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Article

Functionality of *Elaeocarpus serratus* leaves on growth, meat quality and cost return analysis in broiler rearing

Md. Manirul Islam[1*], Meherunnesa Chowdhury Sumy[2], Kona Adhikary[1] and Priunka Bhowmik[1]

[1]Department of Animal Science and Nutrition, Faculty of Veterinary Medicine, Chattogram Veterinary and Animal Sciences University, Zakir Hossain Road, Khulshi, Chattogram - 4225, Bangladesh
[2]Department of Agricultural Economics and Social Sciences, Faculty of Veterinary Medicine, Chattogram Veterinary and Animal Sciences University, Zakir Hossain Road, Khulshi, Chattogram - 4225, Bangladesh

[*]Corresponding author: Md. Manirul Islam, Department of Animal Science and Nutrition, Faculty of Veterinary Medicine, Chattogram Veterinary and Animal Sciences University, Zakir Hossain Road, Khulshi, Chattogram - 4225, Bangladesh. Phone: +8801712736518; E-mail: mrislamcvasu@gmail.com

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Abstract: The study was conducted to evaluate the effects of olive leaves with probiotics (OLP) on growth performance, carcass characteristics, meat quality, blood parameters and oxidative stability of meat in broiler. A total of 160 day old, unsexed Cobb-500 chicks were distributed in to five dietary treatment groups: Control (Basal diet), OLP-1 (Basal diet + 0.4% OLP, DM basis), OLP-2 (Basal diet + 0.8% OLP, DM basis), OLP-3 (Basal diet + 1.2% OLP, DM basis) and OLP-4 (Basal diet + 1.6% OLP, DM basis) having 4 replications with 8 birds in each in a completely randomized design. Results showed that the live weight, overall average daily gain (ADG) increased significantly ($p<0.05$) in all treatment groups compared to control. The weekly feed conversion ratio (FCR) reduced significantly ($p<0.05$) in 0-14 days and the weekly ADG improved in 15-28 days. Blood cholesterol and high density lipoprotein (HDL) increased significantly ($p<0.05$) in all treatment groups except OLP-4 compared to control. The dressing percentage showed significant ($p<0.05$) difference among treatment groups and control. Organs weight were similar among treatment groups, although the breast meat and bursa weight differed significantly ($p<0.05$) in treatment groups. A significant increase ($p<0.05$) in meat crude protein (CP) and total ash content in treatment groups relative to control. Meat thiobarbituric acid reactive substances (TBARS) significantly ($p<0.05$) decreased at 0.8%, 1.2% and 1.8% during 1st, 2nd, 3rd weeks and in average value as well. Net return and benefit cost ratio (BCR) substantially increased in all treatment groups compared to control ($p<0.05$). Finally, dietary OLP supplementation improved growth performance, meat CP and ash content, increased blood cholesterol, HDL content, net rutrun and BCR while reduced meat TBARS value. Thus, olive leaf probiotics can be a potential source to be used as feed additive in broiler.

Keywords: broiler; olive leaves; probiotics; growth performannce; meat quality; BCR

1. Introduction

Broiler farming seems to be a considerable part of meat industry all over the world. The broiler industry has been threatened because of the use of antibiotics as growth promoter in sub-therapeutic doses which can exert health hazard by depositing antibiotic residue in human body (Muaz *et al*., 2018). Considering that, antibiotics were restricted in broiler diet to be used as a growth promoter. Despite that, farmers often use commercial feeds containing antibiotics and also violate the rules of antibiotic usage (Wasnaeni *et al.*, 2015). This opened a necessity for the use of an alternative growth promoter in broiler with no adverse effect on human health, promisingly natural products. Among many other plants, Ceylon olive (*Elaeocarpus serratus*) leaves which has been used as a medicinal plant, can be a potential source to serve the purpose. Olive leaves contain many secondary metabolites such as saponins, tannins, cardiac glycosides, flavanoids, phytosterol, steroids and antioxidant like ascorbic acids (Das *et al*., 2017). The leaves of *E. serratus* also contains fatty acids,

hydrocarbons, alcohols, alkenes and aldehydes (Geetha *et al.*, 2013). Olive leaves also have antibacterial effects whereas the plant extract have antifungal effects (Jayashree *et al.*, 2014). Ethanolic extract of Ceylon olive leaves possesses antibacterial and cytotoxic activity (Biswas *et al.*, 2012). Olive leaf extracts are seen to improve feed intake, weight gain and feed conversion ratio in broiler (Oke *et al.*, 2017). In broiler, the leaves cause an improvement in oxidative stability, physio-chemical and sensory characteristics of meat (Marangoni *et al.*, 2017).

