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Utilization of Untreated and Treated Olive Pulp Meal in Feeding Broiler Chicks

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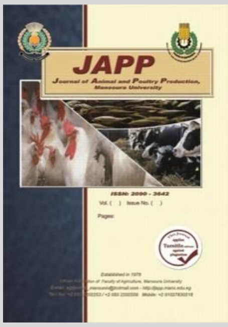

ABSTRACT

Two hundred and ten unsexed one day old Cobb 500 broiler chicks were used until 6 weeks of age to study the effect of *Trichoderma reesei fungus*(10^8 CFU /ml)and sodium hydroxide(NaOH, 10 g/kg OPM)addition in olive pulp meal(OPM)broiler diets on growth rate, digestion coefficients, some blood parameters, carcass traits and the economic efficiency of feed. The chicks were randomly distributed into seven equal treatments, 30 chicks/treatment with three replicates each. The treatments were control, C (The basal diet without OPM),T1(Basal diet+12% OPM),T2 (Basal diet +12% OPM+fungus), T3 (Basal diet+12% OPM+NaOH), T4 (Basal diet +15% OPM), T5 (Basal diet + 15% OPM + fungus) and T6 (Basal diet + 15% OPM + NaOH). The treated OPM with NaOH showed similar results of body weight and gain as the control .The control treatment recorded the highest value($P<0.01$)of feed intake. The best value ($P<0.05$) of feed conversion ratio was noticed with T3. The treated OPM showed a significant ($P<0.05$) in CP, CF, NFE, DCP, TDN (%) and ME(kcal/kg)compared to the untreated OPM; The treated and untreated OPM increased plasma cholesterol, LDL and HDL levels, While Triglycerides were decreased with all treatments compared to the control. All treatments recorded high values ($P<0.05$) of gizzard (%), cecum weight and cecum length compared to the control**,** the treated and untreated OPM decreased the feed cost/kg meat and increased the net return/kg meat.The results concluded that treating OPM with NaOH or fungus improved the nutritive value of OPM without any adverse effects on birds.

Keywords: *Broiler, Growth rate, Trichoderma reesei fungus, NaOH, Olive pulp meal.*

INTRODUCTION

The low amounts and high cost of the traditional feedstuffs is considered the biggest handicap facing the poultry industry in Egypt. The feed accounts for 55-70% of the cost of poultry production (Atteh, 2003).This problem encouraged nutritionists to search for alternative feed sources helping in feeding cost reduction. Using food by-products in livestock feeding is common practice for producers to reduce feed costs(Laudadio & Tufarelli ,2011) The Olive pulp meal (OPM) is a by-product of the olive oil mill extraction process .It is rich in lipids (73%oleic,13%palmitic acid ,and 7% linoleic acid),making it an economic ingredient for the livestock industry (Tufarelli *et al*.,2013).The industrial food wastes represent a valuable resource for replacing a part of the traditional feedstuffs such as yellow corn and soybean in poultry diet (Farhat *et al*., 2001).

Olive pulp (OP) is the remainder of olive cake (the raw material resulting from extraction of olive oil) after the removal of the seed fractions. It results from sieving the dry olive cake to separate most of the seeds. About 0.3 of cell wall fraction will be removed by sieving (Abo Omar, 2000).

Olive pulp is considered as a good source of calcium, copper and cobalt but poor in phosphorus, magnesium and sodium and with fair levels of manganese and zinc (Harb,1986). OP is also a good source of several biologically active compounds, and has antioxidant, antifungal, and antibacterial properties (Al-Harthi, 2014). Due to its low nutritive value (low in energy, digestible proteins and minerals and high in lignin), it is seldom used in poultry feeding. In addition, a xyloglucan, one of the non-starch polysaccharides (NSP) which has anti-nutritive effects on monogastric such as poultry (Gil-Serrano and Tejero-Mateo, 1988). Also, Coimbra *et al.* (1995) showed the occurrence of the xylan-xyloglucan complexes in the OP cell walls. There are some solutions to improve the nutritive value of olive pulp by using some biological and chemical treatments such as the *Trichoderma reesei* fungus and sodium hydroxide respectively.

Trichoderma reesei is one of the non-mycotoxin producing fungal strains and it is considered as a highly efficient cell factory formed by nature and is used to produce proteins. Also, it is an important organism that contributes in lignocellulose degradation. This fungus grows in a media with composed cellulose or lignocellulose biomass as a substrate to secrete complex enzyme mixture mostly of cellulases and hemicellulases (Saloheimo and Pakula, 2012). On the other hand, sodium hydroxide has the ability to solubilize the cellulose and hemicellulose fractions that form the cell wall of olive pulp meal. Al-Yousef *et al* (1989) reported that NaoH treatment of date pits increased the rate of in-vitro digestibility by solubilizing some of the unavailable fiber components of the cell wall. Therefore, Obese *et al* (2001) have been used chemical composition and in-vitro digestibility techniques to assess feeding value of NaOH treated palm press fiber and found that NaOH treatment improved dry matter and organic matter digestibility. The objective of this study is evaluation of

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using untreated and treated OPM with *Trichoderma reesei* fungus and sodium hydroxide in broiler diets containing on their growth performance, digestion coefficients of nutrients and nutritive value and carcass traits, some blood metabolites of olive pulp meal.

