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EFFECT OF PECTINASE ENZYME SUPPLEMENTION AND LOW ENERGY CORN-SOYBEAN MEAL DIETS ON BROILR PEFORMANCE AND QUALITY OF CARCASS AND MEAT.

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ABSTRACT: Two hundred and forty, one day old unsexed Arbor Acres broiler chicks were used to examine the effect of supplementing pectinase enzyme (PE) with varying levels of metabolizable energy (ME) on growth performance, quality of carcass and meat, and feeding cost. Chicks were randomly allocated into six treatments (2x3 factorial design) each had four replicates (n=10). Chicks were fed corn-soybean diet supplemented with two levels of pectinase enzyme (0 and1000 U/kg), and three ME levels which were standard strain recommendation (STD), 100 kcal lower than STD (E100) and 150 kcal lower than STD (E150) of each feeding phase. The dietary ME values were 3000, 2900 and 2850 kcal/kg diet at starter phase; 3100, 3000 and 2950 kcal /kg at grower phase; and 3200, 3100 and 3050 kcal/kg at the finisher phase. All diets were formulated to save the strain requirements from the rest of nutrients. All chicks were housed in open system broiler house and received the same managerial conditions and veterinary program during experimental period (1-40 d of age). Parameters of growth performance, carcass characteristics, physical and chemical evaluation of broiler meat were carried out and feeding cost was calculated.

The recorded results showed that, pectinase (PE) supplementation could not change growth performance significantly, while values of breast pHu, drip loss % of thigh and total protein (TP) of broiler meat were increased. Among ME levels, the reduction in ME of diet by 150 kcal/kg led to significant reduction of final body weight, while the reduction in ME by 100 kcal/kg led to significant reduction of abdominal fat %. Values of breast pHu, MDA and LDL of broiler meat at 40 days of age decreased significantly by the reduction in ME at both level (E100 and E150), while values of feed intake, feed conversion ratio, breast meat yield%, thigh%, drum stick %, drip loss % of breast and TP of broiler meat were increased significantly compared with STD values. Among all treatments the results showed significantly effected on growth performance, carcass and meat quality parameters. Calculation of feeding cost showed that STD group recorded the lowest value than other treatments. The overall results of PE and ME indicated that both could not improve growth performance parameters and feeding cost, while the quality of carcass and meat were enhanced. Applying E100+PE diets could help producers to get acceptable marketing weight with better carcass and meat quality.

Key words: Broiler, Pectinase, Performance and Meat Quality.

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INTRODUCTION

In the poultry industry, profit depends mainly on the cost and nutritive value of the feed. Although corn-soybean meal poultry feed is considered to be favorable because of its high nutritional value, poultry cannot digest 15 to 25% of its nutrients **(Tahir *et al.,* 2008)**.Corn–soybean meal diets are commonly used as a broiler feed because it supplies the majority of energy and protein requirements for broilers. Trials conducted so far by various researchers on the effect of exogenous enzymes have revealed inconclusive results. Some studies have shown that commercial enzymes have a positive effect on the growth of broilers fed a corn–soybean diet **(Wyatt *et al*., 1997; Zanella *et al*. 1999).** However, other studies have found no positive effects **(Mohamed and Hamza, 1991; Marquardt *et al,*. 1994; Marsman *et al*., 1997; Kidd *et al*., 2001 and Bedford, 2000).** However, there is a substantial body of evidence to the using corn and soybean meal, which make up the majority of the energy component.

Energy one of the most costly nutrients in the broiler diet required for optimum growth performance. Because of the expense of providing sufficient energy to growing broilers. Numerous studies have been carried out to investigate the possibility of reducing energy by adding feed enzymes **(Pack and Bedford, 1997; Min *et al*., 2011 and Abou El-Wafa *et al*., ٢٠١٣)**. The metabolizable energy (ME) of soybean meal is notably low for poultry due to Non-Starch Polysaccharides (NSPs) **Pierson *et al*., (1980)**. **Choct, (2004)** reported that the insoluble NSPs were 80 g/kg of corn and 165 g/kg of soybean meal **(Irish and Balnave, 1993)** and may be encapsulating sources of energy **(Bedford, 2002).** Thus, AME contents could be increased by using exogenous carbohydrates **(Kocher *et al*., 2002; Gracia *et al*., 2003)** and degradation of NSPs **(Mandels, 1985; Brenes *et al*., 1993; Frigard *et al*., 1994; Mcknight, 1997; Bedford and Schulze, 1998; Mathlouthi *et al.,* 2003 and Saki *et al*., 2005).** Making these unused energy sources available for broiler chickens would have an impact on the economic value of the corn-soybean meal diet.