Although Ceylon olive leaves are available throughout the country, the most suitable method of feeding and formulation are needed to be determined. This study was designed to evaluate the functionality of Ceylon olive leaves with probiotics on the growth performance, meat quality, oxidative stability and cost return analysis of broiler rearing.

2. Materials and Methods

2.1. Preparation of olive leaves probiotics (OLP)

After collection of olive leaves from Chattogram region, they were washed, cleaned and air dried. Then, those were ground by an electric grinder (Panasonic MX-AC555). The probiotics cultures (*Lactobacillus plantarum* KCTC 3104 and *Saccharomyces cerevisiae* KCTC 7915) were purchased from the Add Bio Bd Inc., Dhaka Bangladesh. MRS broth (HiMedia Laboratories Pvt. Ltd., India) and YM broth (HiMedia Laboratories Pvt. Ltd., India) used for growth of *Lactobacillus plantarum* and *Saccharomyces cerevisiae* respectively as per instructions of the company.

For solid state fermentation, deoiled rice bran and distiller's dried grains with solubles (DDGS) were used as media. 1% of *Lactobacillus plantarum* KCTC 3104 and 1.0% of *Saccharomyces cerevisiae* KCTC 7915 were added to the olive leaves and made it's moisture content about 40% to make the fermentation process properly by adding adequate distilled water. The mixture was then incubated at 37ºC for 3 days (Incubator model: LGI-150T, Labnics®, USA). The formulated probiotics mixtures were air dried for 2 days until the moisture level was less than 15% using a dry oven (Labnics®, USA).

To determine the concentration of probiotics in OLP, 10-fold serial dilution were performed and then cultured in MRS agar (Hi-media®, Ref:M641-500G) and Potato Dextrose agar (Hi-media®, Ref:M096-500G) for growth of *Lactobacillus plantarum* and *Saccharomyces cerevisiae* respectively after which the number of colonies was counted by colony counter and expressed as cfu/gm (Table 1).

2.2. Experimental birds, diet and treatment

A total of 160 day old, unsexed Cobb-500 chicks were distributed in to five dietary treatment groups: Control (Basal diet), OLP -1 (Basal diet + 0.4% OLP, DM basis), OLP -2 (Basal diet + 0.8% OLP, DM basis), OLP -3 (Basal diet + 1.2% OLP, DM basis) and OLP -4 (Basal diet + 1.6% OLP, DM basis) having 4 replications with 8 birds in each in a completely randomized design.

A maize and soybean meal-based iso-caloric and iso-nitrogenous diet was prepared for both the starter and grower stage according to the nutrient requirements broiler chickens (NRC, 1994). The starter diets were offered from day 1 to day14, while grower diets were provided from day 15 to day 28. The proximate composition of dried OLP and basal diet (starter and grower) were determined by the method described by the Association of Official Analytical Chemists (AOAC, 2000). The ingredients and nutrient compositions of the experimental diets are shown in Table 2. Birds were kept in a close ventilated, wire-floor caged broiler house (90 cm long × 80 cm wide × 40 cm high/cage) at a stocking density of 720 cm^2/bird and supplied with *ad libitum* feed and water throughout the experimental period.

2.3. Growth Performance

The body weight and feed consumption was recorded per pen on a weekly basis from the initial day to the final day of the experiment. Then feed conversion was calculated as feed consumed divided by body weight gain per pen.

2.4. Carcass characteristics

At the end of the feeding trial (day 28), birds were randomly selected from each replicate and sacrificed according to Muslim (Halal) method by severing the jugular vein and carotid artery. The birds were dressed following Jones (1984) method and dressing percentage were calculated. Different organ and body part such as thigh, breast, abdominal fat, liver, spleen, bursa, caecum, total intestine and gizzard were weighed.

2.5. Meat sampling and analysis

The breast meat sample were collected and stored at −20°C until analysis. The proximate composition and oxidative rancidity of the meat were determined. For proximate analysis, meat samples were analyzed in triplicate for moisture (934.01), crude ash (942.05), crude protein (988.05), and ether extract (920.39) as described by AOAC (2000).

