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EFFECTS OF GRADED LEVELS OF POTATO BY-PRODUCT AND TOMATO POMACE ON THE PERFORMANCE AND CARCASS CHARACTERISTICS OF BROILER CHICKENS.

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ABSTRACT

The objective of the present study was to evaluate the potato by-product (PB) and tomato pomace (TP) as unusual feedstuff in broiler diets in terms of performance and carcass characteristics. A total number of 504 one day old male Ross broiler chicks were used in the experiment. The by-products were added to the experimental diets at 8, 16 and 24 % of the diet. After that, the experimental diets were divided into two groups. The first group was supplemented with enzyme mixture while the other group was free of enzyme supplementation. Two control diets were also used as positive and negative control. Each dietary treatment was fed to 3 replicates of 12 chicks each up to 35 days of age. The results of the experiment showed that significantly lower body weights and weight gain were recorded for the two groups fed 24% potato by-product with or without enzyme supplementation when compared to their respective controls. On the other hand, no significant differences in body weight and weight gain were observed for the birds fed Tomato pomace (TP) at different replacement levels compared to their respective control groups whether the birds fed diets supplemented with enzyme or not. All the groups fed TP at different replacement levels, whether supplemented or not with enzyme and the groups fed PB (8%) and PB (16%) without enzyme recorded significantly higher feed intake in comparison with their respective control group. Non significant differences were obtained among different groups for carcass parameters. The addition of enzyme enhanced in general the numerical values of chicken performance parameters. It could be concluded that either potato by-products (PB) or tomato pomace (TP) could be incorporated into broilers' diets by replacement levels up to 16%. The negative effect of high fiber content on chickens' performance could be avoided by addition of fiber degrading commercial enzyme to the diets.

INTRODUCTION

In the face of population growth and urbanization, increasing the supply of animal products is a major factor contributing to food security and quality. Poultry rearing is one of the activities that can directly address this important issue. In the last years, the key challenge in poultry production is providing feed with less cost. Feed costs, may be reduced by including locally and regionally grown crops and by-products into poultry diets. In the recent years, several studies have reported the possibility of utilizing food industry by-products for poultry feed. These tested by-products included olive pulp *(Rabayaa et al., 2001),* apple by-products (*Zafar et al., (2005),* yam peel meal *(Ekenyem et al., (2006),* artichoke leaves meal *(Zeinab et al., 2007),* guava by-product *(El-Deek et al.,(2009),* carrot and fruit juice wastes mixture *(Rizal* *et al. , 2010).* Food processing is the second largest industry in Egypt; it yields a huge amount of by-products which need to be disposed off (Egypt-Spain report, 1998).

In Egypt, potato is one of the most important and economic tubers crop. The total potato harvested area in Egypt reached about 100,000 ha; this area produced 2.5 million tons/ha with an average of 25 tons/ha (FAO, 2006). Potato wastes are the by- products that results from potatoes processing. The by-products might include peeling, cull potatoes, reject French fries and other residuals. Approximately 35% of the total processed potato crop is discarded as a waste during processing. This waste ferments rapidly and can cause environmental pollution (*Tawila et al., 2008)*.

Tomato *(Lycopersicon esculentum)* is one of the most popular crops in Egypt. It is used as a salad, in food preparations and as juice, soup, puree, ketchup or paste. Commercial processing of tomato produces a large amount of waste at various stages. Tomato pomace constitutes the major part of the waste that comes from the pulper *(Basuny et al., 2009)*.

The present study was performed to investigate the effect of incorporating different levels of potato-by products or tomato pomace with and without enzyme supplementation in broiler chicken diets on their performance and carcass characteristics.

MATERIALS AND METHODS

This study was carried out at the poultry experimental station of the Regional Center for Food and Feed (RCFF) located in Nubaria, Alexandria, Egypt during 2009. The tested potato and tomato by-products used in this study were obtained from “Farm Frites” company, commercial market and “Kaha” company; respectively. The tested by-products were air dried, finely ground and thoroughly homogenized before mixing with the other ingredients of the experimental diets. Chemical analyses of the tested by-products were done according to the AOAC, 2006.

