EFFECT OF ENZYME SUPPLEMENTATION ON PERFORMANCE OF BROILER CHICKS

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ABSTRACT

An experiment was conducted to study the effect of adding a commercial enzyme (Nutrase Xylan) to diets of male broiler chicks on their productive performance. The enzyme is of bacterial origin (*Bacilluis subtilis*) which contains Endo-1,4-β-xylanase combined with α-amylase. The enzyme was added to a balanced corn/soy diet at two levels, (0.05% and 0.1%). The experiment was designed to test two different energy levels against a normal energy requirement (recommended oil addition).

A total number of 150 one-day old male Ross chicks was individually weighed and randomly distributed among five groups of 30 chicks each. The control was fed a starter-grower diet (0-28 day old) which contained 22% CP and 3100 Kcal ME/kg feed, 1.72% oil and a finisher diet (28-42 day old) which contained 19% CP and 3200 Kcal ME/kg feed and 3.51% oil. The control group were fed dites which contained normal energy, 3100 and 3200 Kcal ME for starter/grower and finisher, respectiviley. The Control group compared with four treated groups as follows: En 1/0.05 (3040 and 3060 Kcal ME/ Kg diet) with 0.05% enzyme; En 1/0.10 same as En 1/0.05 but with 0.10% enzyme; En 2/0.05 (2970 and 2920 Kcal)l with 0.05% enzyme and En 2/0.10 same as En 2/0.05 but with 0.10% enzyme.

/The results obtained were as follow:

- No significant difference was found between supplementation of enzyme at 0.05% or 0.1% levels over all the experiment.
- No significant increase in body weight (BW) between the control group and En1 groups in either of starter/grower or finisher: 953g vs. 946g and 945g; 1791g vs. 1764g and 1743g, respectively. No significant differences in BW were found between both En 2 groups overall the experiment.
- Feed intake (FI) showed no significant difference between the control group and En1 treated groups in starting/growing and finishing periods. In addition, in the whole period, no significant difference in FI was found between En2 groups.
- Weight gain (WG) showed no significant difference in starting/ growing and finishing periods between the control group and En1 groups (911g vs. 904 and 903g). No significant difference in WG was found between En2 treated groups through out the experiment.
- The enzyme treated groups containing low energy levels (En 1/0.05 and En 1/0.1) gave similar results of body weight as obtained from the control group (normal energy or recommended oil requirement). However, starter/grower and finisher diets had 1.99% and 4.4% reduction in ME/kg values (DM), respectively.

Key words: **Broilers, feed enzymes, energy restriction, vegetable oil, chick performance**

INTRODUCTION

Poultry feeds depend mostly on plant feed ingredients. Consequently, a considerable quantity of water soluble non-starch polysaccharides (NSPs) exists as the major antinutritional factor in cereals and other plant materials, **(Campbell and Bedford 1992; Bedford 1995; Jaroni *et al* 1999; Zhang *et al* 2000; Zyla *et al* 2000; Zhang *et al* 2001; Benamrouche 2002 and Brenes *et al* 2002).**

Poultry do not digest NSP compounds similarly to other monogastric animals such as pigs and rats,**(Huisman and Tolman 1992 and Jorgensen *et al* 1996)**. Therefore, the proper choice of exogenous enzymes are needed, **(Malathi and Devegowda 2001; Bedford and classen 1992; Alam *et al* 2003 and Yakout *et al* 2003).**

The supplementation of feed enzymes, i.e. xylanase and /or β-glucanase, into the basal diet are able to release the available energy stored in NSPs **(Rotter et al 1990;Salobir 1998;Salobir et al 2000;Kocher *et al* 2000; Mathlouthi *et al* 2002 and Speers 2002).**

The objective of this study was to investigate the efficacy of dietary energy levels as supplemented with **two different levels of a commercial enzyme preparation**, on the performance of male broiler chicks.

MATERIALS AND METHODS

The exogenous enzyme used in the current study is a commercial preparation (Nutrase Xylam) produced from *Bacillus subtilis* containing Endo-1,4-β-xylanase and α-amylase. The feeding program was designed to supplement two levels of this enzyme preparation i.e. at 0.05% and 0.10% of the feed. Two levels of energy were used. i.e. vegetable oil in starter-grower broiler diets was added at the levels of 1.72% and 0.86%, respectively, and in the finisher diets at the levels of 3.51% and 1.755%, respectively.