To determine the oxidative stability, meat samples were preserved in a refrigerator at 4°C, after which thiobarbituric acid reactive substance (TBARS) values of meat were assayed when fresh as well as at 1, 2, and 3 weeks according to the modified method described by Du and Ahn (2002). Briefly, 4 g of each sample was mixed with a 10 ml solution composed of 2 M phosphoric acid and 20% trichloroacetic acid. The mixture was then diluted with 10 ml of distilled water and homogenized by homogenizer and filtered through Whatman No. 1 filter paper. Following filtration, 2 ml of the filtrate were transferred to a test tube, after which 2 ml of 2-thiobarbituric acid (0.005 M in DW) was added. The sample test tube was kept in 80 degree celsius in a hot water bath for 30 min. The absorbance was measured using a Spectrophotometer at 530 nm. TBARS values are expressed as μmol of malondialdehyde (MDA) per 100 g of meat.

2.6. Hematological analysis

After collection of blood, serum was separated from which different blood parameters (cholesterol, triglyceride, LDL and HDL) were measured in automatic analyzer (Humalyzer 300, Merck®, Germany) according to the manufacturer's instruction (FVMAAU; Addis Ababa, Ethiopia).

2.7. Cost and return analysis

Cost and return was calculated based on recurrent and fixed cost, while return was calculated on sale of birds per unit. Recurrent cost included cost of bird, labour, feed, medicine, vaccine, electricity and miscellaneous cost. Whereas fixed included housing and equipment cost. Finally net return and BCR was calculated based on total cost and total return.

2.8. Statistical analysis

All the data were analyzed following the General Linear Model (GLM) procedure using the Statistics Analysis Systems Institute employing polynomial analysis (version 9.1; SAS Ins. Inc., Cary, NC, USA). Individual cages served as an experimental unit and a group of two birds served as the experimental units for organ weight, meat composition, and oxidative stability. Treatment means were computed with the LSMEANS option of the SAS program and a probability level of $p \leq 0.05$ was considered statistically significant.

3. Results and Discussion

3.1. Growth performance

The dietary effects of OLP on growth performance of broiler of 4 weeks growth trial are presented in Table 3. Results showed a significant ($p<0.05$) increase in overall live weight in all treatment groups compared to control. There was a significant increase in average daily gain (ADG) observed in all dietary groups than control from 0-28 days of age where the highest gain was observed in OLP-4 group (38.74 g/b/d) suppled with 1.6% OLP in diet. During 15-28 days, the weekly ADG has also increased and average feed intake (ADFI) decreased significantly ($p<0.05$) in treatment groups compared to control. The overall ADFI reduced significantly ($p<0.05$) in all dietary groups than control. The feed conversion ratio (FCR) decreased significantly ($p<0.05$) in all treatment groups than the control group.

In a study conducted in Saudi Arabia, olive leaves containing 85 g crude protein, 45 g crude fat, 149.9 g crude fiber and 96.9 g ash (Shafey *et al.*, 2013). The proximate composition tested in this study showed that olive leaves contain a great amount of protein (10.41%) and ash (6.75%) may be due to geographic and climatic change.

A study by Shafey *et al.* (2013), showed that body weight increased at 3rd week of age with 15 g/kg feed but reduced with 30 and 50 g/kg feed. In our study, the highest live weight gain was found in 1.6% OLP which is close to Shafey *et al.* (2013). In an experiment, higher ADG and lower FCR were observed in olive pomace extract supplied (750 ppm) group than control in broiler (Herrero-Encinas *et al.*, 2020). Another study revealed that daily body weight gain, feed intake and FCR improved in all treatment groups supplied with alcoholic extract of olive leaves (Erener *et al*., 2020). These results showed similarity with that of the present study. The final weight, ADG and FCR have improved remarkably in different treatment groups in this study, may be due to fermentation and the microflora improved digestibility of feed. *Lactobacillus plantarum* enhanced ADG and FCR in broiler in an experiment by Peng *et al.* (2016).

3.2. Hematological parameters

Supplementation effects of olive leaves probiotics are displayed in Table 4. The blood cholesterol shows significant (P=0.05) difference where the lowest found in OLP-4 (143 mg/dl). There was significant (P<0.05) rise in HDL level in all treatment groups compared with control except OLP-4 (46.88 mg/dl). The triglyceride and LDL level remained static.