MATERIALS AND METHODS

The current study was carried out at South Sinai Experimental Research Station (Ras-Suder City) which belongs to the Desert Research Center, during the period from May to June, 2018. This work was carried out to study the effect of incorporation of untreated and treated OPM with either fungi (*Trichoderma reesei*) or sodium hydroxide (NaOH) in the broiler diets. The olive pulp is the remainder of olive cake (the raw material resulting from extraction of olive oil) after the removal of the seed fractions. The dry olive cake was sieved to separate most of the hard seeds. We added fungus (*T*richoderma *reesei*) or sodium .hydroxide to olive pulp meal complete the degradation for long two weeks until it is used in the experimental trail. The fungus *Trichoderma reesei* concentration is 1 L of *Trichoderma reesei* plus 1 L of molasses and 98 L of water and fermented for 2 weeks before using, each 20 L of fungus added to 1 ton of olive pulp meal. About sodium hydroxide, each 1 kg of NaOH added to 100 kg of olive pulp meal.

Two hundred and ten unsexed one day old Cobb 500 broiler chicks were used in this experiment and were randomly distributed into seven equal treatments. Each treatment had 30 chicks divided equally into three replicates. The 1st group fed the basal diet without either untreated or treated OPM as control The 2nd group(T1) was fed the basal diet containing 12%untreated OPM. The 3rd and 4th groups (T2 and T3) were fed the basal diet containing 12% treated with Trichoderma reesei fungus (10^{8} cfu /ml) and NaOH (10 g /kg OPM}, respectively. The group5 (T4) was fed the basal diet containing 15% untreated OPM the group 6 and 7 (T5 and T6) were fed the basal diet containing 15% treated OPM with Trichoderma reesei fungus and NaOH respectively. All chicks were vaccinated. Light was constant for 24 hours daily throughout the experimental period. Feed and water were offered *ad libitum*. Chick's body weight and feed intake were weekly recorded and feed conversion ratio (g feed/g gain) was calculated per each pen. The mortality rate was recorded during the whole period of the experiment. The experimental chicks were housed in ventilated open house into vertical batteries (160 cm length x 200 height x 160 width) containing three rows in each side, each row contains two cages (100 cm length x 40 height).

Seven experimental diets were used and formulated based on the NRC (1994) for starter and finisher periods. The composition and chemical analysis of the experimental diets are shown in Table 1. The proximate analysis of OPM assayed using methods of A.O.A.C. (1990). The estimation of the phenolic compounds content in the treated or untreated OPM was according to Biswas *et al*. (2013). Live body weight and feed consumption were weighted weekly. Body weight gain and fed conversion ratio (g feed /g gain) were calculated. At the end of the experimental feeding period, digestion trials were conducted using 28 adult cub (4 for each level of OPM)to determine the digestion coefficients and the nutritive values (DCP and TDN) of the experimental diets as affected by OPM levels . Birds were housed individually in metabolic cages. The digestibility trials extended for 9 days of their 5days as a preliminary period followed by 4 days as collection period .The individual LBW was recorded during the collection period to determine any loss or gain in the live body weights. During the main period, excreta was collected daily and weighted, dried at 60 C0 bulked, finally ground and stored for chemical analysis. The faecal nitrogen was determined according to Jakobsen *et al*. (1960). Urinary organic matter was calculated according to Abou-Raya and Galal (1971). Apparent digestion coefficients % of dry matter (DM), Organic matter (OM), crude protein (CP) crude fiber (CF), ether extract (EE), and nitrogen free extract (NFE) of the experimental diets were estimated. The nutritive values expressed as digestible crude protein (DCP), total digestible nutrients (TDN) were calculated, Metabolizable energy (ME) was calculated as suggested by Kalashnikof ,A.P., *et al* .,(1985).

Table 1. Composition and calculated analysis of the experimental diets.

Ingredient	Starter diet (1- 21 days)			Finisher diet (22- 42 days)		
	0% OPM	**12% OPM**	**15% OPM**	**0% OPM**	**12% OPM**	**15% OPM**
Yellow corn	57.00	43.00	40.00	65.72	52.00	49.00
Soybean meal 44%	29.60	30.06	30.00	24.6	24.52	24.31
Corn gluten meal 60%	8.20	8.10	8.10	3.00	3.00	3.00
Olive pulp meal	0.00	12.00	15.00	0.00	12.00	15.00
Sunflower oil	1.50	3.29	3.38	3.30	5.10	5.31
Limestone	1.10	0.94	0.90	0.93	0.93	0.93
Di-calcium phosphate	1.70	1.70	1.70	1.65	1.65	1.65
L-lysine	0.30	0.30	0.30	0.18	0.18	0.18
DL-methionine	0.10	0.11	0.12	0.12	0.12	0.12
Salt	0.25	0.25	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25	0.25	0.25
Total	100	100	100	100	100	100
Calculate analysis						
Crude protein (%)	22.95	22.95	22.94	18.27	18.12	18.04
ME (kcal/kg)	3020	3026	3007	3180	3189	3178
Calcium (%)	0.89	0.90	0.90	0.80	0.87	0.89
Available P (%)	0.44	0.44	0.44	0.41	0.40	0.40
L-lysine	1.33	1.30	1.29	1.04	1.01	0.99
DL-methionine	0.51	0.49	0.50	0.43	0.41	0.40
Methionine&Cystein	0.90	086	0.86	0.75	070	0.68

