Annals of Agric. Sci., Moshtohor **ISSN 1110-0419**
Vol. 59(2) (2021), XXX – XXX **https://assjm.journals.ekb.eg**

Response of Broiler Chicks to Low-Energy Diet Supplemented With Lecithin or Xylanase Enzyme

Zangabel S.M. El-sayed[1], Amira M. Refaie[2], G.A. El-sayaad[1] and M.M. Abdella[1]
1-Animal Production Department, Faculty of Agriculture, Banha University, Egypt
2-Animal Production Research Institute – Agriculture Research Center – Dokki – Giza – Egypt
Corresponding author: Zangabel_saad@yahoo.com

Abstract

Two experiments were conducted to study the effect of adding soy-lecithin or xylanase to low-energy diet on broilers growth performance, nutrient digestibility, intestinal lipase enzyme activity and economical efficiency. A total number of 256 unsexed Cobb500 broiler chicks, a day old, were classified into two equal experiments, 128 chicks each (4 treatments × 4 replicates × 8chicks). In each experiment, chicks were divided into 4 groups as follows: - the 1st group fed basal diet and served as control which fed recommended energy diet, the 2nd group fed diet low (100 Kcal / kg diet) than recommendation (LED), the 3rd and 4th groups were fed 2nd diet added with 0.5g lecithin / kg diet or 1.0g lecithin / kg diet, respectively (EXP.1). While, chicks were fed 2nd diet supplemented with 0.1g xylanase / kg diet or 0.2g xylanase / kg diet, respectively (EXP.2). The growth trail was lasted at 35 days of age. The results revealed that, groups of LED + 0.5g lecithin (EXP.1) and LED + 0.2g xylanase (EXP.2) recorded significantly higher BWG and better FCR during overall period than control and LED groups. In both experiments, there is a gradual increase in EE% digestibility coefficient, intestinal lipase activity and economical efficiency by increasing the addition level of either soy-lecithin or xylanase.

It could be concluded that enriching low-energy diet with either 0.5g lecithin / kg diet or 0.2g xylanase / kg diet can improve broilers growth performance, intestinal lipase activity and enhanced economical net profit.

Keywords: low energy diet, broiler chicks, lecithin, xylanase, lipase.

Introduction

Birds require feed for body maintenance, growth, production and reproduction. Genetically any strain of birds may possess higher productive potentiality but until and unless optimum nutrition is offered this potentiality will never be expressed. Oils are important components of broiler ration since they are the richest source of metabolizable energy, essential fatty acids and fat soluble vitamins **(Hossain and Das, 2014)**. Studies on adding oil to the poultry diets started in the 1950s and the latest studies showed that up to 7% oil could be added to the broiler rations successfully **(Cullision and Lowrey, 1987).**

It is well documented that the physiological ability for fat utilization is poorly developed in young birds **(Hertramf, 2001)** and a marked improvement of the apparent metabolizable energy value of fats has been reported after 10 days of age **(Wiseman and Salvador, 1989).**

Crude soy-lecithin is the main phospholipid of crude soybean oil, which is an alternative in the formulation of rations as a source of energy, phosphorus and choline **(Menten *et al.*, 1997)**, it also acts as a source of polyunsaturated fatty acids **Evans (1935). Huang *et al.* (2007)** and **Dubey (2009)** reported that broilers fed diets supplemented with different levels of soybean lecithin achieved significantly higher growth performance and nutrient digestibility coefficients comparing to control group.

Adding non-starch polysaccharides -degrading enzymes such xylanase in poultry diets has increased considerably in recent years. Birds do not produce enzymes like xylanase, which is required for the digestion of NSPs **(Horvatovic *et al.*, 2015).** Supplementation of NSPs degrading enzymes may not only reduce the anti-nutritive effects of NSPs, but also releases some nutrients from these, which could be utilized by the birds **(Balamurugan and Chandrasekaran, 2009).**

Also, xylasnase enzyme has been reported to improve energy utilization and the performance of broilers **(Cowieson, 2010 ; Williams *et al.*, 2014)** by hydrolysis of cell wall arabinoxylans and improve the access of endogenous digestive enzymes to cell contents **(Francesch and Geraert 2009)**.

Luo *et al.* (2009) who found that broilers fed different levels of xylasase had numerically higher body weight gain at different periods (1-21d, 22-42d ; 1-42d) compared to control group. Moreover, **Wu and Ravindran (2004)** reported that broilers fed wheat diet supplemented with xylanase (1000XUkg−1 diet) had a significant ($P < 0.01$) increase in FI and improve in FCR compared to groups fed diets without enzyme supplementation. In addition to, **Saleh *et al.* (2019)** reported that supplementation of Xylanase and Arabinofuranosidase enzymes (Rovabio® Advance) to broiler chicks fed low energy diet had significantly ($P<0.05$) improved nutrient digestibility coefficient compared to control group.

The aim of the present study was to improve the utilization of energy as well as enhancing growth performance and lipase enzyme activity by adding two feed additives (soy lecithin ; xylanase enzyme) in broilers fed low-energy diet.

Materials and Methods

This study was conducted at the Poultry Research Farm of Animal Production Department, Faculty of Agriculture at Moshtohor, Benha University.

Additives used in this study:-

1- Crude soy lecithin.

It is a commercial source of soy lecithin 100% which contains:-

Acetone insoluble Matter 62%, Acid value 30%, Peroxide value 3% and hexane insoluble Matter 0.3%. The recommended level for poultry is 500g – 1 kg / ton of finished feed.

2- Xylanase enzyme.

The activity until of xylanase is 20000 u / g. This enzyme produced by *Trichoderma reesei* and *Asperigullus niger*, it's media is mineral oil 0.5g, rice hulls 44.5g and calcium carbonate 35g. The recommended level for poultry is 100g – 200g / ton of finished feed.