Total number of 150 one-day old male Ross chicks were obtained from a commercial hatchery and were randomly distributed among five treated groups (each of 30 chicks). Birds were brooded in a washed fumigated brooder house using electric heaters to keep the required temperature during brooding period while light was provided 24 hrs daily throughout the experimental period. The chicks were individually weighed, feed and water were provided ad-libitum.

Control group: Normal energy content

- 3100 Kcal/kgDM for the starter/grower diet
- 3200 Kcal/kg DM for the finisher diet

The control group was fed a starter-grower diet from day-old up to 28 days of age, Table (1), which containing 22% CP and 3100 Kcal ME/kg and 1.72%vegetable oil. After that chicks were fed a finisher diet from 29th day till 42nd day, Table (2), containing 19% CP and 3200 Kcal ME /kg and 3.51% vegetable oil. The control group was compared with the following four treated groups:

Energy 1/0.05:

- 3040 Kcal/kg DM for the starter/grower diet + 0.05% enzyme
- 3060 Kcal/kg DM for the finisher diet + 0.05% enzyme

A starter-grower diet, Table (1), containing 22% CP and 3040 Kcal ME/kg and 0.86% vegetable oil. This quantity of oil represents half of oil for the control group, then chicks were fed a finisher diet, Table (2), containing 19% CP and 3060 Kcal ME/kg, supplemented with 50mg enzyme and 1.755% vegetable oil. This quantity of oil represents half of oil of the control group.

Energy 1/0.1 :

- 3040 Kcal/kg DM for the starter/grower diet + 0.1% enzyme
- 3060 Kcal/kg DM for the finisher + 0.1% enzyme

Energy 2/0.05:

- 2970 Kcal/kg DM for the starter/grower diet + 0.05% enzyme
- 2920 Kcal/kg DM for the finisher diet + 0.05% enzyme

A starter-grower diet, Table (1), containing 22% CP, 2970 Kcal ME/kg, supplemented with 50mg enzyme and no added vegetable oil, then fed a finisher diet, Table (2), containing 19% CP, 2920 Kcal ME/kg feed, supplemented with 50mg enzyme and no added vegetable oil.

Energy 2/0.1 :

- 2970 Kcal/kg DM for the starter/grower diet + 0.1% enzyme
- 2920 Kcal/kg DM for the finisher diet + 0.1% enzyme

The same diet like Energy 2/0.05 but supplemented with 100mg enzyme preparation.

The chicks were weighed individually on 28th and 42nd day of age. Feed intake was recorded throughout the periods on a group basis. The feed conversion ratio (unit feed/unit gain) was calculated.

The data were statistically analysed using the general linear model for analysis of variance **(SAS Institute, 1990)**. Significant differences among treatments means were separated by Duncan's new multiple range test **(Duncan, 1955)**.

Table (1): Composition of experimental diets for broilers from 0-28 days of age (starter-grower period).

Ingredients, %	Control	En1/ 0.05	En1/0.1	En 2/0.05	En 2/0.1
Yellow corn	62.68	62.68	62.68	62.68	62.68
Soybean meal	25.50	25.50	25.50	25.50	25.50
Corn gluten meal	6.00	6.00	6.00	6.00	6.00
Di-Ca-ph	2.05	2.05	2.05	2.05	2.05
Limestone	0.68	0.68	0.68	0.68	0.68
Vit&Min.mixture *	0.40	0.40	0.40	0.40	0.40
Salt	0.30	0.30	0.30	0.30	0.30
L-lysine HCl	0.44	0.44	0.44	0.44	0.44
DL-methionine	0.23	0.23	0.23	0.23	0.23
Vegetable oil	1.72	0.86	0.86	000	000
Sawdust	000	0.81	0.76	1.67	1.62
Enzyme	000	0.05	0.10	0.05	0.10
Total	100.00	100.00	100.00	100.00	100.00
Calculated values:					
CP	22.00	22.00	22.00	22.00	22.00
ME (kcal/kg)	3100	3040	3040	2970	2970
Ca	0.97	0.97	0.97	0.97	0.97
Avail. P	0.50	0.50	0.50	0.50	0.50
Methionine	0.52	0.52	0.52	0.52	0.52
Meth+Cys	0.94	0.94	0.94	0.94	0.94
Lysine	1.30	1.30	1.30	1.30	1.30

* Vitamin-mineral mixture supplied per kg of diet:Vit A=12000 IU;Vit D3= 2000 IU; Vit E=10mg;Vit K3=2mg;VitB1=1mg;VitB2-5mg;B6=1.5mg;VitB12=10µg; Biotin=50µg;Choline chloride=500mg;Pantothenic acid=10mg;Niacin=30mg;Folic acid=1mg;Manganese=60mg;zinc=50mg;Iron=30mg;Copper=10mg;Iodine=1mg;Selenium=0.1 mg and Cobalt=0.1mg.

