.343	0.071
NFE %	73.0 ^{c}	77.9 ^{abc}	75.2 ^{abc}	80.0 ^{a}	79.4 ^{ab}	74.0 ^{bc}	72.8 ^{c}	1.422	0.051
ME %	77.5 ^{c}	83.8 ^{a}	81.1 ^{bc}	82.6 ^{ab}	80.9 ^{cd}	79.2 ^{d}	82.6 ^{ab}	0.555	0.0001

a, b .... means with different superscript(s)in the same row are significantly different ($P < 0.05$).

** Standard error mean for comparison.*

***Probability.*

Table 9: Effect of enzymes supplementation on economic efficiency at the end of the experimental period.

Treatments / Item	T_1 (Control)	P_1		P_2		P_3		SEM^1	P^2
		T_2	T_3 (low ME)	T_4	T_5 (low ME)	T_6	T_7 (low ME)		
Feed intake(kg/bird)	4.47^{a}	4.33^{a}	4.33^{a}	4.33^{a}	4.33^{a}	4.53^{a}	4.47^{a}	0.089	-
Total feed cost (L.E/bird)	6.44^{ab}	6.32^{ab}	6.06^{b}	6.41^{ab}	6.11^{b}	6.66^{a}	6.43^{ab}	0.130	-
Body weight gain(kg/bird)	1.907^{bcd}	1.982^{ab}	1.891^{cd}	1.965^{abc}	1.847^{d}	2.022^{a}	1.991^{ab}	0.028	0.001
Feed cost/ 1 kg BWG^3 (L.E)	3.38^{a}	3.19^{b}	3.21^{ab}	3.26^{ab}	3.30^{ab}	3.29^{ab}	3.23^{ab}	0.057	0.3115
Relative feed cost %	100	94.4	95.0	96.4	97.6	97.3	95.6	-	-
Total income (L.E / bird)	7.628	7.928	7.564	7.860	7.388	8.088	7.964	-	-
Net revenue (L.E / bird)[4]	1.188	1.608	1.504	1.450	1.278	1.428	1.538	-	-
Economic Efficiency	0.184	0.254	0.248	0.226	0.209	0.214	0.238	-	-
Relative Economic Efficiency %	100	138.28	134.88	122.94	113.68	116.53	129.35	-	-

a, b ..... means with different superscript(s)in the same row are significantly different ($P < 0.05$).

(1) Standard error mean for comparison.

(2) Probability.

$$\text{(3) Feed cost/ 1kg BWG (L.E)} = \frac{\text{Feed cost (LE/bird)}}{\text{Kg. BWG (7-49days)}}$$

(4) Net revenue (LE / bird) = Total income (L.E / bird) -Total feed cost (LE / bird)

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الملخص العربي

تأثير المستحضرات الإنزيمية على الأداء الإنتاجى لدجاج اللحم المغذى على علائق أساسية من الذرة وكسب فول الصويا

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أجرى هذا البحث بهدف دراسة تأثير إضافة بعض المستحضرات الإنزيمية على أداء دجاج التسمين المغذى على علائق أساسية من الذرة وكسب فول الصويا. تم استخدام ثلاثة مستحضرات إنزيمية تجارية كلا مع مستويين من طاقة العليقة:المستوى الموصى به (المقارنة)، مستوى أقل من الطاقة.استخدم فى التجربة ٣٥٠ كتكوت "هبرد" عمر يوم- تم تغذيتها على ٧ علائق تجريبية.

لم تؤثر إضافة الإنزيمات على معدل استهلاك الغذاء خلال فترة التجربة- بينما أدت إلى زيادة النمو و تحسن معامل التحويل الغذائى عند عمر ٤٩ يوم. ولم تؤثر إضافة الإنزيمات على معدل النفوق وصفات الذبيحة.

Enzyme, Broilers, Performance, Feed Conversion, Digestibility

أدت إضافة المستحضرات الإنزيمية إلى زيادة معاملات هضم البروتين والدهون والكربوهيدرات الذائبة. ولم تؤثر معنويا على معاملات هضم الألياف. بينما تحسن معدل الإستفادة من طاقة الغذاء المأكولة– معنويا– بإضافة الإنزيمات إلى العلائق بغض النظر عن محتواها من الطاقة الفسيولوجية النافعة.

أوضحت النتائج أن إضافة الإنزيمات إلى العلائق الأقل فى الطاقة حسنت الأداء الإنتاجي بدون فروق معنوية مع مجموعة المقارنة. كما أوضحت نتائج الدراسة الاقتصادية أن إضافة المستحضرات الإنزيمية له تأثير إيجابى فى خفض تكلفة العلف/ كجم زيادة فى الوزن، وكذلك على قيم الكفاءة الإقتصادية.

يمكن إستخدام المستحضرات الإنزيمية- التى تحتوى على الأميليز، البروتييز، الزيلينيز، الليبيز والإنزيمات المحللة للسكريات العديدة الغير نشوية المكونة لجدر الخلايا فى علائق دجاج اللحم المتكونة أساسا من الأذرة وكسب فول الصويا لتحسين الأداء الإنتاجى وبصورة إقتصادية، وهكذا يمكن إستخدام هذه المستحضرات الإنزيمية بطريقتين:

١) بالإضافة للعليقة الكنترول وتحسين الأداء الإنتاجى. أو

٢) بالإضافة للعليقة المنخفضة فى مستوى الطاقة وتقليل التكلفة مع الحصول على نفس الأداء الإنتاجى للكنترول.