Birds and experimental diets

A total number of 256, day-old unsexed Cobb 500 broiler chicks were divided equally into two experiments, each has 4 groups of 32 chicks in 4-replications, 8 chicks each. The four groups were as follows: the first group (control), received the strain recommended of metabolizable energy (3000, 3000 and 3100 Kcal / kg diet during starter (1-10 d), grower (11-22 d) and finisher (23-35 d), respectively), while the second group was fed low energy diet (LED), less 100 Kcal / kg diet than the previous recommendation levels being 2900, 2900 and 3000 Kcal / kg diet during the same growth periods, and the third and fourth groups for each experiment received LED diet and supplemented with 0.5 g / kg diet and 1.0 g / kg diet lecithin, respectively for EXP.1 while 0.1 g / kg diet and 0.2 g / kg diet xylanase, respectively for EXP.2. The experimental period lasted for 35 days of age. Chicks were fed corn-soybean based diet. All diets were formulated to meet the nutrients of Cobb 500 broilers (Table, 1). Feed and water provided *ad libitum*. All chicks were housed in floor pens and kept under the same management, hygienic environmental conditions. They vaccinated against common diseases. Live body weight (LBW) and feed intake (FI) were recorded individually at start and end of each growth period, then weight gain (BWG) and feed conversion ratio (FCR) were calculated.

Table 1. Composition and calculated values of experimental diets.

	Control diets			**-100kcal**		
	Starter 1-10d	**Grower 11-22d**	**Finisher 23- 35d**	**Starter 1-10d**	**Grower 11-22d**	**Finisher 23- 35d**
Yellow corn	53.60	56.80	62.75	55.00	59.20	65.20
Soybean meal (44%)	32.75	33.20	25.55	34.00	32.85	25.40
Corn gluten (60%)	7.00	3.00	4.55	6.00	3.00	4.25
DI-Calcium phosphate	1.90	1.90	1.90	1.90	1.90	1.90
Limestone	1.30	1.30	1.30	1.30	1.30	1.30
Soya oil crude	2.50	2.85	3.00	0.85	0.80	1.00
NaCl	0.30	0.30	0.30	0.30	0.30	0.30
Vitamins and minerals mix *	0.30	0.30	0.30	0.30	0.30	0.30
DL-Methionine	0.15	0.15	0.15	0.15	0.15	0.15
L-lysine HCL	0.10	0.10	0.10	0.10	0.10	0.10
Sodium bicarbonate	0.10	0.10	0.10	0.10	0.10	0.10
Total	100	100	100	100	100	100
Calculated analysis **						
Crude protein %	23.1	21.0	19.1	23.1	21.1	19.0
Metabolizable energy (Kcal / kg)	3003	3002	3100	2902	2903	3001
Crude Fiber %	3.76	3.79	3.40	3.87	3.82	3.44
Crude Fat %	5.18	5.57	5.87	3.58	3.61	3.95
Calcium %	1.01	1.01	0.99	1.02	1.01	0.990
Available phosphorus %	0.51	0.51	0.49	0.51	0.51	0.50
Lysine %	1.24	1.23	1.01	1.27	1.22	1.03
Methionine %	0.59	0.53	0.52	0.58	0.53	0.51
Meth + Cyc. %	0.97	0.87	0.84	0.96	0.88	0.83
Sodium %	0.16	0.16	0.16	0.16	0.16	0.16

* Each 3kg of vitamins and minerals contains: Vitamin A 12,000,000 IU, Vitamin D3 5,000,000 IU, Vitamin E 80,000 mg, Vitamin K3 3000 mg, Vitamin B1 3000 mg, Vitamin B2 9000 mg, Vitamin B6 4000 mg, Vitamin B12 20 mg, Niacin 60,000 mg, Biotin 150 mg, Folic acid 2000 mg, Pantothenic acid 15,000 mg, Choline 500,000 mg, Manganese 100,000 mg, Zinc 100,000 mg, Iron 40,000 mg, Copper 15,000 mg, Iodine 1000 mg, Selenium 350 mg, and Cobalt 100 mg.

** According to **NRC (1994)**

Digestibility trails technique.

At the end of finisher period, a total number of 16 Cobb broiler chicks from each experiment (EXP.1; EXP.2) were individually used for conducting the digestibility trails. Chicks placed in an individual metabolism cages provided by diet and fresh water *ad libitum*, and enabled complete separation and collection of excreta, after collecting the excreta, spraying with 1% boric acid to prevent any loss in ammonia, then dried at 60°c for 24 hrs. Diets and dried excreta were analyzed according to **AOAC (1990)** for dry matter (DM), crude protein (CP), ether extract (EE), crude fiber (CF), organic matter (OM) and nitrogen free extract (NFE).

3.12. Lipase enzyme assay:-

Four samples per group for each experiment, being total 16 samples for each experiment, were taken from small intestine. Digesta were collected from the distal end of the duodenum to the ileo-caecal junction. A homogenous intestinal digesta sample was collected by massaging the tract from both ends. The digesta samples were stored immediately at -20°c until used. Lipase activity was determined using the turbidimetric method of **Verduin *et al.* (1973)** and one lipase unit is defined as the amount of enzyme that hydrolyses 1 µmol of olive oil per minute.

3.14. Economical Efficiency.

To determine the economical efficiency (EEf) for meat production, the price of experimental diets was calculated according to the price of the used ingredients of the local market at the time of the study. Accordingly, the cost of feed consumed of each treatment was easily calculated. The live body weight (kg) from each treatment at the end of the experimental period was multiplied by 25 LE, which represents the price table of live body weight in local market at present. The economical efficiency was calculated as described by **Bayoumi (1980)** as the net revenue per unit of feed cost.