A total number of 504 one day old male Ross broiler chicks were used in this study. The experimental diets were formulated to cover the chick requirements as recommended by the management guide data (Ross). The by-products were added to the experimental diets at 8, 16 and 24 % of the diet. The diets were divided into two groups. The first group was supplemented with enzyme mixture while the other group was free of enzyme. Each dietary treatment was fed to 3 replicates of 12 chicks’ each. The average initial live body weights of all replicates were nearly the same. Electric heaters were used to keep the required temperature for the brooding period. Light was provided 24 hr daily throughout the experiment. Feed and water were provided *ad-libitum* throughout the 35-day experimental period. Feed consumption and live body weight were recorded at 35th day after fasting overnight and feed conversion ratio (feed/ gain) was then calculated.

Tables (1-4) show the formulation and nutrients composition of the experimental diets used as well as the control diets.

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Table 3: Composition and analysis of control diets without enzyme

Ingredients	Starter diet	Grower diet	Finisher diets
Ground yellow Corn 7.5% CP	58.250	60.357	63.391
Soybean meal 46% CP	30.321	26.700	23.553
Corn Gluten meal 58.1% CP	7.102	8.000	6.818
Vegetable Oil	0.250	1.220	2.597
Di-Ca phosphate	1.900	1.670	1.700
Limestone	0.789	0.700	0.689
NaCl	0.400	0.400	0.400
Premix	0.300	0.300	0.300
Choline	0.075	0.075	0.075
Dl-Methionine	0.253	0.230	0.208
L-lysine HCl	0.360	0.348	0.290
Total	100	100	100
Determined analysis (%)			
CP	23.400	22.200	20.500
Ca	1.100	0.950	0.930
Total P	0.760	0.700	0.690
E E	2.950	3.200	3.550
Ash	6.500	5.900	5.400
CF	2.510	2.490	2.520
NFE	53.440	56.140	59.110

(*)Premix supplied per Kg of diet: Vit. (A), 12000 I.U., Vit.(D_3), 2000I.U. ; Vit.(E), 10mg ;Vit.(K_3) , 2mg; Vit.(B_1), 1 mg; Vit.(B_2), 5 mg; Vit.(B_6), 1.5 mg; Vit.(B_{12}), 10 ug; Biotin, 50ug; Choline chloride,500mg; Pantothenic acid , 10 mg; Niacin,30mg; Folic,1mg; Manganese, 60mg; Zinc,50mg; Iron,30mg;Copper,10mg;Iodine,1mg;Selenium,0.1mg and Cobalt,0.1mg (According to NRC;1994).

Table 4: Composition and analysis of control diets with enzyme:

Ingredients	Starter diet	Grower diet	Finisher diets
Ground yellow Corn 7.5% CP	58.200	60.307	63.341
Soybean meal 46% CP	30.321	26.700	23.553
Corn Gluten meal 58.1% CP	7.102	8.000	6.818
Enzyme **	0.050	0.050	0.050
Vegetable Oil	0.250	1.220	2.597
Di-Ca phosphate	1.900	1.670	1.700
Limestone	0.789	0.700	0.689
NaCl	0.400	0.400	0.400
Premix*	0.300	0.300	0.300
Cholin	0.075	0.075	0.075
Dl-Methionine	0.253	0.230	0.208
L-lysine HCl	0.360	0.348	0.290
Total	100	100	100
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CP	23.400	22.200	20.500
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(**) Each 1000g of the enzyme contains: Cellulase 700000 U, Amylase 100000 U, Pectinase 60000 U, Phytase 100000 U, Xylanase 1000000 U and Carrier (Silica sand) up to 1000g.

At the end of the experimental period (5 weeks), a slaughter test for carcass traits was performed on 114 birds including 3 birds from each of the control groups and 3 birds from each treatment level of each tested by-product.

Data obtained from growth experiment were statistically analyzed for the analysis of variance using the general linear model of SAS (SAS institute, 1990). Means were compared (p≤0.05) using Duncan's new multiple range test (Duncan, 1955).

RESULTS

The effect of the different dietary treatments on live body weight, weight gain, feed intake and feed conversion allover the whole feeding period (1-35 days) is presented in Table (5)

The results indicated that body weight of the birds fed Potato by-products (PB) at the levels of 8 and 16% with or without enzyme showed non significant differences compared to their respective controls, whereas significantly lower body weights were recorded for the two groups fed 24% potato by-product with or without enzyme when compared to their respective controls. For the birds fed Tomato pomace (TP) with or without enzyme, the results showed that the three tested replacement levels exhibited non significant differences compared to their respective control groups.