Table (2): Composition of the experimental diets for broilers from 28-42 days of age (Finisher period).

Ingredient, %	Control	En 1/0.05	En 1/0.1	En 2/0.05	En 2/0.1
Yellow corn	67.997	67.997	67.997	67.997	67.997
Soybean meal	20.800	20.800	20.800	20.800	20.800
Corn gluten meal	4.00	4.00	4.00	4.00	4.00
Di-Ca-Ph	1.73	1.73	1.73	1.73	1.73
Lime stone	0.57	0.57	0.57	0.57	0.57
Vit&Min.mixture	0.4	0.4	0.4	0.4	0.4
Salt	0.3	0.3	0.3	0.3	0.3
L-lysine HCl	0.454	0.454	0.454	0.454	0.454
Dl-methionine	0.239	0.239	0.239	0.239	0.239
Vegetable oil	3.51	1.755	1.755	000	000
Sawdust	000	1.705	1.655	3.46	3.41
Enzyme	000	0.05	0.10	0.05	0.10
Total	100.00	100.00	100.00	100.00	100.00
Calculated values:					
CP	19.00	19.00	19.00	19.00	19.00
ME (kcal/kg)	3200	3060	3060	2920	2920
Calcium	0.85	0.85	0.85	0.85	0.85
Avail.P	0.44	0.44	0.44	0.44	0.44
Methinine	0.47	0.47	0.47	0.47	0.47
Meth+Cys	0.85	0.85	0.85	0.85	0.85
Lysine	1.13	1.13	1.13	1.13	1.13

* Vitamin-mineral mixture supplied per kg of diet:Vit A=12000 IU;Vit D3= 2000 IU; Vit E=10mg;Vit K3=2mg;VitB1=1mg;VitB2-5mg;B6=1.5mg;VitB12=10µg; Biotin=50µg;Choline chloride=500mg;Pantothenic acid=10mg;Niacin=30mg;Folic acid=1mg;Manganese=60mg; Zinc=50mg;Iron=30mg;Copper=10mg;Iodine=1mg;Selenium=0.1mg and Cobalt=0.1mg.

RESULTS AND DISCUSSION

The effects of feeding enzyme on broiler performance during starter-grower (0-28 days), finisher (29-42 days) and the whole period (0-42 days) are shown in Tables 3-5.

At the **starting-growing period**, from the beginning of the trial up to 28 days of age, the performance results are summarized in Table (3):

Table (3): The effect of enzyme supplementation on broiler performance during the starting-growing period.

Treatment	Body Weight (g)	Feed Intake (g)	Weight Gain (g)	Feed Conversion
Control	953^{a}	1514^{a}	911^{a}	1.66^{b}
En 1/0.05	946^{a}	1605^{a}	904^{a}	1.77^{ab}
En 1/0.10	945^{a}	1582^{a}	903^{a}	1.75^{ab}
En 2/0.05	893^{ab}	1568^{a}	851^{ab}	1.84^{a}
En 2/0.10	861^{b}	1505^{a}	819^{b}	1.84^{a}

a-c means in the same column with different letters are significantly different ($p \leq 0.05$).

Body weight (BW): No significant increase in BW was found between the control group (953g) and each of En1/0.05 (946g), En1/0.1 (945g) and En2/0.05 (893g), while there was a significant decrease in BW between the control group (953g) En1/0.05 (946g), En1/0.1 (945g) and En2/0.1 (861g). However, no significant difference between En/0.05 and En/0.1 was found ($p \leq 0.05$).

Feed intake (FI): No significant difference in FI was found between the control group and any of the treated groups ($p \leq 0.05$).

Weight gain (WG): No significant increase in WG was found between control group (911g) and either of the following groups: En1/0.05 (904g), En1/0.10 (903g) and En2/0.05(851g). But a significant decrease was found in WG between the control (911g), En1/0.05 (904g), En1/0.10 (903g) and those fed En 2/0.1, which scored the lowest value, (819g). However, no significant difference between chicks fed En2/0.05 diet and those fed En2/0.10 diet was found ($p \leq 0.05$).