A study by Erener *et al.* (2020) revealed that plasma cholesterol and HDL increased in all treatment groups compared to control which shows similarity with the current study findings. Furthermore, cholesterol level increased with 2% supplementation of olive leaf meal in diet in broiler whereas the TG, LDL level remained unaffected (Sateri *et al.*, 2017). Another experiment in broiler by Nafea and Hussein (2018) showed that HDL and LDL in serum increased while cholesterol decreased with 5, 10 and 15 g/kg olive leaf power supplement in diet. The highest level (1.6%) of olive leaf in diet significantly reduced cholesterol level may be due to the presence of phenolic compounds in leaves which proved to have hypocholesterolemic effect in rats (Fki *et al.*, 2007). The cause of increased HDL and LDL in serum may be due to the presence of vitamin E in olive leaf which showed to decrease the oxidative susceptibility of HDL and LDL (Arrol *et al.*, 2000). In contrast, a study found that probiotic, *Lactobacillus plantarum* lowered the cholesterol, in serum in rats though no significant differences was found in serum HDL level (Huang *et al.*, 2013).

3.3. Relative meat yield and internal organs weight

Relative internal organs weight, presented in Table 5, shows that the dressed weight and relative breast meat weight were significantly different (p<0.05). The weight, length and width of thigh bone showed no notable changes from control. Among internal organs, the relative weight of bursa differed significantly (p<0.05) where the highest (0.28 g) was in OLP-2 and the lowest (0.13 g) in OLP-1.

Shafey *et al.* (2013) reported no significant effect of olive leaves on carcass characteristics with a significant reduction of the eviscerated carcass weight when 15, 30, 50 g/kg wheat bran are substituted by olive leaves in broiler. Another study by Omar (2005) showed that carcass characteristics remained unaffected by the supplementation of olive pulps in broiler. The relative breast weight increased may be because of the inoculation of probiotics along with olive leaves. A study reported diet containing commercial probiotics increased breast percentage in broiler (Mehr *et al.*, 2007).

3.4. Meat composition

Dietary effects of OLP in proximate composition of meat are represented in Table 6. There was a significant increase of CP in all treatment groups than control (22.05) except in OLP-4 (21.65). The highest CP found in OLP-1 (23.45). There was a highly significant (p<0.001) relation found in ash content of meat where the lowest (1.44) in control and highest (1.68) in OLP-2.

In this experiment, the probiotics along with olive lives may result in the increase of CP% and Ash%. Olive leaves contains a significant amount of sodium, calcium, potassium, iron and some others like copper, magnesium, zinc and phosphorus (Chand and Azeez, 2018). The minerals may increase the ash percentage of meat. A study conducted by Khaksefidi and Rahimi (2005) concluded that probiotics in diet increased the moisture, CP and Ash in leg and breast meat of broiler. Podolian (2017) stated that calcium, phosphorus, iron, zinc, magnesium and copper increased in thigh muscle of poultry which resulted in higher ash content of meat. Same study found that probiotic in broiler diet increased the synthesis of essential amino acids in pectoral muscle such as lysine, histidine, arginine, threonine, valine, methionine, leucine and phenylalanine. This ultimately resulted in the increase of protein percentage of meat.

3.5. Meat thiobarbituric acid reactive substances (TBARS) value

The effects of OLP in TBARS value of breast meat are shown in Figure 1. No significant difference was observed in the fresh meat sample. But a significant reduction was noted in first to third weeks in comparison with control (p<0.05). Furthermore, average TBARS value was significantly reduced compared to control (p<0.05).

The treatments with addition of olive leaves via broiler feed showed lower peroxide values was capable of delaying the onset of oxidative process (Marangoni *et al.*, 2017). The causes of reduction of TBARS value is due to the synergistic effects of olive leave that contains phenolic compounds which scavenges free radicals (Devatkal *et al.*, 2010) and probiotics which also act as antioxidant (Wang *et al.*, 2017).

3.6. Cost and return analysis

Cost and return analysis is represented in Table 7. According to the results, significant variation was found for recurrent cost, total cost, total return, net return and benefit cost ratio (BCR). Higest total cost was found in control whereas lowest total cost was in 0.8% fermented olive leaves group ($p<0.01$). Maximum net return and BCR was calculated in fermented olive leaves group compared to control and other treatment ($p<0.05$). The findings of this current study is agree with Hossain *et al.* (2019) who reported that 0.4% fermented elephant apple leaf showed higher BCR than non fermented leaves group.

Table 1. Microbial concentration and nutrient composition of olive leaves probiotics (OLP).