The results of body weight gain as influenced by the different dietary treatments under investigation followed the same trend observed with live body weight.

Table (5): Effect of different dietary treatments on chickens' performance allover the experimental period.

Treatments	Body weight (g)	Weight gain(g)	Feed intake(g)	Feed conversion
Control (negative)	1621 ^{bc}	1577 ^{bc}	2804 ^{f}	1.78^{e}
Control + Enzyme (positive)	1670 ^{abc}	1626 ^{abc}	2866 ^{ef}	1.77 ^{e}
Potato 8%Without Enzyme	1598 ^{c}	1554^{c}	3121 ^{bcd}	2.00 ^{abc}
Potato 16%Without Enzyme	1586 ^{c}	1542^{c}	3067 ^{bcde}	1.99 ^{abcd}
Potato 24%Without Enzyme	1382 ^{d}	1338^{d}	2795 ^{f}	2.08 ^{a}
Potato 8%+ Enzyme	1607 ^{bc}	1563^{bc}	2914 ^{def}	1.86 ^{de}
Potato 16%+Enzyme	1602 ^{bc}	1558^{bc}	2995 ^{cdef}	1.92 ^{bcd}
Potato 24%+ Enzyme	1465 ^{d}	1421^{d}	2987 ^{cdef}	2.10 ^{a}
Tomato 8%Without Enzyme	1651 ^{abc}	1607^{abc}	3171 ^{abc}	1.97 ^{abcd}
Tomato 16%Without Enzyme	1650 ^{abc}	1606^{abc}	3367 ^{a}	2.09 ^{a}
Tomato 24%Without Enzyme	1625 ^{abc}	1581^{abc}	3247 ^{ab}	2.05 ^{ab}
Tomato 8%+ Enzyme	1698 ^{a}	1654 ^{a}	3110 ^{bcd}	1.88 ^{cde}
Tomato 16%+ Enzyme	1677 ^{ab}	1633 ^{ab}	3226 ^{ab}	1.94 ^{bcd}
Tomato 24%+ Enzyme	1643 ^{abc}	1599 ^{abc}	3079 ^{bcd}	1.92 ^{bcd}
SEM	*± 29.03*	*± 29.03*	*±65.25*	*± 0.04*

a,b,c,….means within same column with different superscripts are significantly different (p<0.05)

All the groups fed TP at different replacement levels, whether supplemented or not with enzyme and the groups fed PB (8%) and PB (16%) without enzyme recorded significantly higher feed intake in comparison with their respective control group.

There was no significant difference regarding feed conversion ratios between birds fed diets containing 8% by-products supplemented with enzyme and their respective control (PB,(1,86), TP (1.88) and Control (1.78)). While, the worst feed conversion was observed by groups fed diets containing PB (8, 16 and 24%) without enzymes and those containing PB (16 and 24%) with enzyme. A similar trend was observed for the groups fed TP (8, 16 and 24%) without enzymes and those containing TP (16 and 24%) with enzyme which recorded also inferior feed conversion ratios as compared to their respective control groups.

Effect of the different dietary treatments on carcass characteristics:

Table (6) gives the carcass characteristics (dressed weight, liver, gizzard, heart, drumstick and thigh percentage) recorded for the chicks at the end of the experiment. There was no effect of the experimental diets on the absolute weight at slaughter, yield of gutted carcass, gutted carcass without feet, head and breast except for 24% PB with and without enzyme which showed the lowest significant weight compared to other groups. There was no significant effect of the experimental diets for breast weight except for the group 24% PB without enzyme which recorded significantly lower value compared to other groups.

The results of drumstick showed non significant differences among the experimental groups fed the tested by-products without enzymes in comparison to their corresponding control. The groups fed enzyme-free diets containing PB at the level 16% and those containing TP at the levels 8 and 16% showed non-significant differences compared to their respective control, whereas the enzyme-free groups containing 8 and 24% PB and those containing 24% TP recorded lower drumstick percent compared to their respective control.