Pectinases are a group of enzymes that breakdown pectins. Pectin is a structural polysaccharide present in primary cell wall and middle lamella of fruits and vegetables. Pectin or pectic substances are heterogeneous group of high molecular weight, complex, acidic structural polysaccharides with a backbone of galacturonic acid residues linked by α-(1-4) linkages (**Kumari *et al.,* 2013**). **Cowan *et al.* (1999)** reported that pectinase addition in broiler diet based on sorghum increased final body weight and improved feed conversion ratio. **Abudabos (2012)** observed that body weight of broilers at 42 days was affected significantly by using both low density diet (less ME diets by 180,150 and 170 kcal/kg for starter, grower and finisher respectively) and adding commercial enzyme (containing 30 Ug^{-1} unites pectinase) while the interaction between them did not change body weight significantly. However values of overall feed conversion ratio were improved by either enzyme supplementation, increasing ME of diet, or their interaction. Also, **Reddy *et al*. (2011)** found that, the final weight and total body gain of pigs fed on low energy diet (ME 2500 Kcal/ kg) –high fiber (6.7%) supplemented with a mixture of enzymes (containing pectinase 30 Ug^{-1} unites) were significantly higher compared to negative control (without enzyme supplementation). While, values of feed conversion ratio and cost of body weight gain was significantly lower.

Most experiments concerning supplementation of pectinase enzyme to broiler diets used the commercial mixed enzymes. While, the present study was conducted to clarify the effect of the pectinase enzyme in its pure form on the performance and carcass traits of broiler chicks fed a corn–soybean meal diet with different levels of metabolizable energy (ME) during three feeding phases.

MATRIALS AND METHODS

Experimental design: Two hundred and forty, one day old Arbor Acres unsexed broiler chicks were randomly allocated in a 2x3 factorial design in six treatments, four replicates per treatment and ten birds / replicate. The examined factors were two supplementation levels of pectinase enzyme (0 and 1000 U/kg diet), and three levels of metabolizable energy, strain recommendation (STD); 100 kcal lower than STD (E100); and 150 kcal lower than STD, (E150) for each feeding phase as shown in Table (1).

Experimental diets: Chicks fed on diets based on corn-soybean meal during starting (1-10 d), growing (11-24 d) and finishing (25-40 d) periods as described in Table (2). Standard diets were formulated to be 3000 kcal of ME/kg and 23% CP, 3100 kcal of ME/kg and 21% CP and 3200 kcal of ME/kg and 19% CP and contained whole strain requirement from the rest of macro and micro nutrients during starting, growing and finishing periods, respectively. Chicks were reared on wire battery cages and subjected to the same managerial and veterinary procedures throughout the growth trial term. Birds were fed *ad libitum* diets and had access to water. At the end of each of growth phases live body weight (BW) and feed intake (FI) were recorded while, body weight gain (BWG) and feed conversion ratio (FCR) were calculated.

Slaughtering and carcass characteristics: At the termination of the growth trial period (40 days of age), four representing birds of each experimental treatment, around the average live BW of each treatment, were overnight fasted, slaughtered and eviscerated, then carcass characteristics including carcass weight, abdominal fat weight, giblets (liver, gizzard and heart) weight, as percentages of live BW were recorded. Weights including front quarter (breast quarter without wing) and back quarter (leg quarter) were recorded as percentage of carcass weight. While weights including of drumstick (DS) and thigh samples were recorded as percentage of back quarter. Skin weight of every part was recorded as percentage of its part. After that all breast, thigh and drumstick samples (72 samples) were weighed and kept for 24 h at 4°C to complete the physical and chemical analysis of broiler meat.

Physical measurements:

Drip loss: A total of 72 samples (24 breast, 24 drumsticks and 24 thigh samples) were used for drip loss analysis. Breast fillets, drumsticks and thigh were individually weighted, placed in Ziploc bags, stored at 4°C for 24 h. Samples were lightly blotted using filter paper before reweighing. Drip loss % was calculated as the percentage of the difference between weights before and after chilling for 24 h. and divided by the first weight as described by **Saenmahayak *et al*. (2012).**

Ultimate pH (pHu): After 24 h of chilling samples of breast meat, drumsticks and thigh on 4°C, ultimate pH (pHu) was measured using pH meter, provided by a temperature control system, by probe method. The minimum depth to adopt was 1 cm after incision of the muscles as described by **Selim *et al*. (2013).**

Chemical measurements: Mixture (of equal weight) of breast, drumsticks and thigh meat of each bird were stored on -20°C for 60 days before chemical measurements, then malondialdehyde (MDA), total protein (TP), low density lipids(LDL) and high density lipids(HDL) contents were determined by colorimetric methods using analytical kits produced by Biodiagnostic Company,Egypt.

Statistical procedures: The collected data were subjected to two way analysis of variance to detect the effects of pectinase supplementation (P) and metabolizable energy level (M) and their interaction (P*M) using the general liner model (GLM) procedure of SAS User's guide **(SAS, 2001)** as the following model:

$Y_{ijk} = \mu + P_i + M_j + (PM)_{ij} + e_{ijk}$.
Where:
Yijk = Trait measured
μ = Overall mean
P_i = Pectinase supplementation, i= (1,2)
M_j = Metabolizable energy level, j= (1,.,3)
$(PM)_{ij}$ = Interaction between pectinase supplementation and Metabolizable energy level
e_{ijk} = Experimental error
In addition data of all experimental treatments were subjected to one way analysis of variance to detect the differences between all treatments as following model:
$Yij = \mu + Ti + eij$
Where:
μ = overall mean of Yij,
Ti = effect of treatment, i = (1,….,6)
eij = Experimental error
Duncan's Multiple Range test **(Duncan's, 1955)** was used to separate means when separation was relevant. Statistical significance was accepted at probability level of (P<0.05).