Statistical Analysis:

Data were statistically analyzed using ANOVA procedures of SAS **(SAS, 2004),** and significant differences between means was determined using Duncan's New Multiple-Rang test **(Duncan, 1955)** for all of experimental treatments**.**

The statistical model used for both trials was:-

$X_{ij} = \mu + T_i + e_{ij}$

Whereas:

X_{ij} = the observations

μ = the overall mean

T_i = the effect of treatments, (i = 1,2,3 and 4)

e_{ij} = experimental error

Results and Discussion

Growth performance

Live body weight and body weight gain

Results of average LBW of broiler chicks as affected by feeding diets supplied with different levels of soy-lecithin (EXP.1) and xylanase (EXP.2) are presented in Table (2). In the first experiment, it is worthy to note that chicks fed LED + 0.5 g lecithin recorded significantly higher LBW comparing to control and LED diet during all growth periods except at finisher period, which the former group did not show any significant differences to LED groups. The same trend was observed in BWG (EXP.1). These results are in agreement with **Mahmoudi *et al.* (2015)** who found that broilers fed diet contained soy-lecithin at different levels had a significant improvement (P<0.05) in average BWG during the whole experimental period compared to control group. **Khosravinia *et al.* (2015)** showed that dietary supplementation with Bio choline (1g/kg), and Lecithin extract (0.5g/kg) with Moderate and high energy level, improved (P<0.05) body weight of the birds compared to the control diet at 42 day of age. However, **Blanch *et al.* (1996)** showed that no effect in body weight was observed when roosters received food containing soybean lecithin and tallow. This enhancement may be due to increase in absorption of soy acid oil by the birds which may be facilitated by lecithin due to its emulsifying nature, which increases its utilization **(Lipstein and Bornstein, 1968)**.

In the second experiment, chicks fed LED + 0.2g xylanase recorded significantly the highest LBW comparing to all tested groups during starter and finisher periods. While, at the grower period, the group of LED + 0.1g xylanase achieved the highest value of LBW comparing to the rest of groups. Similar observations were recorded for BWG. These results confirmed those reported by previous investigators who concluded that growth performance of broiler chicks fed corn soybean meal diets was improved by xylanase supplementation (**Olukosi and Adeola, 2008; Abou El-wafa *et al.*, 2013; Selim *et al.*, 2015).** This improvement in xylanase enzyme group may be due to that xylanase hydrolyses NSP through breakdown β 1-4, D-xylosidic linkage of highly polymerized and substituted β 1-4 linked D-xylobiose, xylotriose and glucaronosyl resides. Furthermore, xylanase may create pre-biotic xylo-oligomers that benefit digestion indirectly via increasing fermentation in hind gut and stimulation of the ileal brake mechanism **(Cowieson, 2005).**

Table 2. Effect of lecithin and xylanase enzyme supplementation on live body weight and body weight gain of broiler chickens.

Treatments	Live body weight (g)				Body weight gain (g)			
	Initial BW	10 days	22 days	35 days	1-10days	11-22days	23-35days	1 - 35days
EXP.1								
Recommended energy level (control)	40.75	179.25^{c}	735.25^{c}	1565.00^{b}	138.50^{c}	556.00^{c}	829.75^{d}	1524.25^{b}
Low energy diet (LED)	40.50	185.25^{b}	720.00^{d}	1859.50^{a}	144.75^{b}	534.75^{d}	1139.50^{a}	1819.00^{a}
LED + 0.5g lecithin	40.75	195.25^{a}	818.50^{a}	1867.75^{a}	154.50^{a}	623.25^{a}	1049.25^{c}	1827.25^{a}
LED + 1.0g lecithin	40.50	179.25^{c}	782.00^{b}	1873.75^{a}	138.75^{c}	602.75^{b}	1091.75^{b}	1833.00^{a}
±S.E	±0.27	±1.69	±2.74	±12.56	±1.69	±2.57	±12.45	±12.56
Sig.	NS	***	***	***	***	***	***	***
EXP.2								
Recommended energy level (control)	40.50	180.75^{c}	731.50^{c}	1563.00^{d}	140.25^{d}	550.75^{b}	831.50^{c}	1522.50^{d}
Low energy diet (LED)	40.25	183.25^{bc}	720.25^{d}	1873.00^{c}	143.00^{bc}	537.00^{c}	1152.75^{b}	1832.75^{c}
LED + 0.1g xylanase	40.50	186.75^{b}	756.25^{a}	1906.50^{b}	146.50^{b}	569.25^{a}	1150.25^{b}	1866.00^{b}
LED + 0.2g xylanase	40.75	194.75^{a}	743.75^{b}	1986.75^{a}	154.03^{a}	549.00^{bc}	1243.00^{a}	1946.00^{a}
±S.E	±0.27	±1.68	±3.40	±6.83	±1.76	±4.02	±8.56	±6.82
Sig.	NS	***	***	***	***	***	***	***

a, b….d means having different letters at the same column are significantly (P<0.05) different.
NS= not significant ***= (P<0.001)

Feed intake and feed conversion ratio

Results in Table (3) show that chicks of LED + 0.5g lecithin recorded significantly lower FI values comparing to LED group during starter and finisher periods, but the same groups did not show any significant differences in FI during grower period. At starter, grower and finisher periods, LED + 0.5g lecithin group achieved the best FCR comparing to control and LED group (EXP.1). These obtained results agree with, **Dubey (2009)** who found that birds fed diet with 1.5% crude soy lecithin recorded significantly higher feed intake comparing to un-supplemented group. Also**, Azman and Ciftci (2004)** observed higher feed intake when broilers fed diet containing beef tallow added with soy lecithin. In contrast to our observations **Cantor *et al*. (1997)** found no effect in feed intake when soy lecithin was supplemented in the diet. While, broilers fed low energy diet with o.5g lecithin recorded the best FCR compared to other treatments at overall period. Moreover, **Nagargoje *et al.* (2016)** found that broilers fed diet replaced 50% vegetable oil by 50% soy lecithin alone or in combination with lipase enzyme achieved significant (P<0.01) improvement in feed conversion ratio (FCR) compared with control group. Moreover, better FCR was observed when lecithin was added in broilers basal ration **(Cox *et al*., 2000; Yang *et al*., 2005),** however, poor feed conversion efficiency was reported by **Huang *et al*. (2007)** when lecithin was supplemented at 2% in broiler's diet.