No significant differences were observed in case of thight weights for the groups fed 8% PB treated with enzyme and the groups fed TP at replacement levels 8, 16% whether supplemented with enzyme or not, as compared to their respective control group. Non significant differences were also recorded for the thight weight for the groups fed 8 and 16% TP with enzyme compared to their control. While at the replacement level 24% TP a significant decrease in thight weight occurred for the diet supplemented with enzyme, yet when the diet at this replacement level was not supplemented with enzymes no significant differences were observed compared to their respective controls. On the other hand the groups containing 16 and 24% PB without enzyme and those containing 8, 16 and 24% PB with enzyme, recorded significantly lower thigh weights as compared to their respective control groups.

The inclusion of potato by-products and tomato pomace in broiler diets was economically better as there was a decrease in the experimental diets cost compared to the control diets cost.

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DISCUSSION

Regarding the overall data, it can be concluded that feeding the diet containing potato by-product meal at the level 24% without enzyme supplementation had a negative effect on the body weight and the weight gain of the broiler chickens. This might be attributed to the high fiber content of this diet which consequently reduced energy access to the chickens. It has to be noted also that, the addition of enzyme to the diet did not compensate for this recorded negative effect. In this connection, Whittemore *et al.,* (1974) reported that the performance of broilers given diets containing 0, 10 and 20% potato flakes in place of maize were similar. They also found no change in feed conversion in the tested diets compared to the control group. D'Mello and Whittemore (1975) concluded that potato flakes enhanced the performance of birds compared to potato starch. Gerry (1977) found that the inclusion of 2,4 and 8% dehydrated soluble potato solids (DSPS) in broiler diets had little or no effect on growth and feed efficiency of the broilers. Whereas the inclusion of higher levels of DSPS (12 and 16%) depressed body weight and dropped feed efficiency significantly. *Hulan et al.,* (1882 a and b) concluded that potato waste meal supplemented with methionine could substitute successfully up to 20% of ground corn in practical poultry diets. Moustafa (1992) reported that live body weight decreased when dietary potato by-product (PB) level increased in broiler chick diets, the rate of growth was not significant between 33.3% and 25% potato by-product levels. Feed efficiency was not significant between the control diet and 25% PB level, but the treatment with 33.3% PB recorded high feed intake than the control. Soliman and El-Taweel (2001) reported that no significant differences in growth performance were observed between chicks fed the control diet and those consumed the 20% DSPS diet. Nasr El-Deen, 2007 found that chicks fed 5% potato by-product recorded the highest live body weight and weight gain values and those fed 20% potato by-product achieved the lowest ones.

Regarding the overall results obtained for the groups fed tomato pomace (TP), it can be seen that although the groups fed TP showed higher numerical values for live body weights compared to other groups, yet incorporation of TP in chicks' diets didn't cause significant changes in chickens' performance as compared to control. It was also noted that increasing the level of TP caused reduction of live body weight of the chickens and the groups supplemented with enzymes recorded higher live body weights compared to their respective ones with no enzyme supplementation. In this respect, Kelley (1958) found a superior growth with broilers fed 5% dried tomato seed cake compared with wheat middlings.

In agreement with our results, El-Alialy (1974), Tomczynski (1976) and Garcia and Gonzales (1984) indicated that various tomato wastes and by-products can be included in small amounts (< 5%) in broiler diets. Large amounts severely restrict available energy content of the diet due to their high fiber content (Yannakopoulus *et al.*, 1992). Also in agreement with these results, Nasr El-Deen (2007) stated that broilers fed 5% tomato by-product meal (TBM) recorded the highest live body weight and weight gain values followed by those fed the control diet, while those fed 20% TBM achieved the lowest ones. He also reported that, both live body weight and weight gain of chicks mostly decreased with increasing the dietary TBM level during all the experimental periods.

The addition of enzymes caused numerical increase of body weight and body weight gain for the groups fed the diets containing tested by-products. This is in accordance with the findings of Marck and Splitek (1990) and Arora *et al.,* (1991) who concluded that cellulolytic enzymes when added to a high fiber diet of broiler chicks resulted in increased body weight.