RESULTS AND DISSCUTION

Growth performance: The obtained results of growth performance parameters of broiler chicks fed on different pectinase and metabolizable energy levels are shown in Table (3). The presented results including final body weight (FBW), feed intake (FI), body weight gain (BWG) and feed conversion ratio (FCR) showed that pectinase supplementation at level 1000 U/kg did not cause any significant change of the examined parameters. However reducing ME of experimental diets from STD to E150 level cause significant depression of FBW, BWG and FCR and increase significantly feed consumption during the experimental period. Among all treatments the results showed significant effect on all performance parameters, whereas chicks of E150 treatment recorded the worst growth performance parameters while these reductions were improved significantly by pectinase supplementation. The best FCR recorded by STD chicks (1.68) followed by STD+PE (1.71) and E100+PE (1.78) groups.

Concerning with the obtained reduction of growth performance by decreasing dietary ME, these finding confirmed those reported previously by **Golian *et al*. (2010).** Furthermore **Abou El-Wafa *et al*. (2013)** recorded that 100 kcal /kg less in broiler diet significant decrease in total BWG associated with increase in total FI and a worsening in FCR. Also the same trend recorded by pigs in experiments conducted by **Reddy *et al.* (2011)** whereas they recorded depression in pigs performance received low ME diet (2500 kcal/kg) compared with those received high ME (2900 kcal/kg). On the other hand, **Downs *et al*. (2006) and Min *et al.* (2011)** reported that decreasing dietary ME level about 100 and 40 kcal/ kg respectively in broiler diet resulted in a significant comparable BWG and FBW. While FCR was significantly improved by increasing dietary ME level **(Downs *et al*., 2006)**.

Regarding effect of pectinase supplementation on broiler performance the recorded results in this study confirmed those published by **Igbasan *et al* (1997)** who reported that, growth rate; feed intake and feed conversion of broilers fed pea diets supplemented with graded levels of pectinase enzyme were not different from their counterpart fed a diet without pectinase supplementation. Also, **Min *et al*. (2011)** observed that using enzyme mixture containing pectinase (provided by 200g/tone feed) to diets contained lower 40 kcal/kg ME could not improve FBW and FCR. On the other hand **Cowan *et al.* (1999); Igbasan and Guenter (1996); and Khalil *et al*. (2014)** reported that supplementing diets with pectinase enzyme improved broiler performance. However, many researchers reported significant improvements of growth performance of broilers by using enzymes supplemented diets when applying mixture of enzymes even the ME values of diets were decreased

(**Kocher *et al*., 2002 ; Gracia *et al*., 2003; Tahir *et al.*, 2008; and Abudabos, 2012)** . **Tahir *et al.*, (2008)** indicated that both mixed enzyme preparation containing Cellulase (C), hemicellulase (H), pectinase (P) at level C, 0.33 U; H, 2 U; and P, 2 U/g of feed and ME of feed at levels 3000 and 2940 kcal/kg could effectively degrade indigestible cell constituents and thus enable the nutrients of the broiler feed to become more digestible which reflected on growth rate. Furthermore, **Abudabos (2012)** observed the same trend when using low energy diets (less 180, 150 and 170 kcal/kg corn soy diet than control for starter, grower and finisher respectively), and 0.05% Tomako commercial enzymes (containing 30 U g^{-1} pectinase).

The inconsistency of responses of enzyme supplementation may be due to its specific composition, concentrations, feed ingredients, environment, or genetic factor of experimental animals (**Douglas *et al.*, 2000, and Zakaria *et al*., 2010)**.

The recorded improvement of growth performance parameters by pectinase supplementation to low ME diets E150 + P while E100 + P did not show significant improvement than E100 may be indicate that the response of supplemental pectinase depends on ME of diet.

Carcass traits:

Results of carcass traits in Table (4) showed that neither pectinase supplementation, dietary ME level nor their interactions had significant effect on dressing % of broiler chicks at 40 days of age. Although pectinase supplementation to broiler diets based on corn and soybean meal did not cause any significant change in carcass traits including edible parts, abdominal fat, front quarter (FQ) and back quarter (BQ) % and their smaller cuts (skin, thigh, and DS). On the other side reducing dietary ME from STD to E100 and E150 resulted in significant increase of breast meat yield % (by 11.6 and 7.9 %), total weight of BQ % (by 3.5 and 7.5 %) and DS % from BQ (10.7 and 14.8 %), while edible parts, skin of breast and thigh weight % from BQ were decreased significantly ($P=0.06$ and $P<0.01$, respectively) compared with values of STD group. Mean values of abdominal fat % decreased significantly by reducing ME and the lowest value recorded in E100 group (0.71%) with 41.8 % reduction compared with STD (1.22%). While the reduction in ME to E100 level increased skin of DS significantly by 30.9 % as compared with STD value.