Item	Olive leaves probiotics (OLP)
Microbial stains in (OLP) (cfu/gm)	
*Lactobacillus plantarum*KCTC 3099	2.4×10^9
Saccharomyces cerevisiae KCTC 7928	1.9×10^9
Chemical composition	
Dry matter (%)	98.80±0.06
Crude Protein (% dry matter)	10.41±0.25
Crude Fat (% dry matter)	2.60±0.12
Crude Fiber (% dry matter)	23.05±0.23
Crude Ash (% dry matter)	6.75±0.06
pH	4.07 ± 0.02

Table 2. Ingredients and nutrient composition of experimental diet.

Ingredients (as % feed basis)	Starter (0-14 days)	Grower (15-28 days)
Corn	52.00	53.00
Wheat	2.00	2.00
Rice polish	2.50	3.20
Soybean meal	32.00	29.20
Fishmeal	4.00	3.50
Palm oil	3.50	5.00
DCP	1.79	1.79
Limestone	1.15	1.15
NaCl	0.30	0.30
Choline chloride	0.06	0.06
Vitamin min premix[1]	0.15	0.15
L-lysine	0.40	0.40
DL-methionine	0.22	0.22
Toxin binder	0.25	0.25
Enzymes	0.04	0.04
Chemical composition (as fed basis)[3]		
ME (kcal/kg)	3001.65	3104.85
Crude protein %	22.09	20.71
Crude fiber %	3.76	3.68
Ether extract %	3.67	3.68
Lysine%	0.72	0.80
Calcium%	1.30	1.26
Phosphorus%	0.72	0.70

[1]Vitamin-mineral mixture provided the following nutrients per kg of diet: Vitamin A 15,000 IU, Vitamin D3 1500 IU, Vitamin E 20.0mg, Vitamin K3 0.70 mg, Vitamin B12 0.02 mg, Niacin 22.5 mg, thiamin 5.0 mg, folic acid 0.70 mg, pyridoxine 1.3 mg, riboflavin 5 mg, pantothenic acid 25 mg, choline chloride 175 mg, Mn 60 mg, Zn 45 mg, I 1.25 mg, Se 0.4 mg, Cu 10.0 mg, Fe 72 mg, Co 2.5 mg, (Arif's Bangladesh Ltd., Bangladesh).

Table 3. Effects of dietary supplementation of OLP on growth performance in broiler.

Parameters	Treatments					SEM	P value
	Control	0.4% OLP1	0.8% OLP2	1.2% OLP3	1.8% OLP4		
0-14 days							
Initial weight (g/b)	47.96	47.75	48.04	47.92	47.79	0.30	0.96
Final weight (g/b)	355.67	360.75	364.17	356.29	367.19	8.83	0.90
ADG (g/b/d)	21.98	22.36	22.58	22.03	22.82	0.63	0.90
ADFI (g/b/d)	42.88	41.87	41.14	39.93	42.58	1.40	0.69
FCR	1.96^{a}	1.88^{ab}	1.82^{b}	1.82^{b}	1.87^{ab}	0.02	0.03
15-28 days							
Initial weight (g/b)	355.67	360.75	364.17	356.29	367.19	8.83	0.90
Final weight (g/b)	1089.29	1127.65	1113.70	1125.21	1133.80	29.24	0.87
ADG (g/b/d)	52.40^{b}	54.78^{a}	53.54^{ab}	54.92^{a}	54.76^{a}	0.42	0.03
ADFI (g/b/d)	107.07	90.12	83.48	76.04	84.63	6.78	0.08
FCR	2.26	2.04	2.21	1.68	2.01	0.25	0.62
0-28 days							
Initial weight (g/b)	47.96	47.75	48.04	47.92	47.79	0.30	0.96
Final weight (g/b)	1089.29^{b}	1127.65^{a}	1113.70^{ab}	1125.21^{a}	1133.80^{a}	6.24	0.04
ADG (g/b/d)	37.19^{b}	38.57^{a}	38.06^{ab}	38.47^{a}	38.78^{a}	0.31	0.04
ADFI (g/b/d)	74.97^{a}	66.29^{ab}	61.34^{b}	59.03^{b}	42.32^{c}	3.38	0.001
FCR	2.02^{a}	1.72^{b}	1.61^{b}	1.54^{b}	1.09^{c}	0.09	0.001

^{a,b,c}Means in a row with no common superscripts significantly differ (P<0.05).
[1]Data presented as the mean value of four replicate groups with eight birds per replication (n=32).
OLP = Olive leaves probiotics; ADG = average daily gain; ADFI = average daily feed intake.
SEM = Standard error of the mean.