In treatments with enzyme, though no significant differences were found, the feed intake was reduced because of the effects of enzyme on non starch polysaccharides and subsequent improvement in digestibility and absorption. There was no impact of experimental diets on cumulative feed consumption over the entire experimental period. This result may be related to ingestion and digestion capacity which, increases as the birds get older i.e. adult birds seem to be able to fit to high dietary fiber content as they have a better developed digestive tracts compared to younger birds so that they can reduce or neutralize negative effects of fibrous portion of the diet (Potter *et al.,* 1990; Philip *et al*., 1995).

Feed conversion ratio deteriorated significantly as the inclusion level of TP increased and birds receiving the control diets exhibited the best FCR ($p<0.05$). High fiber content of the diets containing TP and the limitation of dietary energy or the presence of pesticides residue in the outer skin layer of tomato pulps may account in part for deterioration of FCR.

Previous reports indicated that the different by-products used in broiler diets had little or no effect on the dressing percentages of the edible parts as long as the diet contained the requirements of protein and energy (Hegazy *et al.*, 1998). In line with our results, Kamal (1998) and Mohamed (1999) reported that there were no significant differences in giblets weight percentage for broilers fed diets containing different levels of tomato wastes.

Conclusion:

Results from this experiment suggest that Potato by-products (PB) and tomato pomace (TP) could be incorporated into broilers' diets by replacement levels up to 16%. The negative effect of high fiber content of the two studied by-products on chickens' performance could be avoided by addition of fiber degrading enzyme.

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تأثير إستخدام مستويات مختلفة من مخلفات تصنيع البطاطس و الطماطم على مقاييس الاداء و خصائص الذبيحة في دجاج التسمين

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تم إجراء الدراسة الحالية بهدف تقييم استخدام مخلفات البطاطس و مخلفات الطماطم كمصدر للعلف غير التقليدي في علائق دجاج التسمين و معرفة تأثير ذلك على اداء الدواجن و خصائص الذبيحة. تم إستخدام 504 كتكوت عمر يوم من سلالة "روس". استخدمت المخلفات المختبرة بمستويات الإحلال 8 و 16و 24 % . بعد ذلك تم تقسيم العلائق إلى مجموعتين حيث تم إضافة مخلوط من الانزيمات إلى إحدى المجموعتين و الثانية بدون إضافة . تم إستخدام عليقتي كونترول (كونترول سلبي و كنترول ايجابي) . تم تقديم كل معامله غذائية إلى ثلاث مكررات كل منها يحتوي على 12 كتكوت حتى عمر 35 يوم. أوضحت نتائج التجربة وجود فروق معنوية بالنسبة لوزن الجسم الحي و الوزن المكتسب وذلك بالنسبه للمجموعات التي غذيت على العليقة المحتوية على 24% من مخلف البطاطس سواء تلك المضاف اليها إنزيم او الغير مضاف إليها مقارنة بالكنترول المقابل لكل معامله. على الجانب الاخر لم توجد فروق معنوية بالنسبة للمجموعات التي تغذت على العلائق المحتوية على مستويات مختلفة من مخلف الطماطم سواء كانت العلائق تحتوي على انزيم أو لا. كما اظهرت النتائج وجود فروق معنويه بالنسبه لكمية الغذاء المأكول والتي تم تسجيلها بالنسبة للمجموعات التي تغذت على العلائق المحتويه على مخلف الطماطم عند مستويات الإحلال المختلفه سواء المضاف اليها الانزيم او تلك التي لم يضاف اليها إنزيم.، كذلك بالنسبه للمجموعات التي إحتوت على مخلفات البطاطس بنسب 8 و 16% بدون انزيم . لم يلاحظ وجود فروق معنوية بالنسبة لخصائص الذبيحة للمجموعات التي تغذت على المخلفات مقارنة بالعلائق الكنترول. حسنت إضافة الانزيم بوجه عام من النتائج الرقمية لمقاييس الاداء بالنسبة لدجاج التسمين. و قد بينت الدراسة انه يمكن اضافة مخلفات البطاطس او الطماطم إلى علائق دجاج التسمين بمستويات حتى 16% ، كما انه يمكن الحد من الاثر السلبي لنسبة الالياف العالية في العلائق عن طريق إضافة مخلوط الانزيمات.

قام بتحكيم البحث

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Table (1): Composition and analysis of the experimental diets containing potato by-products (PB) or tomato pomace (TP) without enzyme supplementation at the three feeding periods (starter, grower and finisher).