Regarding to the all treatments the chicks fed on STD+PE increased the edible parts 13.5% significantly compared with STD while the rest of treatments didn't affected. Also, abdominal fat of chicks fed on E100+PE reduced significantly ($P=0.08$) by 46.2% compared with STD. The breast meat yield % increased significantly by 17, 15.5 and 13.5 % for chicks fed on E100, E100+PE, and E150+PE respectively compared to STD treatment. Chicks fed on E100+PE and E150+PE diets showed significantly reduce ($P=0.08$) of breast skin % by 29.9 and 29.8 compared with STD+PE respectively. Also, chicks fed on E100+PE and E150+PE groups gained the highest BQ% compared with other treatments. The recorded values of thigh % decreased significantly in groups subjected to low ME diets regardless PE supplementation. While DS % showed significantly increase in the same groups whereas increased significantly by 16.8, 16.1 and 16.7 % for E100+PE, E150 and E150+PE compared with STD respectively.

These results were in match with those reported by **Abou El-Wafa *et al* (2013)** who reported that carcass yield and abdominal fat percentages were not significantly affected by decreasing dietary ME level by 50 and 100 kcal/kg for starter, grower and finisher respectively. The same trend of effect of ME of broiler diets on carcass yield reported by **Williams *et al* (2014)**. Deposits of fat in the abdominal region of the broiler are considered a waste by the poultry industry and it also added expense for the processing effluent treatment. Supporting our results

Abudabos (2012) observed that abdominal fat, eviscerated, breast, thigh, drumsticks and total meat for broiler chicks was significantly decreased by low density diet (less 180,150 and 170 kcal/kg corn soybean diet for starter, grower and finisher period, respectively) than control, while enzyme (commercial enzyme containing 30 Ug^{-1} unites pectinase) supplementation for broiler diet improved eviscerated, breast and total meat percentages 1.25, 5.13 and 1.68 %.

The overall carcass traits results showed enhancement of breast meat yield, BQ and DS %, back quarter and thigh percentage by the interaction (PE x ME) this effect might be due to the enzyme which could be able to restore the nutritional value in the low density diet by releasing the entrapped protein during disruption of the cell wall matrix **(Chesson, 2001 and Bedford, 2000).** On contrary **Min *et al*. (2011)** obtained that when broiler were fed on diet supplemented with Rovabio Max 200g/tone (containing pectinase) and low energy diet (40 kcal/kg diet) didn't differ significantly compared with control group in dressing and breast meat yield %.

Meat quality: Table (5) presents the effect of pectinase enzyme supplementation and ME on some physical and chemical broiler meat quality measurements.

Physical measurement: The determined values of pHu and drip loss of different broiler cuts at the end of experiment showed significant increase of breast pHu (by 2.4%) and drip loss of thigh (by 69%) samples by pectinase supplementation compared with values of free supplemented group.

Reduction in ME to E100 and E150 levels decreased significantly breast pHu by 25.5 and 25.1 % respectively compared with STD measured value. While, drip loss increased by 36 and 46.4 % for E100 and E150 group, respectively. Applying E100 dietary ME for broilers caused 18.8 % reduction in DS drip loss than STD group but without significant different.

Among all treatments the drip loss of breast samples was increased by using E150+PE diets as compared with values determined in STD and STD+PE samples, while thigh drip loss values increased for E100+PE and E150+PE significantly compared with STD value. Chicks fed on E100, E100+PE, E150 and E150+PE diets showed significantly lower breast values of pHu by 24.4, 24.4, 25.6 and 22.4 %, respectively compared with STD. Regarding DS samples, using STD, E100+PE or E150+PE reduced drip loss significantly compared with the rest of treatments samples.

The recorded increased breast pHu values by pectinase supplementation may be indicate that PE decreased glycogen storage in breast meat and releases energy to chicks' metabolic use, as there was a reported relation between breast pH and glycogen storage by **Le-Bihan-Duval *et al.* (2008)**. According to pH and drip loss results, water holding capacity and possessing ability of breast meat might be increased **(Barbut, 1993; and Zhang and Savage, 2010).** While on the other side reducing dietary ME from STD level to E100 or E150 enhanced glycogen storage in breast meat whereas breast pH values decreased. Also increased values of processing yield (**Zhang and Savage, 2010**). In previous study by **Zakaria *et al.* (2010)** who recorded that the addition of mixture enzymes (containing pectinase) did not significantly impact meat quality traits of broiler (pH, cooking loss and water holding capacity).

Chemical measurements: The determined values of MDA, TP, LDL and HDL in samples of broiler meats showed that PE supplementation could increased concentration of TP only (7.9 % more than un supplemented group) while the rest of measurements didn't changed. Regarding the ME of experimental diets, decreased levels of E100 and E150 resulted in significant reduction of both MDA (by 25.2 and 33.3 %, respectively) and LDL (by 24.8 and 29.5 %, respectively) compared with STD values, while values of TP increased by

35.1 and 42.8 %, respectively. The recorded results for all treatment showed generally enhancement of meat quality of treatments E100, E100+PE, E150 and E150+PE compared with STD and STD+PE treatments.