***Premix, each kg contains: Vit A 12000 IU, Vit D3 3000 IU, Vit E 12 mg, Vit K 1 mg, Vit B12 0.02 mg, Vit B1 1 mg, Vit B2 4 mg, Vit B6 1.5 mg, Nicotinic acid 20 mg, Folic acid 1 mg, Biotin 0.05 mg, Choline chloride 160 mg, Copper 3 mg, Iron 30 mg, Manganese 40 mg, Zinc 45 mg and Selenium 3 mg.**

At the end of the experiment (at 6-weeks of age) three birds were taken at random from each treatment and sacrificed by cervical dislocation, while blood samples were immediately taken, centrifuged at 3000 rpm for 20 minutes, and then plasma stored at -20ºC for later analysis. The value. Blood metabolites were cholesterol, LDL (low density lipoprotein), HDL (high density lipoprotein) and triglycerides. All samples were determined calorimetrically by using commercial kits. Also, carcass traits were taken (the weight of carcass, gizzard, intestinal tract and cecum and the length of the intestinal tract and the cecum). These parameters are calculated as a percentage (%) of live body weight.

The economic efficiency of feed for meat production was calculated according to costs of the experimental diets and the price of one kilogram meat. The value of the economic efficiency was calculated as the net return per unit of total costs.

Data were analyzed by one way analysis of variance (Completely Randomized Design), according to the General Linear Models (GLM) procedures of SAS (2002). The difference between means was determined by Duncan's Multiple Range Test (Duncan, 1955). The data were analyzed by the following model:

$$Y_{ij} = \mu + T_i + e_{ij},$$

where: μ = General mean. T_i = Random effect of treatment (j = 1, 2, 3, 4. 5, 6, and 7). e_{ij} = Random error.

RESULTS AND DISCUSSION

The proximate analysis of OPM

The proximate chemical analysis of either treated or untreated OPM are shown in (Table 2) which indicated that the CP, ash, nutrients of either *Trichoderma reesei* fungus (10^8 CFU/ ml) or NaOH1 (500g/50 kg OPM) treated OPM were higher than that of untreated one. However, it decreased the contents of OM, CF, EE, and NFE when compared with untreated OPM. These results agree with , Abd El-Galil *et al*. (2017),and Rabayaa *et al*.(2001 **)**.,While dis agreement with Abo omar.,(2000). Fiber fraction (NDF and ADF) were higher recorded the values as 56.85, 44.70% respectively OPM untreated, while were decreased in treated OPM. Regarding ME (kcal/kg) were increased by OPM treated while were decreased by OPM untreated may be attributed to tannin and lignin content of olive pulp, Tannins as naturally occurring polyphenol compound which from complexes with macromolecules (protein, cellulose, hemicellulose, and starch) minerals and vitamins affect their availability in man and animals (Makkar., (1993).

Total tannins were higher recorded the values (9.76) % in OPM untreated compared than that of treated OPM 6.88, 6.09% respectively this result agree by Salima *et al*.,(2019) found that decreased of Total condensed Tannins up to 42% with treated Olive cake (OC) by *(Rhizodiscina of Lignyota fungus*).

The estimation of the phenolic compounds of either treated or untreated OPM are shown in Table 2. It is good to know that the treatment of treated OPM by fungus (*Trichoderma reesei*) and sodium hydroxide (NaOH) decreased the level of Phenanthrene to zero compared by untreated OPM. Phenanthrene is a compound that poses a large toxicity risk to exposed living organisms (Mastrangelo *et al*., (1996). On the other hand, Kaempferol and Resorcinol were higher in the treatment of untreated OPM compared with treated OPM. This results agree by Salima *et al*., (2019) showed that decreased of phenolic compounds up to 43% for treated (OC) by *(Rhizodiscina of Lignyota fungus*).

Table 2. The proximate chemical analysis of treated and untreated olive pulp meal (OPM)

Items	OPM	OPM+Fungus	OPM+NaOH
DM, (%)	91.85	91.39	91.04
OM, (%)	91.83	79.93	86.64
CP, (%)	8.76	9.48	10.07
CF, (%)	26.10	21.30	20.11
EE, (%)	12.00	11.70	11.48
Ash, (%)	8.17	20.07	13.36
NFE, (%)	48.78	47.07	44.98
NDF, (%)	56.85	48.36	45.98
ADF, (%)	44.70	39.75	37.78
ADL, (%)	21.15	17.23	16.08
ME, (kcal/kg)	2201	2377	2440
Total Tannins, %	9.76	6.88	6.09
Phenolic compounds:			
a-Kaempferol,(ppm)	4577.90	10.87	28,10
b-Resorcinol,(ppm)	415.09	72.50	41.05
c-phenanthrene(ppm)	36.80	0.00	0.00

DM= dry matter, OM= organic matter, CP= crude protein, CF= crude fiber, EE= ether extract, NFE= nitrogen free extract, Ca= calcium, P= phosphorus