Ingredient	Starter diets			Grower diets			Finisher diets			Starter diets			Grower diets			Finisher diets		
	PB 8%	PB 16%	PB 24%	PB 8%	PB 16%	PB 24%	PB 8%	PB 16%	PB 24%	TP 8%	TP 16%	TP 24%	TP 8%	TP 16%	TP 24%	TP 8%	TP 16%	TP 24%
Ground yellow Corn 7.5% CP	53.119	47.536	42.202	55.244	49.300	44.590	58.201	53.278	48.374	52.921	48.000	42.850	55.174	49.840	44.953	58.078	55.134	48.107
Soybean meal 46% CP	27.633	26.466	24.680	24.033	21.837	20.470	20.890	18.299	15.553	27.650	24.987	22.321	24.033	21.367	18.70	20.886	18.219	15.553
Corn Gluten meal 58.1% CP	7.000	6.000	5.000	8.000	7.700	6.400	6.818	6.700	6.600	7.102	6.686	6.500	7.800	7.800	7.500	6.718	6.300	6.200
By-product	8.000	16.000	24.000	8.000	16.000	24.000	8.000	16.000	24.000	8.000	16.000	24.00	8.000	16.000	24.000	8.000	16.000	24.000
Vegetable Oil	0.130	0.100	0.100	1.000	1.610	0.937	2.420	2.200	2.000	0.250	0.250	0.252	1.220	1.220	1.260	2.667	2.250	2.617
Di-Ca phosphate	1.880	1.780	1.750	1.670	1.550	1.600	1.700	1.700	1.650	1.900	1.900	1.900	1.670	1.670	1.670	1.700	1.700	1.700
Limestone	0.820	0.700	0.770	0.700	0.650	0.600	0.698	0.550	0.550	0.789	0.789	0.789	0.700	0.700	0.600	0.678	0.570	0.550
NaCl	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300
Premix *	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400
Choline	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075
Dl-Methionine	0.243	0.243	0.243	0.230	0.230	0.230	0.208	0.208	0.208	0.253	0.253	0.253	0.230	0.230	0.230	0.208	0.208	0.208
L-lysine HCl	0.400	0.400	0.480	0.348	0.348	0.398	0.290	0.290	0.290	0.360	0.360	0.360	0.398	0.398	0.398	0.290	0.290	0.290
Total	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Determined analysis (%)																		
CP	23.200	23.100	23.300	22.100	22.300	22.300	20.300	20.000	20.100	23.100	22.950	23.200	22.100	22.300	22.500	20.500	20.200	20.300
Ca	1.150	1.140	1.140	0.950	0.970	0.940	0.930	0.920	0.930	1.120	1.080	1.100	0.960	0.9400	0.970	0.910	0.940	0.900
Total P	0.770	0.760	0.770	0.710	0.710	0.700	0.690	0.710	0.710	0.780	0.760	0.760	0.710	0.730	0.690	0.690	0.710	0.710
E E	2.900	3.120	3.320	3.100	3.300	3.610	3.000	3.250	3.340	3.190	3.760	4.440	3.290	3.830	4.370	3.300	3.870	4.420
Ash	6.200	6.000	5.800	5.800	6.100	6.200	6.200	6.600	6.600	6.100	6.500	6.600	5.900	6.700	6.700	6.600	6.800	7.000
CF	3.760	5.020	6.260	3.680	4.910	6.170	3.610	4.830	5.6200	4.860	7.100	9.350	4.780	7.020	9.390	4.710	6.490	9.330
NFE	52.950	53.650	51.000	54.210	53.110	52.670	53.440	55.560	57.180	52.910	53.750	51.990	51.710	50.990	54.310	55.250	57.270	57.980

(*)Premix mixture supplied per Kg of diet: Vit. (A), 12000 I.U., Vit.(D_3), 2000I.U. ; Vit.(E), 10mg ;Vit.(K_3) , 2mg; Vit.(B_1), 1 mg; Vit.(B_2), 5 mg; Vit.(B_6), 1.5 mg; Vit.(B_{12}), 10 ug; Biotin, 50ug; Choline Chloride,500mg; Pantothenic acid , 10 mg; Niacin,30mg; Folic,1mg; Manganese, 60mg; Zinc,50mg; Iron,30mg;Copper,10mg;Iodine,1mg;Selenium,0.1mg and Cobalt,0.1mg (According to NRC;1994).