Feed conversion (FC): No significant difference in FC was found between chicks fed the control (1.66) and each of groups fed the En 1/0.05 diet (1.77) or En1/0.10 (1.75).On the other hand, there was significant difference ($P \leq 0.05$) between FC of the control group and chicks fed EN2/0.05 or 0.10 diets. However, no significant difference in FC was found between chicks fed the En2/0.05 diet and those fed the En2/0.10 diet ($p \leq 0.05$).

Birds of all groups were switched to **a finisher diet** (19%CP and 3200 Kcal ME/kg) from 29 to 42 days of age. The results are found in Table (4).

Table (4): The effect of enzyme supplementation on broiler performance during the finisher period.

Treatment	Body weight (g)	Feed intake (g)	Weight gain (g)	Feed conversion
Control	1791[a]	1695[a]	837[a]	2.03[b]
En 1/0.05	1764[a]	1679[a]	818[a]	2.05[b]
En 1/0.1	1743[a]	1648[a]	798[ab]	2.06[b]
En 2/0.05	1622[b]	1671[a]	729[bc]	2.29[a]
En 2/0.1	1564[b]	1606[a]	703[bc]	2.28[a]

a-c means in the same column with different letters are significantly different ($P \leq 0.05$).

Body weight (BW): No significant difference in BW was found between the control group and each of En1/0.05 or En1/0.10 groups. However, significant differences in BW were found between the control, En1/0.05, En1/0.10 groups and either of En2/0.05 and En2/0.10. fed groups. But no significant difference in BW was found between En 2/0.05 and En2/0.10 groups ($p<0.05$).

Feed intake (FI): No significant difference in FI was found between the control group and any of the other groups ($p<0.05$).

Weight gain (WG): No significant difference in WG was found between the control group (837g) and either of En1/0.05 or En1/0.1 group ($p \leq 0.05$). But a significant difference in WG was found between the control, En1/0.05, En1/0.1 and both En2 groups. However, no significant difference in WG was found among both of En2 groups ($p \leq 0.05$).

Feed conversion (FC): No significant difference in FC was found between the control group (2.03) and both En1 treated groups. But a significant difference in FC was found between the control, En1/0.05, En1/0.1 (2.03) and

both En2 treated groups. However, no significant difference in FC was found between both En2 treated groups ($p \leq 0.05$).

Concering the **whole period (** 0-42 days of age), the results are found in Table (5).

Table (5): The effect of enzyme supplementation on broiler performance during the whole period.

Treatment	Body weight (g)	Feed intake (g)	Weight gain (g)	Feed Conversion
Control	1791a	3209a	1749a	1.84bc
En 1/0.05	1764a	3283a	1722a	1.91b
En 1/0.1	1643a	3229a	1701a	1.90b
En 2/0.05	1522b	3239a	1580b	2.05a
En 2/0.1	1570b	3111a	1522b	2.04a

a-c means in the same column with different letters are significantly different ($p \leq 0.05$).

In general, within each energy level, no significant difference was found between groups either supplemented with 0.05% or 0.1% enzyme in body weight, feed intake, weight gain and feed conversion.

The present results clarified that, the supplementation of such enzyme at 0.05% or 0.10% gave similar results by the diet containing normal or restricted energy levels, i.e. the enzyme-treated groups containing a low dietary oil level (En 1/0.05or En 1/0.1) gave similar body weight values as obtained from the control group (normal energy requirement). Whereas, starter/grower and finisher diets had 1.94% (from 3100 Kcal to 3040 Kcal) and 4.38% (from 3200 Kcal to 3060 Kcal) reduction of ME/kg (DM), respectively.

This energy restriction was done by the reduction of oil addition in the formulas, i.e. half oil requirement (En 1/0.05 and En 1/0,1) and no addition of oil at all (En 2/0.05 and En 2/0.1).

Attamangkune *et al* (2003) found that the supplementation of a commercial enzyme by the reduction of 2.5%of 3100 Kcal ME/kg, 5% of 3150 Kcal ME/kg and 7.5% of 3200 Kcal ME/kg during starting, growing and finishing periods, respectively, had no detereminal effects as compared with the control diet containing 3100 Kcal ME/kg diet.

Elliot (2002) evaluated a commercial enzyme mixture (Amylase- Xylanase-protease) and concluded that the mixture appeared to be effective in liberating energy with corn/soybean meal diet.

Mathlouthi *et al* (2002) found a significant difference between hens fed basal diet those fed and the treated diet with xylanase in egg mass, feed intake, feed conversion and change in body weight. In addition, with wheat and barley, they gave similar trend to the present results where, the addition of 1400 IU xylanase Kg-1 to low-energy diet values by 5.2% and 2.44% for wheat and barley, respectively.