Growth Performance

Live body weight and body weight gain:

The data of live body weight and body weight gain showed that (Table 3) the live body weight at 2, 4 and 6 weeks of age and body weight gain at the periods of 0-2 ,2-4, 4-6 weeks and 0-6 weeks of age were affected significantly (P<0.01). At 2 weeks of age, The results in Table 3, indicated that, LBW at 2 weeks of age and BWG through 0-2 weeks were significantly (P<0.01)reduced in chicks received diets containing either untreated and treated OPM at different levels (12 and 15%)compared with control, However, LBW at 4 and 6 weeks of age and BWG during 2-4 weeks,4-6 weeks and 0-6 weeks periods were significantly (P<0.01)decreased in chicks fed diets contained untreated and treated OPM with fungs (Trichoderma reesei) comparatively with control and other dietary treatment groups.

Table 3. The effect of treated or untreated olive pulp meal containing diets on growth performance of broilers

Item	Treatments							SE	Sig
	C	T1	T2	T3	T4	T5	T6		
Body weight (g)									
Initial	39.70	39.83	39.70	39.80	39.87	39.70	39.70	0.062	NS
At 2 weeks	420.94[a]	355.17[g]	375.84[e]	410.29[c]	370.08[f]	395.99[d]	415.03[b]	0.526	**
At 4 weeks	1195.59[a]	1092.06[e]	1109.35[d]	1190.31[a]	1130.97[c]	1150.42[b]	1192.04[a]	3.02	**
At 6 weeks	2099.43[a]	1819.93[d]	2018.29[b]	2085.44[a]	1924.81[c]	2026.61[b]	2085.76[a]	15.28	**
Body weight gain (bird/g/period)									
0-2 weeks	381.24[a]	315.34[g]	336.13[e]	370.49[c]	330.22[f]	356.29[d]	375.33[b]	0.523	**
2-4-weeks	774.65[a]	736.89[c]	733.51[c]	780.02[a]	760.89[b]	754.43[b]	777.00[a]	3.09	**
4--6 weeks	903.85[a]	727.87[c]	908.93[a]	895.14[a]	793.84[b]	876.19[a]	893.72[a]	14.92	**
0-6 weeks	2059.73[a]	1780.10[d]	1978.58[b]	2045.64[a]	1884.94[c]	1986.91[b]	2046.06[a]	15.28	**

a,b,c, d, e, f, g: Means within the same row showing different letters are significantly different. SE=Stander error, Sig= significant,), NS = not significant ** (P<0.01. C= Control, T1= (12% OPM), T2= (12% OPM + fungi), T3= (12% OPM + NaOH), T4= (15% OPM), T5= (15% OPM + fungi), T6= (15% OPM + NaOH)

The reduction in growth rate (LBW and BWG) as affected by untreated and treated OPM may be due to the presence of tannins, which may decrease palatability of feed and decrease in digestibility of nutrients in diets contained untreated and treated OPM this results with agreement Attia *et al* (2002) reported that body weight gain of broiler chicks recorded no significant increase after feeding diets containing OPM till 16%.

Results obtained of LBW and BWG in the present study disagree with these reported by Azazi *et al*. (2020) who found that the rabbits fed on the diet supplemented with 10 % olive cake meal with 0.25 sodium bicarbonate ($NaHCO_3$) recorded the highest value of final body weight, total gain and daily weight gain. Also, Balnave and Oliva (1991) noted that supplemented with $NaHCO_3$ in diets or drinking water produced a significant improvement in birds. Ikpe *et al*., (2018). found that the final average body weight and the average body weight gain in the broilers fed on the different levels of 4% sodium hydroxide (NaOH) treated rice husk were similar with those on the control diet. Our results agree with, Abd El-Galil *et al*. (2017) used the levels of 4, 8 and 12% olive pulp meal in growing hens diets and found that the final live body weight, body weight gain and feed intake were decreased (P<0.05) with increasing the level of olive pulp meal.

Feed intake and feed conversion ratio

The results in (Table 4), Indicated that feed intake significantly (P<0.01) decreased in chicks fed diets containing untreated and treated OPM at different levels compared with control during all the interval periods. The control treatment recorded the highest FI values (P<0.01) in all the experimental periods except at the period from 2 to 4 weeks of age compared to the other experimental treatments. This reduction in feed intake may be due to low palatability that resulted from the astringency of tannins in OPM (Abd El-Galil *et al*. (2017). The best value (P<0.05) of feed conversion ratio at all periods of age was noticed with the group fed on the diet containing 12% OPM treated with NaOH (T3). This result may be attributed to the low feed intake and high body weight gain in this group. On the other hand, Al-Shanti (2003) observed that there was a significant decrease in feed consumption with feeding different levels of fiber during the growing periods, so that there was an improvement in feed conversion ratio of chicks fed diets incorporated with 10% OPM. %).