Table (2): Composition and analysis of the experimental diets containing potato by-products (PB) or tomato pomace (TP) with enzyme supplementation at the three feeding periods (starter, grower and finisher).

Ingredient	Starter diets			Grower diets			Finisher diets			Starter diets			Grower diets			Finisher diets		
	PB 8%	PB 16%	PB 24%	PB 8%	PB 16%	PB 24%	PB 8%	PB 16%	PB 24%	TP 8%	TP 16%	TP 24%	TP 8%	TP 16%	TP 24%	TP 8%	TP 16%	TP 24%
Ground yellow Corn 7.5% CP	53.069	47.486	42.152	53.069	47.548	42.152	53.069	47.486	42.170	52.871	47.970	42.800	55.124	49.790	44.817	58.028	54.638	48.057
Soybean meal 46% CP	27.633	26.466	24.680	27.633	26.466	24.680	27.633	26.466	24.680	27.650	24.987	22.321	24.033	21.367	18.700	20.886	18.219	15.553
Corn Gluten meal 58.1% CP	7.000	6.000	5.000	7.000	6.000	5.000	7.000	6.000	5.000	7.102	6.686	6.500	7.800	7.800	7.500	6.718	6.300	6.200
By-product	8.000	16.000	24.000	8.000	16.000	24.000	8.000	16.000	24.000	8.000	16.000	24.000	8.000	16.000	24.000	8.000	16.000	24.000
Enzyme **	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050
Vegetable Oil	0.130	0.100	0.100	0.130	0.100	0.100	0.130	0.100	0.100	0.250	0.250	0.252	1.220	1.220	1.260	2.667	2.250	2.617
Di-Ca phosphate	1.880	1.780	1.750	1.880	1.780	1.750	1.880	1.780	1.750	1.900	1.900	1.900	1.670	1.670	1.670	1.700	1.700	1.700
Limestone	0.820	0.700	0.770	0.820	0.700	0.770	0.820	0.700	0.770	0.789	0.789	0.789	0.700	0.700	0.600	0.678	0.570	0.550
NaCl	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300
Premix *	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400
Choline	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075
Dl-Methionine	0.243	0.243	0.243	0.243	0.243	0.243	0.243	0.243	0.243	0.253	0.253	0.253	0.230	0.230	0.230	0.208	0.208	0.208
L-lysine HCl	0.400	0.400	0.480	0.400	0.400	0.480	0.400	0.400	0.480	0.360	0.360	0.360	0.398	0.398	0.398	0.290	0.290	0.290
Total	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Determined analysis (%)																		
CP	23.200	23.100	23.300	22.100	22.300	22.300	20.300	20.000	20.100	23.100	22.950	23.200	22.100	22.300	22.500	20.500	20.200	20.300
Ca	1.150	1.140	1.140	0.950	0.970	0.940	0.930	0.920	0.930	1.120	1.080	1.100	0.960	0.940	0.970	0.910	0.940	0.900
Total P	0.770	0.760	0.770	0.710	0.710	0.700	0.690	0.710	0.710	0.780	0.760	0.760	0.710	0.730	0.690	0.690	0.710	0.710
E E	2.900	3.120	3.320	3.100	3.300	3.610	3.000	3.250	3.340	3.190	3.760	4.440	3.290	3.830	4.370	3.300	3.870	4.420
Ash	6.200	6.000	5.800	5.800	6.100	6.200	6.200	6.600	6.600	6.100	6.500	6.600	5.900	6.700	6.700	6.600	6.800	7.000
CF	3.760	5.020	6.260	3.680	4.910	6.170	3.610	4.830	5.620	4.860	7.100	9.350	4.780	7.020	9.390	4.710	6.490	9.330
NFE	52.950	53.650	51.000	54.210	53.110	52.670	53.440	55.560	57.180	52.910	53.750	51.990	51.71	50.990	54.310	55.250	57.270	57.980