In 2nd experiment, all tested groups recorded higher FI comparing to group received recommended energy level (control). Regarding FCR, chicks fed LED supplemented with 0.2g xylanase recorded significantly the best value comparing to all groups either control, LED or LED + 0.1g xylanase during finisher and overall periods.

These results agreement with, **Wu *et al.* (2004)** who showed that addition of xylanase or phytase alone or in combination to chicks fed wheat-based diet, recorded significant increase in FI and achieved the best FCR value compared to control group. Furthermore, **Cowieson *et al.* (2010)** recorded that FCR of broilers fed low energy diets (-46 MJ/kg less than basal diet) supplemented with Xylanase (8000 and 16000 u/kg feed) alone or combination with glucanase was significantly improved compared to those fed low energy diets without enzyme supplementation. On contrary, **Kocher *et al*. (2003)** and **Singh *et al*. (2012)** did not record any significant effect of xylanase on FI and FCR of broilers. FCR improvement of broilers fed xylanase supplemented diets without change of consumed feed and were explained by improved feed efficiency due to the ability of xylanase to hydrolyze non starch polysaccharides (NSP) compounds and increased the available energy for growth (**Cowieson *et al*., 2010; O'Neill *et al*., 2012).** The improvement in groups fed LED and supplemented with xylanase enzyme may be due to that xylanase can compensate some of ME reduction and help chicks to increase BWG can mentioned in Table, 2 in addition to improve FCR comparing with others fed control diet.

Table 3. Effect of lecithin and xylanase enzyme supplementation on feed intake and feed conversion ratio of broiler chickens.

treatments	Feed intake (g/bird)				Feed conversion ratio (g feed/ g gain)			
	1-10days	11-22days	23-35days	1 - 35days	1-10days	11-22days	23-35days	1 - 35days
EXP.1								
Recommended energy level (control)	229.00	829.75[b]	1633.00[c]	2692.25[b]	1.66	1.49[c]	1.97[a]	1.77[a]
Low energy diet (LED)	220.25	1094.25[a]	1808.25[b]	3123.25[a]	1.52	2.05[a]	1.59[c]	1.72[a]
LED + 0.5g lecithin	224.00	768.75[b]	1748.25[b]	2741.00[b]	1.45	1.24[d]	1.67[bc]	1.50[b]
LED + 1.0g lecithin	216.00	1093.75[a]	1920.25[a]	3230.25[a]	1.55	1.82[b]	1.76[b]	1.76[a]
±S.E	±13.60	±31.17	±31.74	±41.85	±0.09	±0.06	±0.03	±0.03
Sig.	NS	***	***	***	NS	***	***	***
EXP.2								
Recommended energy level (control)	227.75	765.00[b]	1675.75[b]	2668.75[c]	1.63	1.39[c]	2.02[a]	1.75[a]
Low energy diet (LED)	209.50	1040.00[a]	1823.25[a]	3072.75[a]	1.46	1.94[a]	1.58[b]	1.68[b]
LED + 0.1g xylanase	223.50	975.75[a]	1812.00[a]	3011.25[ab]	1.53	1.72[b]	1.58[b]	1.62[b]
LED + 0.2g xylanase	214.75	966.25[a]	1764.25[ab]	2945.25[b]	1.40	1.76[b]	1.42[c]	1.51[c]
±S.E	±9.87	±29.16	±36.10	±34.27	±0.07	±0.05	±0.03	±0.02
Sig.	NS	***	*	***	NS	***	***	***

a, b….d means having different letters at the same column are significantly (P<0.05) different.
NS= not significant ***= (P<0.001)

Nutrient digestibility coefficients

Effect of different treatments on nutrients digestibility coefficients is listed in Table 4. Regarding to the first experiment, group of LED + 1g lecithin achieved the highest EE% value without significant differences to those fed LED + 0.5g lecithin but with a significant varation to LED and control groups with an improvement of 5.88% and 6.81%, respectively. This enhancement reflects the increase in lipase activity as mentioned in Table 5. On the other hand, the rest of nutrient digestibility coefficients (OM%, CP%, CF%, NFE %) did not record any significant differences among all groups. These results agree with, **Siyal *et al.* (2017)** who showed that broilers fed palm oil enriched diet supplemented with 0.1% soy lecithin had significantly improved EE compared to control at 19 – 21 days. Moreover, **Jaapar *et al.* (2020)** showed that there was a significant (P <0.05) improvement in organic matter (OM), CP and EE digestibility when broiler fed prilled palm fat supplemented with 2% lysolecithin (PFL) at level of 1% instead of palm oil compared to the other treatments (0, 3, 5, 7%PFL). Also, **Zampiga *et al.* (2016)** speculated that increased all nutrient digestibility in broilers fed low dietary fat level and incorporated with fat emulsifier.

In the current study, EE digestibility enhanced as a result of supplementing soy-lecithin which increased digestibility coefficient of the most fatty acids **(Zhang *et al.*, 2011).** Hence, the improvement in performance may be relate to this explanation. Also, soy lecithin forms a small sized and stable micelles which has an important factor for absorption of lipid and lipophilic substances. Moreover, formation of smaller micelles may also have an effect on other nutrients present in the digesta **(Reynier *et al.*, 1985)**.