Table 4. The effect of the treated or untreated olive pulp meal containing diets on feed intake of broilers

Item				Treatments				SE	Sig
	C	T1	T2	T3	T4	T5	T6		
Feed intake (bird/g/period)									
0-2 weeks	1026.67^{a}	770.00^{cd}	720.00^{d}	758.33^{cd}	800.00^{c}	780.00^{c}	890.00^{b}	16.50	**
2-4 weeks	1250.00^{bc}	1226.67^{c}	1300.00^{ab}	1180.00^{d}	1210.00^{c}	1270.00^{bc}	1340.00^{a}	20.97	**
4-6 weeks	1640.00^{a}	1350.00^{b}	1455.00^{b}	1285.00^{c}	1420.00^{b}	1450.00^{b}	1530.00^{ab}	57.55	**
0-6 weeks	3916.67^{a}	3340.00^{c}	3475.00^{c}	3283.33^{d}	3430.00^{c}	3483.33^{c}	3756.67^{b}	48.33	**
Feed conversion ratio (feed/gain)									
0-2 weeks	2.69^{a}	2.44^{b}	2.14^{cd}	2.05^{d}	2.42^{b}	2.19^{c}	2.37^{b}	0.043	*
2-4 weeks	1.62^{c}	1.66b^{c}	1.77^{a}	1.51^{d}	1.59^{c}	1.68^{abc}	1.72^{ab}	0.029	*
4-6 weeks	1.81^{a}	1.86^{a}	1.60^{a}	1.44^{b}	1.79^{a}	1.66^{a}	1.71^{a}	0.080	*
0-6 weeks	1.90^{a}	1.88^{a}	1.76^{b}	1.61^{c}	1.82^{ab}	1.76^{b}	1.84^{ab}	0.031	*

a,b,c, d: Means within the same row showing different letters are significantly different. SE=Stander error, Sig= significant, ** =(P<0 .01), * = (P<0.05), C= Control, T1= (12% OPM), T2= (12% OPM + fungi), T3= (12% OPM + NaOH), T4=(15% OPM), T5= (15% OPM + fungi), T6= (15% OPM + NaOH)

Digestion coefficients and nutritive values

The digestion coefficients (%) of nutrients as shown in (Table 5), A significant decrease (P<0.05) in CP, CF, NFE, DCP, TDN (%) and ME (kcal/kg).While, Ether extract (%) exhibited a significant (P<0.05) increase was observed with all experimental treatments compared to the control group. About DM (%), a significant increase (P<0.05) was observed with the treatments containing 12% OPM compared to the other treatments, Regarding OM, there was a significant decrease (P<0.05) with T2 (12% OPM + Fungus) compared to the other treatments, The treatments containing 12% and 15% OPM with *Trichoderma reesei* fungus or sodium hydroxide (NaOH) improvement values in CP, CF, NFE, DCP, TDN (%) and ME (kcal/kg) compared to the treatments containing only OPM. This result may be due to the ability of sodium hydroxide to solubilize the cellulose and hemicellulose fractions that form the cell wall of olive pulp meal (Obese *et al*., 2001). On the other hand, *Trichoderma reesei* has the ability to secrete the enzymes of celluloses and hemicelluloses which catalyze the degeneration of fibers to simple sugars and enhance the degradation of plant cell walls (Saloheimo and Pakula, 2012). These results are in agreement with Abd El-Galil *et al*. (2017) who represented that digestibility coefficients of CP, CF, NFE and the nutritive values expressed as DCP, TDN (%) and ME (kcal/kg) were significantly (P<0.05) decreased in growing hens by increasing OPM more than 8% in the diet but EE (%) was increased.. On the other hand, Obese *et al* (2001) have been used chemical composition and in-vitro digestibility techniques to assess feeding value of NaOH treated palm press fiber and found that NaOH treatment improved dry matter and organic matter digestibility. In contrary, nutritive values of the diets in terms of DCP, TDN were not significantly affected by olive pulp inclusion (Mehrez and Mousa, 2011). The decrease in digestion coefficients and nutritive values may be attributed to tannin and lignin content of olive pulp as reported by Martin *et al*. (2003) who showed that olive pulp contains 1.4% tannins (on DM basis). On the other hand, the improvement in digestibility of ether extract is due to the high content of crude fiber in OPM which increases the production of HCl and bile salts. Al-Yousef *et al* (1989) reported that NaoH treatment of date pits increased the rate of in-vitro digestibility by solubilizing some of the unavailable fiber components of the cell wall. Also, Obese *et al* (2001) have been used chemical composition and in-vitro digestibility techniques to assess the feeding value of NaOH treated palm press fiber and found that NaOH treatment improved dry matter and organic matter digestibility. This improvement with sodium hydroxide groups may be due to the ability of sodium hydroxide to solubilize the cellulose and hemicellulose fractions that form the cell wall of olive pulp meal. On the other hand, the improvement in the treatment groups fed on diets containing fungus may be due to the enzymes (celluloses and hemicelluloses) secreted by *Trichoderma reesei* which catalyze the degeneration of fibers to simple sugars and enhance the degradation of plant cell walls (Saloheimo and Pakula, 2012.