The overall determined values of chemical measurements in broiler meat showed improvement due to both studied factors (PE and ME) and this supported by some previous authors as **Zakaria *et al.* (2010)** who reported that the addition of mixture enzymes (containing pectinase) increase CP in thigh meat while no significant difference detected in breast meat and this might be due to improvement in protein digestibility by pectinase supplementation. Also **Tahir *et al.* (2006); Kocher *et al.* (2002); Saleh *et al.* (2005)** used multi-enzyme preparations contained pectinase activity and obtained positive effect on protein digestibility. **Slominski and Campbell, (1990); Simbaya *et al.*, (1996)** explained that improvements by the digestion of pectin polysaccharides and increase of the available nutrients. Furthermore **Chesson (2001)** stated that approximately 10% of soybean protein is contained inside the cell wall matrix. In addition, **Tahir (2008)** recorded that the enzyme preparation containing pectinase stimulated protein digestion when added to broiler diets and indicated that degradation of pectin compound enables protein and energy, especially the protein of broiler feed, to become more digestible.

Generally pectinase supplementation, low energy diet and the interactions between them enhanced the overall quality of produced meat by reducing pHu, drip loss, MDA, LDL and increased TP These results were in agree with **Rao *et al.*, (2004)** who reported that, the chicks feed on yellow maize with supplementing enzymes at 0.5 g/kg diet recorded reduction in LDL and total cholesterol concentrations in serum, while protein concentration in the liver and breast muscle increases. Also, **Ermakova *et al.*, (1992)** recorded favorable effects of meat quality when adding Avizyme (an enzyme preparation contained cellulase, hemicellulase, beta -glucanase and protease activities) to diets of broiler chicks. On contrary meat quality were not changed among treatments when adding Avizyme and beta- glucanase to barley-based broiler diets **(Jeroch *etal*., 1991).**

Feeding coast:

The effect of experimental treatments on feeding cost /bird and feeding cost/kg of BWG are summarized in Table 6. Values were calculated according to prices of feed ingredients in Egypt at the time of the experiment. The calculated values indicated that neither pectinase supplementation to corn soybean meal broiler diets nor reducing ME of the diets by 100 or 150 kcal/kg diets could improve the feeding cost. The best values of feeding cost /bird and feeding cost/kg of BWG recorded by STD group. Although, reducing ME of diets by 100 or 150 kcal/kg resulted in reduction of the prices of formulated feed, the increased values of FCR of chicks in the experimental treatments compared with STD treatment led to increase of overall feeding cost.

CONCLUSION

According to the obtained results of this study it could be conclude that neither pectinase enzyme supplementation at level of 1000 U/kg diet to broiler diet based on corn-Soybean meal, nor reducing ME of diets by 100 or 150 kcal/kg diet could improve growth performance parameters and feeding cost, while the quality of carcass and meat were enhanced. Applying E100+PE formula could help producers to get acceptable marketing weight with better carcass and meat traits.

Table (1): experimental design.

Treatments	Std	Std+PE	E100	E100+PE	E150	E150+PE
Pectinase supplementation[1]						
Without	--		--		--	
With (PE)		1000U/kg diet		1000 U/kg diet		1000 U/kg diet
Dietary Metabolism Energy Level[2]						
Standard (STD)	3000,3100 and 3200	3000,3100 and 3200				
Lower 100 kcal of ME/kg of Std. (E100)			2900,3000 and 3100	2900, 3000 and3100		
Lower 150 kcal of ME/kg f Std. (E150)					2850,2950 and 3050	2850, 2950 and 3050

1: The enzyme was supplemented at rate of 1000 U pectinase activity /kg diet.
2: Dietary metabolizable energy level was calculated to be standard, lower 100 or 150 kcal/kg from metabolizable energy of standard for starter, grower and finisher stages.

Table (2): Compositions and calculated analysis of the experimental diets.

Ingredients	Starter (1-10 days)			Grower (11-22 days)			Finisher (23-40 days)		
	STD	E100	E150	STD	E100	E150	STD	E100	E150
Yellow corn	55.10	55.00	54.90	61.65	62.31	62.55	64.74	66.51	65.7
Soybean meal (44%)	31.00	33.57	36.17	23.84	24.44	25.86	19.25	19.48	23.09
Corn gluten meal(60%)	7.50	5.88	4.00	8.57	8.00	7.00	8.16	8.00	5.30
Soybean oil (SO)	1.80	0.95	0.45	2.27	0.60	0.00	3.28	1.44	1.44
Di-Ca-P	2.00	2.00	2.00	1.75	1.75	1.75	1.55	1.55	1.55
Limestone	1.15	1.20	1.15	1.46	1.46	1.46	1.58	1.58	1.58
NaCl	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24
Vit. And Min. pre-mix*	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
Sodium bicarbonate	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23
DL Methionine	0.24	0.26	0.27	0.19	0.19	0.19	0.17	0.17	0.19
L-Lysine HCl	0.34	0.27	0.19	0.40	0.38	0.32	0.40	0.40	0.28
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Calculated analysis									
Crude protein%	23	23	23	21	21	21	19	19	19
ME (kcal/kg diet)	3000	2904	2850	3093	3000	2950	3200	3100	3050
Crude fiber%	3.68	3.81	3.99	3.32	3.38	3.49	3.06	3.06	3.30
Ether extract%	4.52	3.97	2.97	5.05	3.52	2.92	6.21	4.37	4.21
Calcium %	0.98	0.97	0.98	1.00	1.00	1.00	1.00	1.00	1.00
Available P %	0.52	0.52	0.53	0.47	0.46	0.47	0.42	0.42	0.42
Sodium %	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17
Lysine %	1.38	1.38	1.38	1.24	1.26	1.24	1.11	1.11	1.11
Methionine %	0.67	0.68	0.67	0.60	0.60	0.60	0.55	0.55	0.55
Methionine+Cystine%	1.05	1.05	1.05	0.95	0.96	0.95	0.87	0.87	0.87
Cost / ton at Egyptian Local Price (LE)	3550	3471	3400	3443	33327	3263	3372	3260	3200