In respect to the second experiment (Table, 4), chicks fed control diet recorded higher OM digestibility coefficient without significant differences to others fed LED and LED +0.2g xylanase. But with significant differences to group of LED + 0.1g xylanase. Regarding to EE digestibility, the group of LED + 0.2g xylanase achieved significantly the best EE% value comparing to control and other tested groups. Our findings partial agreement with, **Saleh *et al.* (2019)** who found that supplementation of Xylanase and Arabinofuranosidase enzymes (Rovabio® Advance) to broiler chicks fed low energy diet had significantly (P<0.05) improved crude protein and crude fat digestibility coefficient. **Almirall *et al.* (1995)** reported that xylanase improve energy utilization and the performance of broilers by hydrolysis of cell wall arabinoxylans and improve the access of endogenous digestive enzymes to cell contents and this effect was connected with improving the digestibility and minimizing the viscosity of intestinal contents.

Table 4. Effect of lecithin and xylanase enzyme supplementation on digestibility nutrient coefficient of broiler chickens.

Treatments	Digestibility coefficient (%)				
	OM	**CP**	**EE**	**CF**	**NFE**
EXP.1					
Recommended energy level (control)	79.95	95.00	74.68^{b}	28.78	76.41
Low energy diet (LED)	75.55	93.85	75.61^{b}	25.69	72.71
LED + 0.5g lecithin	75.73	94.16	79.57^{ab}	26.41	71.92
LED + 1.0g lecithin	80.78	95.43	81.49^{a}	28.40	77.07
±S.E	±2.25	±0.55	±1.65	±1.70	±2.50
Sig.	NS	NS	*	NS	NS
EXP.2					
Recommended energy level (control)	79.84^{a}	94.96	72.16^{b}	29.04	76.66
Low energy diet (LED)	77.83^{ab}	94.15	72.75^{b}	29.06	74.93
LED + 0.1g xylanase	76.10^{b}	94.07	73.68^{b}	27.86	72.89
LED + 0.2g xylanase	78.47^{ab}	94.49	80.29^{a}	28.77	75.23
±S.E	±0.94	±0.30	±1.78	±1.07	±1.15
Sig.	**	NS	*	NS	NS

a…b means having different letters at the same column are significantly (P<0.05) different.
NS= not significant *= (P<0. 05) **= (P<0. 01)

Intestinal lipase

Concerning to first experiment (Table 5), by increasing lecithin level in broilers diet, the activity of intestinal lipase increased. These results agree with, **Guerreiro Neto *et al.* (2011)** who showed that broilers fed diets supplied with different fat sources with emulsifier recorded higher (p<0.05) lipase concentration than broilers fed diets without emulsifier at 42-day-old. While, these results disagree with, **Hu *et al.* (2018)** who reported that broilers fed reduced energy diet without any additives decreased lipase activity compared to broilers fed basal diet. In this respect, lecithin serves as an emulsifier by modifying or binding phospholipid molecules (**Lechowski *et al.*, 1999**). Also, Emulsifiers include hydrophilic and hydrophobic molecules, which can distribute oil droplets evenly in the emulsion and enhance the absorption and digestion of lipids **(Rovers, 2014).**

Table 5. Effect of lecithin and xylanase enzyme supplementation on lipase of broiler chickens.

Treatments	Lipase u/l
EXP.1	
Recommended energy level (control)	2.58^{d}
Low energy diet (LED)	3.01^{c}
LED + 0.5g lecithin	4.49^{b}
LED + 1.0g lecithin	4.97^{a}
±S.E	±0.01
Sig.	***
EXP.2	
Recommended energy level (control)	2.49^{c}
Low energy diet (LED)	3.20^{b}
LED + 0.1g xylanase	3.55^{b}
LED + 0.2g xylanase	4.23^{a}
±S.E	±0.11
Sig.	***

a, b….d means having different letters at the same column are significantly (P<0.05) different.
***= (P<0.001)

Regarding to the second experiment (Table 5), chicks fed low energy diets with 0.2g xylanase achieved significant increase in intestinal lipase activity followed by groups of LED + 0.1 g xylanase and LED while, the worst value was recorded for control group. These results obtained to be agree with, **Engberg *et al.* (2004)** who reported that broilers fed diets supplemented with xylanase (1g/kg feed) recorded higher intestinal lipase content than others fed the same different wheat forms without xylanase. Whereas, differences was not significant.

Economical efficiency

Effect of different treatments in both experiments on economical efficiency is tabulated in Table (6). In the 1st experiment, all tested groups recorded an improvement in economical efficiency. Nethertheless, LED + 1.0 g lecithin achivied superity (134.71%). These results agree with, **Dubey (2009)** who reported that net profit was the highest in broilers fed diet containing 3.0% crude soy lecithin (CSL) than others fed control diet or others fed diets with 1, 1.5, 2 and 2.5% CSL. Moreover, **Nagargoje *et al.* (2016)** concluded that broilers fed diets replaced vegetable oil by 50% CSL alone or in combination with lipase enzyme had significant improvement in net income per bird compared to others fed control diet with or without lipase.

Table 6. Effect of lecithin and xylanase enzyme supplementation on economical efficiency of broiler chickens.