Table 5. The effect of the treated or untreated olive pulp meal containing diets on digestion coefficients of nutrients

Item	Treatments							SE	Sig
	C	T1	T2	T3	T4	T5	T6		
DM, (%)	88.00^{d}	91.43^{b}	92.43^{a}	92.80^{a}	89.33^{c}	88.17^{d}	85.17^{e}	0.280	*
OM, (%)	86.70^{a}	87.13^{a}	81.23^{b}	86.33^{a}	86.93^{a}	85.77^{a}	85.10^{a}	0.698	*
CP, (%)	79.73^{a}	72.60^{e}	75.27^{d}	78.47^{b}	73.20^{e}	76.93^{c}	78.80^{ab}	0.392	*
CF, (%)	42.87^{a}	30.77^{d}	34.90^{bc}	36.20^{b}	30.00^{d}	33.63^{c}	36.07^{b}	0.458	*
EE, (%)	82.57^{e}	84.83^{d}	85.77^{cd}	86.73^{bc}	88.30^{a}	87.73^{ab}	87.13^{ab}	0.389	*
NFE, (%)	69.47^{a}	66.33^{c}	68.07^{b}	68.97^{ab}	64.90^{d}	68.23^{b}	68.00^{b}	0.354	*
DCP, (%)	14.60^{a}	13.13^{d}	13.67^{cd}	14.20^{abc}	13.23^{d}	13.87^{bc}	14.40^{ab}	0.180	*
TDN, (%)	76.50^{a}	63.73^{d}	68.50^{c}	70.50^{b}	63.63^{d}	67.87^{c}	70.33^{b}	0.291	*
ME, kcal/kg	2893.33a	2527.67^{c}	2664.67^{b}	2761.67^{b}	2538.00^{c}	2684.67^{b}	2764.33^{b}	39.610	*

a,b,c,d,e: Means within the same row showing different letters are significantly different. SE=stander error, Sig= significant,
*** = (P<0.05), C= Control, T1= (12% OPM), T2= (12% OPM + fungus), T3= (12% OPM + NaOH), T4=(15% OPM),**
T5= (15% OPM + fungus), T6= (15% OPM + NaOH.

Blood biochemical analysis:

The results of plasma cholesterol, LDL (low density lipoproteins, harmful cholesterol), HDL (high density lipoproteins, harmless cholesterol) and triglycerides are shown in (Table 6).

Table 6. The effect of the treated or untreated olive pulp meal containing diets on some blood biochemical profiles.

Item	Treatments							SE	Sig
	C	T1	T2	T3	T4	T5	T6		
Cholesterol, (mg/dl)	71.0^{d}	78.0^{c}	81.5^{c}	81.0^{c}	90.3^{b}	115.0^{a}	94.0^{b}	1.28	*
LDL, (mg/dl)	5.6^{d}	10.5^{c}	5.8^{d}	5.84^{d}	22.1^{a}	17.9^{ab}	17.43^{b}	1.42	*
HDL, (mg/dl)	65.2^{d}	59.1^{e}	71.0^{b}	67.9^{c}	58.6^{e}	90.0^{a}	68.8^{c}	0.455	*
Triglycerides, (mg/dl)	50.3^{a}	42.0^{b}	40.0^{bc}	38.7^{c}	49.5^{a}	35.5^{d}	38.7^{c}	0.76	*

a,b,c,d,e: Means within the same row showing different letters are significantly different. SE= Stander error, Sig= significant,
*** = (P<0.05), C= Control, T1= (12% OPM),T2= (12% OPM + fungi), T3= (12% OPM + NaOH), T4= (15% OPM), T5= (15% OPM + fungi), T6= (15% OPM + NaOH).**

Plasma cholesterol was increased and triglycerides were decreased with all the experimental treatments compared to the control group. Incorporate of OPM treated with fungus and NaOH to the diets increased plasma cholesterol and HDL, While decreased plasma triglycerides and LDL especially with the T5 treatment 15% OPM(treated with fungus) compared with control. Addition of fungus and NaOH on diets contained OPM reduced LDL and increased HDL levels. The lowest value of LDL was noticed with T2 treatment (12% OPM+Fungus) and the highest value was observed with T4 treatment (15% OPM), while T5 treatment (15% OPM+Fungus) recorded the highest level of HDL and the lowest level was observed with T4 treatment (15% OPM) followed by T1 (12% OPM) compared to the other treatments. These results agree with Azazi *et al*. (2020) who noticed that rabbits fed diets with 10% olive cake meal (OCM) plus 0.25 or 0.5% NaHCO3 had the lowest ($P \leq 0.01$) plasma triglyceride while concentrations of serum cholesterol were higher in groups fed diets with 0 or 20% OCM without NaHCO3 ($P \leq 0.01$) compared with other treatments. Abdel-Aleem (2010) observed that plasma cholesterol concentration of growing rabbits was significantly decreased with increasing the level of NaHCO3 from 0.5 to 1%. Cholesterol was not significantly affected for rabbits fed diets containing 20, 25 and 30% OP (Mehrez and Mousa, 2011) or diet containing OCM (Bakr *et al*., 2019). On the other hand, olive cake up to 9% in laying hens' diets had no significant influence on serum cholesterol and triglycerides (Zangeneh and Torki, 2011). Using 10 and 20% of OC had no significant effect on triglycerides content but the level of 5% reduced plasma cholesterol concentration (Hashish and Abd El-Samee, 2005). On the other hand, Abd El-Moneim and Sabic (2019) reported that the significant increase ($P<0.01$) in HDL value was noticed only in the group fed on 10% OP plus *Aspergillus awamori* compared with the control group. On contrary, Zangeneh and Torki (2011) reported that dietary OP inclusion did not exert any significant effect on the blood parameters. Generally, there were not available reports about the utilization of sodium hydroxide and *Trichoderma reesei* in poultry diets containing olive pulp meal.