* Vitamins and minerals premix will provide each kg of diet with: Vit. A, 11000 IU; Vit. D3, 5000 IU; Vit. E, 50 mg; Vit K3, 3mg; Vit. B1, 2mg; Vit. B2 6mg; B6 3 mg; B12, 14 mcg; Nicotinic acid 60 mg; Folic acid 1.75 mg, Pantothenic acid 13mg; Biotine 120 mcg ; Choline 600 mg; Copper 16mg; Iron 40mg Manganese 120 mg; Zinc 100mg; Idoine 1.25mg; and Selenium 0.3 mg.

Table (3): Effect of pectinase supplementation and metabolizable energy levels on growth performance of broiler chicks at 40 days of age.

Treatments	Body weight (g)	Feed intake (g)	Body weight gain (g)	Feed conversion ratio
Main effect	**Pectinase supplementation (1000U/kg)**			
Without	1915.24	3421.29	1876.99	1.83
With (PE)	1948.40	3375.05	1908.40	1.77
Mean of SE	±18.87	±33.98	±18.27	±0.02
Probability	N.S	N.S	N.S	N.S
Metabolizable Energy (Kcal/kg)				
STD	1980.50^{a}	3287.31^{b}	1945.63^{a}	1.69^{c}
E100	1936.08^{ab}	3390.54^{b}	1893.58^{ab}	1.79^{b}
E150	1878.89^{b}	3561.66^{a}	1838.89^{b}	1.94^{a}
Mean of SE	±23.12	±41.62	±22.37	±0.03
Probability	0.02	0.004	0.01	0.0001
Treatments				
STD	2023.50^{a}	3343.25^{ab}	1983.75^{a}	1.68^{c}
STD+PE	1937.50^{a}	3231.37^{b}	1897.50^{ab}	1.71^{bc}
E100	1932.22^{a}	3401.04^{ab}	1887.22^{b}	1.81^{b}
E100+PE	1939.93^{a}	3380.04^{ab}	1899.93^{ab}	1.78^{bc}
E150	1790.00^{b}	3519.57^{a}	1750.00^{c}	2.01^{a}
E150+PE	1967.78^{a}	3513.74^{a}	1927.78^{ab}	1.82^{b}
Mean of SE	±32.69	±58.85	±31.64	±0.04
Probability	0.003	0.02	0.001	0.0003

a,b,...= Means in the same column with different superscripts, differ significantly ($P<0.05$)

N.S= Non significant. STD = Standard requirements PE = Pectinase

E100= 100 kcal/kg lower than STD. E150 =150 kcal/kg lower than STD.

Table(4): Effect of pectinase enzyme supplementation and metabolizable energy levels on carcass characteristics of broiler chicks at 40days of age.

Treatments	Carcass			Front quarter (FQ)		Back quarter (BQ)				
							Thigh		Drums stick (DS)	
	Dressing (% from live weight)	Edible Parts (% from carcass)	Abdominal fat (% from carcass)	Breast weight (% from carcass)	Skin (% from Breast)	Total weight (% from carcass)	Weight (% from BQ)	Skin (% from Thigh)	Weight (% from BQ)	Skin (% from DS)
Main effect	**Pectinase supplementation (1000U/kg)**									
Without	71.68	5.46	0.95	18.62	5.80	17.64	59.81	6.91	40.19	9.41
With (PE)	71.94	5.71	0.95	19.14	5.23	18.20	58.24	6.66	41.76	9.91
Mean of SE	±0.57	±0.12	±0.09	±0.35	±0.46	±0.23	±0.79	±0.55	±0.79	±0.52
Probability	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S
Metabolizable energy (Kcal/kg)										
STD	72.53	6.03^{a}	1.22^{a}	17.73^{b}	6.26^{a}	17.29^{b}	62.24^{a}	6.56	37.76^{b}	8.58^{b}
E100	71.00	5.43^{b}	0.71^{b}	19.79^{a}	5.48^{ab}	17.89^{ab}	58.19^{b}	6.99	41.81^{a}	11.23^{a}
E150	71.90	5.30^{b}	0.93^{ab}	19.13^{a}	4.79^{b}	18.58^{a}	56.65^{b}	6.80	43.35^{a}	9.17^{b}
Mean of SE	±0.70	±0.14	±0.11	±0.43	±0.39	±0.28	±0.97	±0.67	±0.97	±0.64
Probability	N.S	0.004	0.02	0.02	0.06	0.02	0.004	N.S	0.004	0.03
Treatments										
STD	73.06	5.65^{b}	1.19^{a}	17.02^{b}	6.00^{ab}	17.27^{bc}	62.76^{a}	7.00	37.24^{b}	8.57
STD+PE	72.01	6.41^{a}	1.26^{a}	18.44^{ab}	6.52^{a}	17.32^{bc}	61.71^{a}	6.13	38.29^{b}	8.58
E100	71.75	5.26^{b}	0.79^{ab}	19.92^{a}	6.39^{ab}	17.11^{c}	59.88^{ab}	7.08	40.12^{ab}	11.13
E100+PE	70.25	5.60^{b}	0.64^{b}	19.66^{a}	4.57^{b}	18.66^{a}	56.49^{b}	6.89	43.51^{a}	11.33
E150	70.25	5.48^{b}	0.89^{ab}	18.94^{ab}	5.00^{ab}	18.54^{ab}	56.78^{b}	6.65	43.22^{a}	8.52
E150+PE	73.56	5.12^{b}	0.97^{ab}	19.32^{a}	4.58^{b}	18.62^{a}	56.53^{b}	6.96	43.47^{a}	9.81
Mean of SE	±0.99	±0.20	±0.16	±0.61	±0.55	±0.40	±1.37	±0.95	±1.37	±0.91
Probability	NS	0.004	0.08	0.05	0.08	0.03	0.02	N.S	0.02	N.S