Kidd *et al* (2001) fed a corn/Soya diet supplemented with enzymes to broilers chicks and found a significant reduction in feed conversion and mortality rate.

From the above mentioned results, it may be concluded that:

- No more than 0.05% from the mixture of Endo-1,4-β-xylanase and α-amylase should be added to the corn/soya diet.

- Similar body weight values obtained from restricted-energy diet by supplementation of enzyme without deleterious effect on performance as compared with the control diet.
- The supplementation of the target enzyme may reduce the dietary oil addition up to half its quantity.
- The reduction of oil in the diets may reduce the load of storing, mixing and rancidity of oils.

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تأثير إضافة الإنزيم على الكفاءة الإنتاجية لكتاكيت اللحم

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المعمل المركزى للأغذية والأعلاف – مركز البحوث الزراعية – الجيزة – جمهورية مصر العربية

أجريت تجربة لدراسة تأثير مستحضر إنزيم تجاري من أصل بكتيري (باسلس سبتيلس) يحتوي على إندو ١ ، ٤ بيتا إكسلنيز وألفا أميليز، تم إضافة مخلوط الإنزيمات إلى عليقة متزنة من الذرة والصويا بمستوين ٠.٠٥ %، ٠.١% صممت التجربة لإختبار مستويين من الطاقة ترجع إلى إختزال في كمية الزيت النباتي المضاف مقارنة مع مستوى الطاقة الموصي به وذلك لإستخدام كمية الزيت النباتي المعتاد إضافتها٠

تم توزيع ١٥٠ كتاكيت روس ذكور سن يوم على ٥ مجاميع وتم مقارنة مجموعة كنترول مع أربع مجاميع معاملة بالإنزيم٠ مجموعة الكنترول غذيت في فترة بادئ/نامي لمدة ٢٨ يوم عليقة تحتوي على ٢٢% بروتين و ٣١٠٠ كيلو كالوري/كجم غذاء طاقة تمثيلية وتحتوي على ١.٧٢% زيت نباتي لتعطي مستوى طاقة طبيعي وفي فترة ناهي (٢٩ – ٤٢ يوم) غذيت على عليقة تحتوي على ١٩% بروتين و ٣٢٠٠ كيلو كالوري/كجم غذاء طاقة تمثيلية وتحتوي على ٣.٥١% زيت نباتي لتعطي مستوى طاقة طبيعي٠ قورنت مجموعة الكنترول بأربعة مجاميع هي: مجموعة مستوى الطاقة (١) بها ٣٠٤٠، ٣٠٦٠ كيلو كالوري بادئ/نامي وناهي على التوالي وتحتوي على ٠.٠٥% إنزيمات ومجموعة أخرى كالسابقة وتحتوي على ٠.١% إنزيمات ومجموعة مستوى طاقة (٢) بها ٢٩٧٠ و٢٩٢٠ كيلو كالوري بادئ/نامي وناهي على التوالي وتحتوي إما على ٠.٠٥% أو ٠.١% إنزيمات٠ أظهرت النتائج عدم وجود إختلافات معنويه بين إستخدام الإنزيمات بمستوى ٠.٠٥% أو ٠.١% على طول التجربة٠ لا توجد إختلافات معنوية بين مجموعة الكنترول ومجموعة مستوى الطاقة (١) في الوزن الحي في كلا فترتي التجربة ولا إختلافات معنوية في الوزن الحي في كلا مستوى الثاني على طول التجربة٠ أظهرت كمية الغذاء المأكول عدم وجود إختلافات معنوية بين مجموعة الكنترول وباقي المجاميع المعاملة في بادئ/نامي وناهي أو فترة التجربة كلها. وأظهرت نتائج الزيادة الوزنية عدم وجود إختلافات معنوية بين مجموعة الكنترول ومجموعتي الطاقة (١) خلال التجربة٠ المجاميع المعاملة بالإنزيمات ٠.١% والتي تحتوي على مستوى طاقة أقل (١) أعطت نتائج مماثلة في وزن الجسم مع مجموعة الكنترول (التي تحتوي على مستوى طاقة طبيعي) ومع ذلك فهذه المجاميع قد إحتوت على طاقة أقل بمقدار ١.٩٩% و ٤.٤% ل باديء/نامي وناهي على التوالي. توصي النتائج المتحصل عليها بإستخدام مخلوط الإنزيمات بمستوى ٠.٠٥%.