Carcass traits

The relative values of carcass, gizzard, intestinal weight, intestinal length, cecum weight and cecum length as a percentage (%) of live body weight are shown in (Table 7). The results showed that all the experimental treatments which contain untreated and treated OPM recorded high values ($P<0.05$) of gizzard (%), cecum weight and length ,While lower values of carcass% compared to the control treatment, This may be due to fiber inclusion affects the gizzard size. One important role of the gizzard is to regulate digesta particle size in the gastrointestinal tract (Hetland *et al*., 2004 and Svihus, 2011) with the ability to modulate the passage of feed from the upper digestive tract to the small intestine based on particle size. Factors such as fiber type and particle size are determinant factors that stimulate the muscular activity of the gizzard, resulting in increased its size (González-Alvarado *et al*., 2008). There were not significant differences among the experimental treatments for the intestinal weight and length (%).The value of cecum weight was observed with T1 compared to the control and other treatments, control group. The results of Azazi *et al*. (2020) disagree with our results where the rabbits fed 10 % olive cake meal plus 0.25 or 0.50% sodium bicarbonate (NaHCO3) had the highest significance ($P \leq 0.01$) value of carcass (%) compared with the others. On the other hand, rabbits fed on the diet supplemented with 10% olive cake meal without NaHCO3 had the lowest values of all traits.

Salama *et al.* (2016) showed that carcass traits were significantly affected by olive cake meal inclusion. While, Bakr *et al.* (2019) showed that olive pulp inclusion in growing rabbits diets at varying levels (15, 20 and 25%) did not show any significant effect on all carcass traits. Similarly, Abd El-Galil (2001) showed non-significant differences in carcass traits of rabbits fed either control or 20% olive pulp meal. Also, Abou-Ela *et al.* (2011) found that carcass traits did not differ significantly with up to 28% olive cake meal in rabbit diets.

Table 7. The effect of the treated or untreated olive pulp meal containing diets on carcass traits of broilers

Item	Treatments							SE	Sig
	C	T1	T2	T3	T4	T5	T6		
Carcass, (%)	76.20[a]	73.69[c]	75.24[ab]	75.76[a]	74.28[bc]	75.24[ab]	75.76[a]	0.486	*
Gizzard, (%)	0.080[d]	0.167[a]	0.153[ab]	0.143[abc]	0.123[c]	0.137[bc]	0.117[c]	0.011	*
Intestinal weight, (%)	0.245	0.267	0.220	0.240	0.217	0.230	0.180	0.024	NS
Intestinal length ,(%)	0.085	0.107	0.087	0.097	0.090	0.083	0.083	0.010	NS
Cecum weight, (%)	0.035[b]	0.073[a]	0.053[b]	0.037[b]	0.040[b]	0.040[b]	0.043[b]	0.008	*
Cecum length, (%)	0.600[c]	1.290[a]	1.110[ab]	0.723[bc]	0.900[abc]	0.853[abc]	0.973[abc]	0.174	*

a,b,c,d: Means within the same row showing different letters are significantly different. SE= Stander error, Sig= significant,) NS = not significant ,* = (P<0.05) ,C= Control, T1= 12% OPM, T2= (12% OPM + fungi), T3= (12% OPM + NaOH), T4= 15% OPM, T5= (15% OPM + fungi), T6= (15% OPM + NaOH).

The economic efficiency of feed:

The data of the economic efficiency of experimental diets during the whole experimental period was shown in (Table 8). Incorporated OPM treated with the fungi and NaOH in broiler diets decreased the feed cost of kilogram meat and increased the net return of the production process during the whole experimental period especially with the treatment T3 (12% OPM treated with NaOH) followed by T5 and T2 containing OPM treated by *Trichoderma reesei* fungus. This increase resulted from the positive effect of OPM treated with sodium hydroxide and *Trichoderma reesei* fungus on the feed conversion ratio by increasing the ability of broilers in utilizing the feed nutrients. In addition, the use of these feed additives is safe and cheap.

Table 8. The effect of the treated or untreated olive pulp meal containing diets on the economic efficiency of feed

Item	Treatments						
	C	T1	T2	T3	T4	T5	T6
Feed conversion ratio	1.90	1.88	1.76	1.61	1.82	1.76	1.84
Cost of kg feed (LE.)	7.370	7.280	7.328	7.388	7.210	7.270	7.345
Feed cost/ kg meat	14.00	13.69	12.90	11.89	13.12	12.80	13.51
Market price of one kg meat (LE.)	30	30	30	30	30	30	30
Net return (LE.)/ kg	16.00	16.31	17.10	18.11	16.88	17.20	16.49
Economic efficiency of feed	1.14	1.19	1.33	1.52	1.29	1.34	1.22

C= Control, T1= (12% OPM), T2= (12% OPM + fungi), T3= (12% OPM + NaOH), T4= (15% OPM), T5= (15% OPM + fungi), T6= (15% OPM + NaOH). The price of 1 ton of feed = 7370 LE., 1 litre of *Trichoderma reesei* fungus= 20 LE. and 1 kg NaOH = 90 LE.