Table 4. Effect of dietary supplementation of OLP on hematological parameters.

Parameters	Treatments					SEM	P value
	Control	0.4% OLP1	0.8% OLP2	1.2% OLP3	1.8% OLP4		
Cholesterol (mg/dl)	166.20^{b}	198.80^{ab}	185.87^{ab}	229.67^{a}	143.00^{b}	15.92	0.05
TRG (mg/dl)	39.91	64.78	46.58	31.94	41.43	9.00	0.22
HDL (mg/dl)	60.37^{bc}	87.09^{ab}	70.62^{abc}	92.90^{a}	46.88^{c}	7.37	0.01
LDL	97.85	98.76	105.93	130.38	87.84	9.94	0.15

^{a,b,c}Means in a row with no common superscripts significantly differ (P<0.05).
[1]Data presented as the mean value of four eplicate groups with two birds per replication (n=8).
OLP = Olive leaves probiotics; SEM = Standard error of the mean.

Table 5. Effect of dietary supplementation of Olive leaves probiotics feed on carcass quality and internal organ weight of broiler.

Parameters	Treatments					SEM	P value
	Control	0.4% OLP1	0.8% OLP2	1.2% OLP3	1.8% OLP4		
Dressed wt (g)	68.23^{a}	60.15^{b}	66.97^{a}	70.34^{a}	68.57^{a}	1.54	0.03
Breast meat wt (g)	19.60^{a}	16.10^{c}	16.84^{bc}	19.24^{ab}	20.55^{a}	0.57	0.01
Thigh meat (with bone)	20.12	17.39	20.37	20.51	18.98	0.67	0.07
Thigh meat wt	15.64	13.21	15.46	16.00	14.60	0.68	0.14
Thigh wt (g)	4.02	3.79	4.61	4.24	4.05	0.18	0.33
Thigh Length (cm)	0.75^{ab}	0.73^{b}	0.82^{a}	0.79^{ab}	0.75^{b}	0.02	0.07
Thigh width (mm)	0.54	0.54	0.56	0.57	0.54	0.02	0.75
Liver (g)	2.32	2.72	2.33	2.72	2.33	0.14	0.14
Gizzard (g)	4.01	4.58	4.25	4.15	3.53	0.29	0.38
Ceca (g)	0.73^{b}	0.79^{ab}	0.93^{ab}	0.74^{ab}	1.17^{a}	0.11	0.16
Total intestine (g)	6.97	7.45	7.66	7.42	7.35	0.52	0.93
Spleen (g)	0.08	0.10	0.09	0.10	0.10	0.02	0.94
Bursa (g)	0.20^{ab}	0.13^{b}	0.28^{a}	0.19^{b}	0.17^{b}	0.02	0.04
Abdominal fat (g)	1.00	1.27	1.50	1.08	1.13	0.15	0.29

^{a,b,c}Means in a row with no common superscripts significantly differ (P<0.05).
Data presented as the mean value of four replicate groups with two birds per replication (n=8).
OLP= Olive leaves probiotics; SEM = Standard error of the mean.

Table 6. Effect of dietary supplementation of OLP on meat proximate composition.

Parameters	Treatments					SEM	P value
	Control	0.4% OLP1	0.8% OLP2	1.2% OLP3	1.8% OLP4		
% DM	92.96	92.33	92.49	90.95	92.64	0.67	0.39
% CP	22.05^{bc}	23.45^{a}	22.81^{ab}	23.04^{a}	21.65^{c}	0.24	0.01
% EE	1.52	2.17	1.59	0.92	1.26	0.26	0.08
% Ash	1.44^{d}	1.62^{ab}	1.68^{a}	1.53^{c}	1.56^{bc}	0.02	0.0004

^{a,b,c}Means in a row with no common superscripts significantly differ (P<0.05).
[1]Data presented as the mean value of four replicate groups with two birds per replication (n=8)
OLP = Olive live probiotics, DM=Dry matter, CP= Crude protein, EE= Ether extract
SEM = Standard error of the mean.

Table 7. Analysis of cost and return of broiler rearing supplemented with olive leaves.