a,b,...= Means in the same column with different superscripts, differ significantly ($P<0.05$); N.S = Not Significant ($P>0.05$) PE= Pectinase
STD= Standard requirements E100= 100 kcal/kg lower than STD.
E150 =150 kcal/kg lower than STD. Front quarter (FQ): Breast quarter without wing Back quarter (BQ): Leg quarter including thigh and drum stick

Table (5): Effect of pectinase enzyme supplementation and metaboilzable energy levels on physical and chemical meat quality of broiler chicks at 40 days of age.

Treatments	Physical measurement						Chemical measurement			
	Breast		Thigh		Drumsticks		MDA (nmol/100g meat)	TP (mg/100g meat)	LDL (mg/100g meat)	HDL (mg/100g meat)
	Drip Loss	pH	Drip Loss	pH	Drip Loss	pH				
Main effect	**Pectinase supplementation (1000U/kg)**									
Without	3.04	6.25^{b}	2.62^{b}	6.49	1.06	6.43	387.01	67.86^{b}	1110.48	666.02
With (PE)	3.33	6.40^{a}	4.43^{a}	6.43	1.00	6.46	348.20	73.25^{a}	1086.03	711.38
Mean of SE	±0.21	±0.05	±0.36	±0.07	±0.11	±0.04	±15.49	±1.42	±25.57	±17.05
Probability	N.S	0.05	0.006	N.S	N.S	N.S	N.S	0.02	N.S	N.S
	Metabolism Energy (Kcal/kg)									
STD	2.50^{b}	7.61^{a}	2.79	6.30	1.06	6.38	456.57^{a}	56.01^{b}	1340.95^{a}	679.50
E100	3.40^{a}	5.67^{b}	3.64	6.51	0.86	6.48	341.55^{b}	75.69^{a}	1008.33^{b}	663.97
E150	3.66^{a}	5.70^{b}	4.17	6.57	1.18	6.47	304.69^{b}	79.98^{a}	945.48^{b}	722.64
Mean of SE	±0.25	±0.06	±0.45	±0.09	±0.13	±0.05	±18.98	±1.74	±31.32	±20.88
Probability	0.007	0.0001	N.S	N.S	N.S	N.S	0.0003	0.0001	0.0001	N.S
	Treatments									
STD	2.51^{b}	7.50^{a}	2.17^{b}	6.27	0.61^{b}	6.42	489.20^{a}	51.13^{c}	1398.57^{a}	665.24
STD+PE	2.49^{b}	7.71^{a}	3.40^{ab}	6.33	1.50^{a}	6.34	423.94^{ab}	60.88^{b}	1283.33^{a}	693.76
E100	3.23^{ab}	5.67^{b}	1.89^{b}	6.52	1.03^{ab}	6.47	364.32^{bc}	74.90^{a}	1005.71^{b}	640.44
E100+PE	3.57^{ab}	5.67^{b}	5.39^{a}	6.49	0.69^{b}	6.49	318.78^{c}	76.47^{a}	1010.95^{b}	687.50
E150	3.39^{ab}	5.58^{b}	3.82^{ab}	6.68	1.54^{a}	6.39	307.51^{c}	77.55^{a}	927.14^{b}	692.39
E150+PE	3.92^{a}	5.82^{b}	4.51^{a}	6.46	0.82^{b}	6.54	301.88^{c}	82.40^{a}	963.81^{b}	752.89
Mean of SE	±0.36	±0.08	±0.63	±0.13	±0.18	±0.07	±26.84	±2.47	±44.29	±29.53
Probability	0.04	0.0001	0.01	N.S	0.01	N.S	0.002	0.0001	0.0001	N.S

a,b,...= Means in the same column with different superscripts, differ significantly ($P<0.05$); N.S = Not Significant ($P>0.05$)

PE= Pectinase STD = Standard requirements. E100= 100 kcal/kg lower than STD. E150 =150 kcal/kg lower than STD.