Mortality rate (%)

The results of the mortality rate (%) were represented in Figure 1. The highest mortality rate was observed with the group fed on untreated 15% OPM (T4) followed by the OPM treated with sodium hydroxide (T3 and T6) compared to the other treatments. Okorie (2006) indicated that the mortality rate are sensitive indicators of changes in the nutritional qualities of a diet. Al-Shanti *et al.* (2003) observed that the mortality rate (%) of birds fed different levels of OPM and control diet recorded a non-significant difference between treatments.

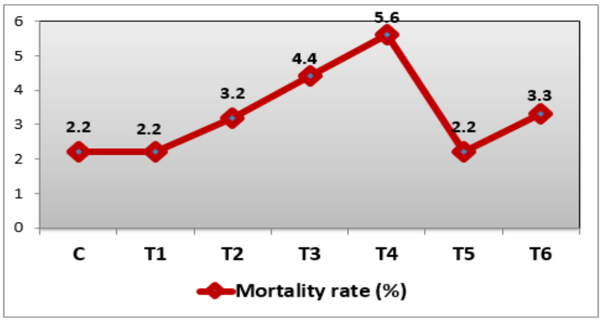

Figure 1. Mortality rate (%) of Cobb broilers as affected by the treated or untreated olive pulp meal containing diets during the whole experimental period. C= Control, T1= (12% OPM), T2= (12% OPM + fungi), T3= (12% OPM + NaOH), T4= (15% OPM), T5= (15% OPM + fungi), T6= (15% OPM + NaOH).

CONCLUSION

It could be concluded that, Incorporate OPM treated 12% and 15% levels with NaOH in the broiler chicks diets improved their performance parameters and economical efficiency without any adverse effects on the bird's health.

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الاستفادة من مسحوق تفل الزيتون المعامل وغير المعامل في تغذية كتاكيت التسمين

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في هذه التجربة، تم استخدام مائتان وعشرة كتكوت تسمين Cobb 500 غير مجنس عمر يوم حتى عمر 6 أسابيع. لدراسة تأثير أستخدام مسحوق تفل الزيتون (OPM) غير المعامل والمعامل بإضافة فطر *Trichoderma reesei* (10^8 CFU /ml) وهيدروكسيد الصوديوم (NaOH, 10 g /kg OPM) في علائق بداري التسمين على معدل النمو و العلف المستهلك ومعاملات الهضم و بعض مقاييس الدم وصفات الذبيحة و كذلك الكفاءة الاقتصادية للعلف. وزعت الكتاكيت عشوائيا على سبع معاملات تجريبية. كل معاملة تحتوي على 30 كتكوت مقسمة بالتساوي إلى ثلاث مكررات. كانت المعاملات التجريبية على النحو التالي: معاملة المقارنة، C (العليقة الاساسية بدون OPM)، T1 (العليقة الاساسية + 12٪ OPM)، T2 (العليقة الاساسية + 12٪ OPM + الفطر) ، T3 (العليقة الاساسية + 12٪ OPM + هيدروكسيد الصوديوم) ، T4 (العليقة الاساسية + 15٪ OPM), T5 (العليقة الاساسية + 15٪ OPM + الفطر), و T6 (العليقة الاساسية + 15٪ OPM + هيدروكسيد الصوديوم). أظهرت المجموعة التي تغذت على مسحوق تفل الزيتون المعامل بهيدروكسيد الصوديوم نتائج مماثلة فيما يتعلق بوزن الجسم والزيادة الوزنية مثل مجموعة المقارنة. سجلت معاملة المقارنة أعلى قيمة (P <0.01) للعلف المستهلك خلال فترة التجربة. لوحظ أفضل قيمة لمعدل التحويل الغذائي (P <0.05) مع المعاملة(T3). أظهرت المعاملات التجريبية التي تحتوي على مسحوق تفل الزيتون المعامل زيادة معنوية (P <0. 05) في CP، CF، NFE، DCP، TDN (٪) و ME مقارنة بالمعاملات التي تحتوي على مسحوق تفل زيتون غير المعامل. مسحوق تفل الزيتون المعامل أوغير المعامل ادى إلى زيادة معنوية في مستويات الكوليسترول في البلازما و HDL, LDL بينما انخفضت نسبة التراى جلسيريد في البلازما لجميع المعاملات التجريبية مقارنة بمجموعة المقارنة. سجلت جميع المعاملات التجريبية قيم معنوية (P <0.05) من نسبة القانصة (٪)ووزن وطول الأعور مقارنة بمعاملة المقارنة. العلائق المحتوية على مسحوق تفل الزيتون المعامل و الغير المعامل اظهرت نقص فى تكلفة العليقة لانتاج كجم لحم حي و زيادة فى صافى الربح. توصلت النتائج إلى أن معاملة مسحوق تفل الزيتون بهيدروكسيد الصوديوم أو فطر *Trichoderma reesei* أدى إلى تحسين القيمة الغذائية لمسحوق تفل الزيتون بدون اى اثار سلبية على الطيور.