Parameters	Treatments					SEM	P value
	Control	OLP1 (0.4%)	OLP2 (0.8%)	OLP3 (1.2%)	OLP4 (1.8%)		
Total recurrent cost (Chick, feed, labour, vaccine, electricity, miscellaneous, interest on operating capital etc., BDT/bird)	110.13^{a}	101.19^{b}	97.87^{b}	95.66^{b}	82.20^{c}	2.74	0.001
Total fixed cost (Housing, equipment etc., BDT/bird)	24.67	24.67	24.67	24.67	24.67	0.00	0.00
Total cost (BDT/bird)	134.80^{a}	125.86^{b}	122.54^{b}	120.33^{b}	106.87^{c}	2.74	0.001
Total return (Bird sale, BDT/bird)	141.61^{b}	146.59^{a}	144.78^{ab}	146.28^{a}	147.40^{a}	0.81	0.038
Net return (BDT/bird)	6.81^{c}	20.74^{b}	22.24^{b}	25.95^{b}	40.53^{a}	2.67	<.0001
BCR	1.05^{c}	1.16^{b}	1.18^{b}	1.22^{b}	1.38^{a}	0.03	<.0001

^{a,b,c} Means in a row with no common superscripts significantly differ (P<0.05).
Data presented as the mean value of four replicate groups with 8 birds per replication (n=32).
OLP = Olive leaf probiotics; SEM = Standard error of mean. BCR = Benefit cost ratio.

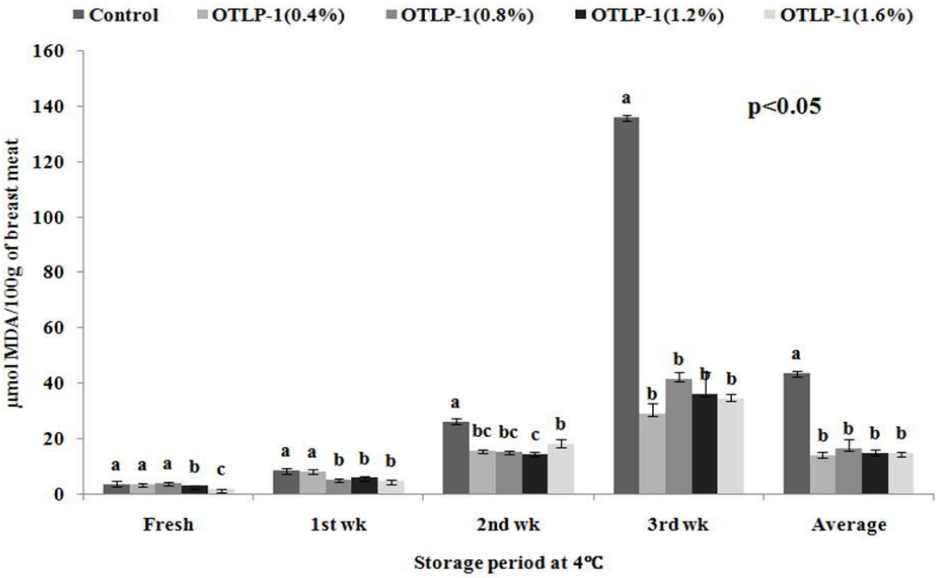

Figure 1. Effect of dietary supplementation of olive leaves probiotics feed on meat TBARS (µmol MDA/100g) in broiler.

[^{a,b,c}Means in a row with no common superscripts significantly differ (P<0.05). Data presented as the mean value of tree replicate groups with three birds per replication (n=9). OLP= Olive leaves probiotics.]

4. Conclusions

The present study investigated the dietary effects of olive leaves fermented with probiotics on growth performance, carcass characteristics, blood parameters, meat quality and oxidative stability of meat in broiler. The results showed that, the weekly and overall live weight and ADG increased, FCR and ADFI decreased in dietary groups from control. No difference was observed in organ weight among the groups. The chemical composition of meat showed, there was a significant increase in meat crude protein and ash content in treatment groups compared to control. The blood HDL level increased in OLP 1, 2 and 3 treatment groups in comparison with control group. In treatment groups, the TBARS value reduced in every week except fresh sample with a significant reduction in overall period from control. Net return and BCR also found better in olive leave fermented supplementation than control. Therefore, a dietary supplement of olive leaves with probiotic fermentation can be used to improve growth performance, blood parameters, meat quality and oxidative stability of broiler meat with a better result when provided with 1.2% and 1.6% of the diet.

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Conflict of interest

None to declare.

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