(*)Premix supplied per Kg of diet: Vit. (A), 12000 I.U., Vit.(D_3), 2000I.U. ; Vit.(E), 10mg ;Vit.(K_3) , 2mg; Vit.(B_1), 1 mg; Vit.(B_2), 5 mg; Vit.(B_6), 1.5 mg; Vit.(B_{12}), 10 ug; Biotin, 50ug; choline chloride,500mg; Pantothenic acid , 10 mg; Niacin,30mg; Folic,1mg; Manganese, 60mg; zinc,50mg; Iron,30mg;Copper,10mg;Iodine,1mg;Selenium,0.1mg and Cobalt,0.1mg (According to NRC;1994). (**) Each 1000g of the enzyme contains: Cellulase 700000 U, Amylase 100000 U, Pectinase 60000 U, Phytase 100000 U, Xylanase 1000000 U and Carrier (Silica sand) up to 1000g.

Table (6): Effect of the different dietary treatments and their supplementation levels on carcass characteristics

Feeding regimens	Body weight (g)	Carcass (%)	Dressed weight (%)	Liver weight (%)	Gizzard weight (%)	Heart weight (%)	Breast weight (%)	Drumstick weight (%)	Thight weight (%)
Control	1625^{abcd}	93.08^{a}	79.92^{ab}	2.31^{a}	3.20^{b}	0.63^{a}	17.18^{abc}	4.64^{bc}	6.07^{a}
Control + Enzyme	1681.3^{abc}	93.32^{a}	81.51^{a}	2.49^{a}	3.40^{b}	0.57^{a}	19.00^{a}	5.26^{a}	6.10^{a}
Potato 8%Without Enzyme	1505.6^{def}	93.48^{a}	81.65^{a}	2.27^{a}	3.39^{ab}	0.57^{a}	18.72^{ab}	4.38^{c}	5.43^{abc}
Potato 16%Without Enzyme	1574^{bcd}	91.03^{b}	77.4^{ab}	2.41^{a}	3.20^{b}	0.59^{a}	17.91^{abc}	4.67^{bc}	4.93^{bcd}
Potato 24%Without Enzyme	1392^{g}	91.88^{ab}	77.74^{ab}	2.57^{a}	3.74^{ab}	0.62^{a}	15.74^{d}	4.54^{c}	4.66^{bcd}
Potato 8%+ Enzyme	1561^{cde}	93.55^{a}	77.93^{ab}	2.13^{a}	3.88^{ab}	0.57^{a}	16.83^{abc}	4.53^{bc}	4.99^{bcd}
Potato 16%+Enzyme	1578^{bcd}	92.72^{a}	79.09^{ab}	2.53^{a}	3.31^{ab}	0.54^{a}	17.16^{abc}	4.83^{abc}	4.66^{d}
Potato 24%+ Enzyme	1435^{ef}	91.92^{a}	79.29^{ab}	2.79^{a}	4.30^{a}	0.58^{a}	16.43^{bcd}	4.54^{bc}	4.49^{d}
Tomato 8%Without Enzyme	1718^{ab}	92.56^{a}	79.68^{ab}	2.48^{a}	3.80^{ab}	0.52^{a}	17.46^{abc}	5.01^{ab}	5.47^{abc}
Tomato 16%Without Enzyme	1664^{abc}	92.70^{a}	79.35^{ab}	2.48^{a}	3.73^{ab}	0.62^{a}	17.1^{abc}	5.00^{ab}	5.46^{abc}
Tomato 24%Without Enzyme	1604^{abcd}	91.85^{ab}	77.78^{ab}	2.39^{ab}	3.65^{ab}	0.50^{a}	16.80^{abc}	4.68^{bc}	5.46^{abc}
Tomato 8%+ Enzyme	1734^{a}	91.55^{ab}	79.24^{ab}	2.13^{a}	3.88^{ab}	0.49^{a}	17.42^{abc}	5.02^{ab}	5.50^{ab}
Tomato 16%+ Enzyme	1671^{abc}	92.58^{a}	80.03^{ab}	2.36^{a}	3.49^{ab}	0.56^{a}	17.21^{abc}	5.01^{ab}	5.47^{abc}
Tomato 24%+ Enzyme	1610^{abcd}	92.42^{a}	77.99^{ab}	2.44^{a}	3.88^{ab}	0.47^{a}	17.03^{abcd}	4.70^{bc}	4.80^{cd}

a,b,c,….means within same column with different superscripts are significantly different ($p<0.05$)