Treatments	Economical efficiency						
	LBW (g)	**Total revenue/g gain (LE)**	**Total feed intake / chick (g)**	**Total feed cost / chick (LE)**	**Net revenue/ chick (LE)**	**Economical efficiency (EEf)**	**Relative EEf%**
EXP.1							
Recommended energy level	1565.00	39.13	2692.25	16.15	22.98	1.42	100
Low energy diet (LED)	1859.50	46.49	3123.25	18.02	28.47	1.58	111.25
LED + 0.5g lecithin	1873.75	46.84	3230.25	19.16	27.68	1.44	101.75
LED + 1.0g lecithin	1867.75	46.69	2741.00	16.03	30.66	1.91	134.71
EXP.2							
Recommended energy level	1563.00	39.08	2668.75	16.01	23.07	1.44	100
Low energy diet (LED)	1873.00	46.83	3072.75	17.73	29.10	1.64	113.96
LED + 0.1g xylanase	1906.50	47.66	3011.25	17.42	30.24	1.74	120.56
LED + 0.2g xylanase	1986.75	49.67	2945.25	17.08	32.59	1.91	132.50

Net revenue/ chick (LE) = Total revenue /g LBW (LE) - Total feed cost/chick (LE)
EEf = Net revenue/ chick (LE) / Total feed cost/chick (LE)
Price of 1kg lecithin = 160LE.
Price of 1kg xylanase = 140 LE
Price of 1kg meat = 25 LE
Price of 1kg recommended feed = 6LE
PRICE of 1kg low -100 Kcal feed= 5.77LE

In the 2nd experiment, broilers fed low energy diets without or with graded levels of xylanase enhanced the net revenue and economical efficiency. The present finding are in close agreement with that reported by **El-Katcha *et al.* (2014)** who found an improvement in economical efficiency for broiler chicks fed diets incorporating with 25% and 50% wheat instead of corn and supplemented with commercial enzyme products (KEMzyme plus dry or COMBOzyme) comparing to groups fed the same ratio of replacement without enzyme supplementation.

Conclusion

It could be concluded that suppleming broiler chicks fed low energy diet with either 0.5 g lecithin or 0.2 g xylanase gave the best growth performance as well as enhancing economical efficiency.

References

Abou El-Wafa, S.; Shalash, S.M.; Selim, N.A.; Abdel-Khalek, A.M.; Radwan, A.M. and Abdel- Salam, A.F. (2013) "Response of broiler chicks to xylanase supplementation of corn/rye containing diets varying in metabolizable energy". *International Journal of Poultry Science* 12.12: 705-713.

Almirall, M.; Francesch, M.; Perez-Vendrell, A.M.; Brufau, J. and Esteve-Garcia, E. (1995). The differences in intestinal viscosity produced by barley and beta-glucanase alter digesta enzyme activities and ileal nutrient digestibilities more in broiler chicks than in cocks. J. Nutr., 125, 947–955.

Association of Official Analytical Chemists, A.O.A.C. (1990): Official methods of analysis. 15th Ed., puplished by the AOAC, Washington, D.C, USA.

Azman, M.A. and Ciftci, M. (2004). Effects of replacing dietary fat with lecithin on broiler chicken zootechnical performance. Revue Méd. Vét., 155: 445-448.

Balamurugan, R. and Chandrasekaran, D. (2009). Effect of multienzyme supplementation on weight gain, feed intake, feed efficiency and blood glucose in broiler chickens. Indian J. Sci. Technol., 3: 193-195.

Bayoumi, S. B. (1980). Effect of different rations on egg production for breeding hens. M. Sc. Thesis Fac. Agric., Kafr-ELsheikh, Tanta Univ., Egypt.

Cantor, A.H.; Vargas, R.; Pescafore, A.J.; Straw, M.L. and Ford, M.J. (1997). Influence of crude soybean lecithin as a dietary energy source on growth performance and carcass yield of broilers. Poult. Sci. 76 (Suppl. 1): 109.

Cowieson, A. J. (2005). Factors that affect the nutritional value of maize for broilers. Anim. Feed. Sci. Technol., 119: 293 - 30.

Cowieson, A. J. (2010). Strategic selection of exogenous enzymes for corn/soy-based poultry diets. Jpn. Poult. Sci. 47:1–7.

Cowieson, A. J.; Bedford, M. R. and Ravinran, V. (2010). Interactions between xylanase and glucanase in maize-soy-based diets for broilers. Br. Poult. Sci. 51: 246-257.

Cox, W.R.; Richis, S.J.; Sifri, M.; Bennett, B. and Kitts, D.D. (2000). The impact of replacing dietary fat with lecithin on broiler chicken performance. Poult. Sci. 79: 67 -71.

Cullision A.E. and Lowrey R.S. (1987). Feeds and Feeding. Prentice-hall, inc., New Jersey

Dubey, M. (2009). Effect of dietary soy acid oil and crude soy lecithin on growth performance, nutrient utilization and biochemical profile in VEN-COBB on broiler chicken. Ph.D. Thesis, College of Veterinary Science and Animal Husbandry, Anjora, Durg. India.

Duncan, D.B. (1955): Multiple range and multiple F tests. Biometrics, 11:1-42.

El-Katcha, M. I.; Soltan, M. A.; El-Kaney, H. F. and Karwarie, E. R. (2014). Growth performance, blood parameters, immune response and carcass traits of broiler chicks fed on graded levels of wheat instead of corn without or with enzyme supplementation. J. Alex. Vet. Sci., 40: 95 - 111.

Engberg, R. M.; Hedemann, M. S.; Steenfeldt, S. and Jensen, B. B. (2004). Influence of whole wheat and xylanase on broiler performance and microbial composition and activity in the digestive tract. Poult. Sci. Ass. Inc., 83: 925 – 938.

Evans, E.I. (1935). Antioxidant properties of vegetable lecithins. Ind Eng Chem., 27: 329 - 331.

Francesch, M. and P. A. Geraert (2009). Enzyme complex containing carbohydrases and phytase improves growth performance and bone mineralization of broilers fed reduced nutrient corn-soybean based diets. Poult. Sci. 88:1915–1924.

Guerreiro Neto, A. C.; Pezzato, A. C.; Sartori, J. R.; Mori, C.; Cruz, V. C. and Fascina, V. B. (2011). Emulsifier in broiler diets containing different fat sources. Brazilian J. Poult. Sci., 13: 119 - 125.