Table (6): Effect of experimental treatments on feeding cost of broiler chicks during 40 days of age.

Treatments	Final BW (g)	BWG (g)	FCR	Feeding cost/bird (LE)	Feeding cost/kg of BWG (LE)
STD	2023	1984	1.68	11.39	5.74
STD+PE	1937	1897	1.71	11.24	5.93
E100	1932	1887	1.81	11.59	6.14
E100+PE	1940	1900	1.78	11.74	6.18
E150	1790	1750	2.01	11.99	6.85
E150+PE	1968	1928	1.82	12.21	6.33

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الملخص العربى

تأثير إضافة إنزيم البكتينييز و مستويات منخفضه من الطاقه لعلائق الأذره وكسب فول الصويا على الأداء الإنتاجى وجودة اللحم والذبيحه لكتاكيت التسمين

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فى هذه الدراسه تم استخدام مائتين وأربعون كتكوت تسمين غير مجنس سلالة أربر إيكرز عمر يوم لإختبار تأثير إضافة إنزيم البكتينييز مع مستويات مختلفه فى الطاقه الممثله على تحسين الأداء الإنتاجى وجودة الذبيحه وجودة اللحم وتكاليف التغذيه. تم توزيع الكتاكيت عشوائيا الى ستة معاملات (تصميم عاملى ٢*٣) كل معامله تحتوى على أربع مكررات (عدد ١٠ كتاكيت/مكرر). غذيت الكتاكيت على علائق الأذره وكسب فول الصويا المضاف إليها مستويين من إنزيم البكتينييز (إما بدون أو بإضافة ١٠٠٠وحدة انزيم /كيلو جرام علف) وثلاث مستويات من الطاقة الممثله وهى القياسيه (الموصى بها للسلاله) وأقل ١٠٠ كيلوكالورى من القياسيه (E100) أقل ١٥٠ كيلو كالورى من القياسيه (E150) وذلك لكل مرحله تغذيه. و كانت مستويات الطاقه بالعلائق ٣٠٠٠ و ٢٩٠٠ و٢٨٥٠ كيلو كالورى/كيلو جرام علف فى مرحلة البادى و ٣١٠٠ و ٣٠٠٠ و ٢٩٥٠ كيلو كالورى/كيلو جرام علف فى مرحلة النامى و ٣٢٠٠ و ٣١٠٠ و ٣٠٥٠ كيلو كالورى/كيلو جرام علف فى مرحلة الناهى. تم تكوين العلائق لتوفير إحتياجات السلاله من بقية المواد الغذائيه. تم تسكين الكتاكيت فى نظام العنابر المفتوحة و خضعت لنفس برنامج الرعاية و البيطرة خلال فترة التجربة (من ١-٤٠ يوم). تم تسجيل مقاييس الأداء الأنتاجى وصفات الذبيحه وتقيم الصفات الطبيعيه والكيماويه للحم و تم حساب تكاليف التغذيه . أظهرت النتائج أن إضافة إنزيم البكتينييز لم يؤثرعلى الأداء الأنتاجى معنويا بينما أدي إلى زيادة قيم pHu ونسبة الفقد فى الماء فى الفخذ و البروتين الكلى فى اللحم (TP). أدى الإنخفاض فى مستوى الطاقه بمعدل ١٥٠ كيلو كالورى/كيلو جرام الى إنخفاض معنوى فى وزن الجسم النهائى بينما الإنخفاض بمستوى الطاقه الى ١٠٠ كيلو كالورى أدى إلى خفض معنوى فى نسبة دهن البطن. قيم pHu الصدر و مركب المالون داى الهيد (MDA) و تركيز الليبوبروتينات منخفضة الكثافة (LDL) فى عينات اللحم عند عمر ٤٠ يوم إنخفضت معنويا مع الإنخفاض فى الطاقة عند كلا المستويين (E100 و E150)، بينما زاد معنويا العلف المستهلك ومعدل التحويل الغذائى و محصول لحم الصدر ووزن الفخد ووزن الدبوس ونسبة الفقد فى الماء للصدر و البروتين الكلى فى اللحم بالمقارنه بقيم المعامله القياسيه. وأظهرت نتائج المعاملات ككل تأثير معنوى على الاداء الانتاجى و قياسات الذبيحة وجودة اللحم. سجلت المجموعه القياسيه أقل قيمه لتكلفة العليقه بالمقارنه بباقى المعاملات.

بوجه عام نستخلص ان اضافة البكتينيز ومستويات منخفضه للطاقه الممثله فى العليقه لم يسجل تحسن فى قياسات الاداء الانتاجى وتكلفة العليقه ولكن حسنت من جودة الذبيحه وجودة اللحم. واستخدام العليقه المنخفضه ١٠٠ كيلو كالورى مع اضافة الانزيم (E100+PE) قد تساعد المنتج للدواجن للحصول على وزن تسويقى مقبول مع الحصول على جودة ذبيحه وجودة لحم افضل.