Hertramf, J.W. (2001). Lecithin improves poultry performance, *Poult. Int.* **Nov.** 26-30.

Horvatovic, M.P.; Glamocic, D.; Zikic, D.; Hadnadjev, T.D. (2015). Performance and some intestinal functions of broilers fed diets with different inclusion levels of sunflower meal and supplemented or not with enzymes. Braz. J. Poult. Sci., 17: 25 – 30.

Hossain, M.E. and Das, G.B. (2014). Effect of crude soybean oil sediment as a substitute for refined soybean oil in broiler diet. Iran of Applied Animal Science. 4:535-540.

Hu, Y. D.; Lan, D.; Zhu, Y.; Pang, H. Z.; Mu, X. P. and Hu, X. F. (2018). Effect of diets with different energy and lipase levels on performance, digestibility and carcass trait in broilers. Asian-Australas. J. Anim. Sci., 31: 1275 - 1284.

Huang, J.; Yang, D. and Wang, T. (2007). Effects of replacing soy-oil with soy-lecithin on growth performance, nutrient utilization and serum parameters of broilers fed corn-based diets. Asian-Aust. J. Anim. Sci., 20: 1880 - 1886.

Jaapar, M. S.; Alshelmani, M. I.; Humam. A. M.; Loh, T. C.; Foo, H. L. and Akit, H. (2020). Effect of feeding prilled palm fat with lyso-lecithin on broiler growth performance, nutrient digestibility, lipid profile, carcass, and meat quality. Poult. Sci. J., 8: 43 - 50.

Khosravinia, H.; Chethen, P. S.; Umakantha, B. and Nourmohammadi, R. (2015). Effects of Lipotropic Products on Productive Performance, Liver Lipid and Enzymes Activity in Broiler Chickens. Poult. Sci. J. 3: 113-120.

Kocher, A.; Choct, M.; Ross, G.; Broz, J. and Chung, T. K. (2003). Effects of enzyme combinations on apparent metabolizable energy of corn-soybeanmeal based diets in broilers. J. Appl. Poult. Res. 12:275–283.

Lechowski, R.; Bielecki, W.; Sawosz, E.; Krawiec, M. and Kluci ´ nski, W. (1999). The effect of lecithin supplementation on the biochemical profile and morphological changes in the liver of rats fed different animal fats. Vet. Res. Commun., 23: 1 – 14.

Lipstein, B. and Bornstein, S. (1968). Lack of interference between dietary acidulated soybean soapstock and calcium in chicks and laying hens. Poult. Sci., 47: 1905 - 1911.

Luo, D.; Yanga, F.; Yang, X.; Yao, J.; Shi, B. and Zhou, Z. (2009). Effects of xylanase on performance, blood parameters, intestinal morphology, microflora and digestive enzyme activities of broilers fed wheat-based diets. Asian-Aust. J. Anim. Sci., 22: 1288 – 1295.

Mahmoudi, P.; Hasan, A.; Hajathi, H. and Javadi, M. (2015). Effect of soy lecithin, soy oil and tallow on performance and expression of SREBP- I- Gene in broiler chickens. Indian J. Animal Science Research., 7: 294 - 304.

Menten, J.F.M.; Pesti, G.M. and Bakalli, R.I. (1997). A new method for determining the availability of choline in soybean meal. Poultry

Science, 76: 1292-1297. doi:10.1093/ps/76.9.1292

Nagargoje, S. B.; Dhumal, M. V.; Nikam, M. G. and Khose, K. K (2016): Effect of crude soy lecithin with or without lipase on performance and carcass traits, meat keeping quality and economics of broiler chicken. International Journal of Livestock Research., 6: 46 - 54.

NRC. (1994): National Research Council**,** Nutrient requirement of poultry. 9th Ed, National Academy of Science. Washington, D. C., USD.

O'Neill, M. H. V.; Liu, N.; Wang, J. P.; Diallo, A. and Hill, S. (2012). Effect of xylanase on performance and apparent metabolisable energy in starter broilers fed diets containing one maize variety harvested in different regions of china. Asian-Aust. J. Anim. Sci., 25: 515 - 523.

Olukosi, O.A. and Adeola, O. (2008). "Whole body nutrient accretion, growth performance and total tract nutrient retention responses of broilers to supplementation of xylanase and phytase individually or in combination in wheat-soybean meal based diets". *The Journal of Poultry Science* 45.3: 192-198.

Reynier, M. O.; Lafont, H.; Crotte, C.; Sauve, P. and Gerolami, A. (1985). Intestinal cholesterol uptake: Comparison between mixed micelles containing lecithin or lysolecithin. Lipid.; 20: 145 – 150.

Rovers, M. (2014). Saving energy and feed cost with nutritional emulsifier. Intl. Poult. Prod., 22: 7 – 8.

Saleh, A. A.; Kirrella, A. A.; Abdo, E. S.; Mousa, M. M.; Badwi, A. N.; Ebeid, A. T.; Nada, L. A. and Mohamed, A. M. (2019). Effects of dietary xylanase and arabinofuranosidase Combination on the growth performance, lipid peroxidation, blood constituents, and immune response of broilers fed low-energy diets. J. Anim., 9: 467 - 478.

SAS Institute (2004). SAS User's Guide. Release 8.2. Ed. SAS Institute Inc. Cary. NC.

Selim A Nessrin., Waly A.H. ; Abdel Magied, H.A.; Habib, H. H.; Fadl, A. A. and Shalash, S. M. (2015). Further benefits of xylanase enzyme supplementation to low energy corn-soybean meal broiler diet. Egyptian Journal of Nutrition and Feeds 18: 443 - 456.

Singh, A.; O'Neill, M. H. V.; Ghosh, T. K.; Bedford, M. R. and Haldar. S. (2012). Effects of xylanase supplementation on performance, total volatile fatty acids and selected bacterial population in caeca, metabolic indices and peptide YY concentrations in serum of broiler chickens fed energy restricted maize–soybean based diets. Anim. Feed Sci. Technol. 177:194–203.

Siyal, F. A.; El-Hack, M. E. A.; Alagawany, M.; Wang, C.; Wan, X. L.; He, J. T.; Wang, M. F.; Zhang, L. L.; Zhong, X.; Wang, T. and Dhama, K. D. (2017). Effect of soy lecithin on growth performance, nutrient digestibility and hepatic antioxidant parameters of broiler chickens. Int. J. Pharmacol., 13: 396 – 402.

Verduin, P. A.; Punt, J. M. and Kreutzer, H. H. (1973). Studies on the determination of lipase activity. Clin Chimica. Acta. 46: 11 - 19.

Williams M. P.; Klein, J. T.; Wyatt, C. L.; York, T. W. and Lee, J. T. (2014). Evaluation of xylanase in low-energy broiler diets. J. Appl. Poult. Res. 23:1–8.

Wiseman, J. and Salvador, F. (1989): Influence of age, chemical composition and rate of inclusion on the apparent metabolizable energy value of fats fed to broilers. *Poult. Sci.* **30**: 653-662.

Wu, Y. B. and Ravindran, V. (2004). Influence of whole wheat inclusion and xylanase supplementation on the performance, digestive tract measurements and carcass characteristics of broiler chickens. Anim. Feed Sci.Tech., 116: 129 – 139.

Wu, Y.B.; Thomas, D.G.; Ravindran, V.; Birtles, M.J. and Hendriks, W.H. (2004). Influence of phytase and xylanase, individually or in combination, on the performance, apparent metabolisable energy, digesta viscosity, digestive tract measurements and gut morphology in broilers fed wheat-based diets containing adequate level of phosphorus. Brit. Poultry Sci. 45:76–84.

Yang, Y.; Wen, J.; Chen, J.L.; Feng, Y.L.; Xie, X.D.; Miao, F.R.; Li, Z.R. and Tu, H.Z. (2005). Effect of soyabean lecithin on lipid metabolism and meat quality of Hetian chickens. China-poultry. 27: 17-19.

Zampiga, M.; Meluzzi, A. and Sirri, F. (2016). Effect of dietary supplementation of lysophospholipids on productive performance, nutrient digestibility and carcass quality traits of broiler chickens. talian Journal of Animal Science., 1: 521 - 528.

Zhang, B.; Haitae, L.; Zhao, D.; Guo, Y. and Barri, A. (2011). Effect of fat type and lysophosphatidylcholine addition to broiler diets on performance, apparent digestibility of fatty acids, and apparent metabolizable energy content. Anim. Feed sci. and tech., 163: 177 - 184.

استجابة كتاكيت دجاج التسمين للعلائق منخفضة الطاقة المضاف إليها الليسيثين أو إنزيم الزيلانيز

زنجبيل سعد محمد السيد[1], محمد محمد عبداللاه[1], جمال على الدين الصياد[1] , أميرة محمود رفاعى[2]

1 قسم الانتاج الحيوانى – كلية الزراعة – جامعة بنها

2 معهد بحوث الانتاج الحيوانى – مركز البحوث الزراعية – الدقى – الجيزة – مصر

أجريت تجربتان لدراسة تأثير إضافة ليسيثين فول الصويا أو زيلانيز لعلائق منخفضة الطاقة على الاداء الانتاجى لدجاج التسمين ، ومعاملات هضم العناصر الغذائية ، ونشاط إنزيم الليبيز المعوي ، والكفاءة الاقتصادية.استخدم فى هذة الدراسة عدد 256 كتكوت عمر يوم غير مجنس من دجاج التسمين كوب 500 ،قسمت إلى تجربتين متساويتين ،بكل منها 128 كتكوت (4 معاملات × 4 مكررات × 8 كتاكيت). بكل تجربة تم تقسيم الكتاكيت إلى 4 مجموعات على النحو التالي: – غذيت المجموعة الأولى على العليقة الاساسية واعتبرت كنترول حيث احتوت على الطاقة الموصى بها ،و تغذت المجموعة الثانية على عليقة منخفضة الطاقة (100 كيلو كالوري / كجم) اقل من الموصى بها ، غذيت المجموعتين الثالثة والرابعة بالتجربة الاولى على العليقة الثانية مضاف اليها 0,5 جم او1,0جم ليسيثين / كجم علف على التوالى, بينما غذيت الكتاكيت بالتجربة الثانية على العليقة الثانية مضاف اليها 0,1 او 0,2 جرام زيلانيز/ كجم علف على الترتيب . استمرت الدراسة حتى 35 يومًا. كانت اهم النتائج:– سجلت المجموعة المغذاة على عليقة منخفضة الطاقة + 0,5جم ليسيثين بالتجربة الاولى و0.2 + LED المجموعة المغذاة على 0,2جم زيلانيز بالتجربة الثانية سجلت أعلى وزن جسم مكتسب و افضل كفاءة تحويل للغذاء خلال الفترة الكلية مقارنة بالكنترول والعلائق منخفضة الطاقة .وجد بكلا التجربتين زيادة تدريجية في معامل هضم الدهن الخام ونشاط الليبيز المعوي والكفاءة الاقتصادية عن طريق زيادة مستوى إضافة فول الصويا ليسيثين أوزيلانيز.

الاستنتاج :– امداد العليقة منخفضة الطاقة بـ 0,5 جم ليسيثين /كجم او 0,2 جم زيلانيز / كجم علف يمكن أن يحسن أداء نمو دجاج التسمين ونشاط الليبيز المعوي ويعزز صافي الربح الاقتصادي.