Journal of the Hellenic Veterinary Medical Society

Vol 74, No 2 (2023)

The effects of laurel (Laurus nobilis L.) leaf powder supplementation on performance, carcass characteristics, meat lipid oxidation and some blood parameters of broiler chicks

A Arslan Duru, AO Gölcü

doi: 10.12681/jhvms.29936

J HELLENIC VET MED SOC 2023, 74 (2): 5677-5686
ΠΕΚΕ 2023, 74 (2): 5677-5686

Research article
Ερευνητικό άρθρο

The effects of laurel (*Laurus nobilis* L.) leaf powder supplementation on performance, carcass characteristics, meat lipid oxidation and some blood parameters of broiler chicks

A.O. Gölcü[1], A. Arslan Duru[2*]

[1]*Department of Animal Science, Graduate Education Institute, Uşak University, 64200, Uşak, Turkey*

[2]*Department of Animal Science, Faculty of Agriculture, Uşak University, 64200, Uşak, Turkey*

ABSTRACT: The purpose of this study was conducted to evaluate the effects of laurel (*Laurus nobilis* L.) leaf powder (LLP) on performance, thigh and breast meat lipid oxidation and chemical composition, body components, digestive tract parts and some blood parameters in broiler chickens. A total of 144 d-old mix-sexed chicks were weighed and randomly assigned to four experimental groups with three replicates of 12 chicks (6 ♀ and 6 ♂) each. Treatments were as follows: (i) basal diet-no additive (control), (ii) basal diet+1000 mg/kg LLP, (iii) basal diet+5000 mg/kg LLP and (iv) basal diet+10000 mg/kg LLP. The results revealed that over entire the experimental period body weight and body weight gain increased by LLP supplementation ($p<0.01$). Feed intake of birds enhanced ($p<0.05$) whilst feed conversion ratio and chemical composition of thigh meat were not significantly affected by LLP concentration ($p>0.05$). Liver weight improved with 10000 mg/kg LLP ($p<0.001$) and the weight of ileum + jejunum improved with 5000 and 10000 mg/kg LLP ($p<0.01$). Breast meat dry matter content ($p<0.05$), serum glucose ($p<0.05$), the TBARS values of breast and thigh meat decreased ($p<0.001$). As a result, LLP supplementation in broiler diets can be advised because it lowers lipid oxidation in the meat.

Keywords: Laurel leaves, broiler, performance, lipid oxidation, blood parameters.

Corresponding Author:
A. Arslan Duru, Department of Animal Science, Faculty of Agriculture, Uşak University, 64200, Uşak, Turkey.
E-mail address: duru.asuman@gmail.com

Date of initial submission: 18-03-2022
Date of acceptance: 19-07-2022

INTRODUCTION

Performance, blood circulation, product amount, quality, and the immune system are all affected by natural feed additives, which are botanically based and known as phytogenic feed additives due to the bioactive components they contain. Studies on the use of chicken feed have increased in recent years due to its impacts (Arslan Duru, 2019; Diarra, 2021). Due to changes in the origin, processing method, content, and doses utilized in feeds, it has been determined that various phytogenic feed additives have distinct effects on bird performance. Many of the features of phytogenic feed additives, on the other hand, are assumed to be related to their essential oil content, which can promote blood circulation, lower pathogenic bacterial load, and have the ability to boost immunological status and digestive secretion production (Zaker-Esteghamati et al., 2021; Kaila et al., 2022; Seidavi et al., 2022).

The essential oils produced by phytogenic plants as a result of their secondary metabolism are commonly employed to enhance the shelf life of foods (Adam et al., 1998). Many studies have underlined the need of selecting appropriate herbs, active components, and effective dietary dosages for these substances' suitability in influencing bird performance (Alagbe, 2018; Ncube et al., 2018; Aderemiet al., 2018; Rahman and Yang, 2018; Sebolaet al., 2019; Oloruntolaet al., 2019; Abdul Basit et al., 2020; Diarra and Anand, 2020; Guliza and Downs, 2020; Abdelattyet al., 2021; Ogwuegbuet al., 2021). Laurel leaves, which come from the bay laurel plant and are high in bioactive components, are one of these phytogenic feed additives.

The laurel (*Laurus nobilis* L.) is an evergreen shrub native to the Mediterranean region and Europe's only Lauraceae representative (Barla et al., 2007). The Mediterranean climate zone is known for its bay laurel, which is a year-round green plant (Derwich et al., 2009). The bay laurel plant and its by-products are utilized in a variety of applications. In Italy, France, Turkey, Algeria, Morocco, Spain, Portugal, and Mexico, its dried leaves and essential oil components are utilized as a valuable spice in the culinary and food industries (Akcan et al., 2017; Santoyo et al., 2006). Essential oils and seed oils from this plant are utilized in cosmetics, food, chemicals, and medicine. It is also renowned as an antiseptic, antimicrobial, appetite-stimulating, antibacterial, anti-inflammatory, hunger stimulant, and digestive source, in addition to its antioxidant capabilities (Baratta et al., 1998; Kamel, 2000; Taban et al., 2018). Alkaloids, essential oils, and fixed oils are all found in bay laurel (Barla et al., 2007). Its leaves include phenols, flavones, and flavanols from the laurel plant, and it has antioxidant properties (Zekovic et al., 2009; Simićet al. 2003; Elmastas et al. 2006). Bay laurel leaves also include chemical compounds such cineole, linalool, alpha-pinene, alpha-terpineol, acetate, tannin, resin, mucilage, and eucalyptol, among others (Li, 2000). The major component of laurel leaf essential oil is 1,8-cineole, according to studies (Borges et al., 1992). In western countries, laurel leaf has been used in traditional and complementary medicine to treat rheumatic disorders and other ailments including dyspepsia (Fang et al., 2004). Laurel leaves also provide key features such as thermostability, phytotoxicity-free status, and the capacity to treat excessive blood sugar, migraines, headaches, stomach ulcers, and bacterial and fungal infections (Sayyah et al., 2003; Polovka and Suhaj, 2010). It is even more critical to feed with functional foods to boost body immunity against Covid-19 and other infectious diseases that are on the rise around the world.

This study was carried out to investigate the effects of laurel (*Laurus nobilis* L.) leaf powder to broiler diets at varying rates affected their growth performance, carcass characteristics, internal organ weights, blood parameters, chemical composition of thigh and breast meat, and lipid oxidation in broiler chickens.

MATERIALS AND METHODS

This study was approved by the Uşak University local Ethics Committee (No: 2019/01-02).

Birds management and experimental design

First, one-day old a total of 144 broiler chickens (Ross-308) were weighed and randomly assigned to four experimental groups in three replicates of 12 chickens (6 ♀ and 6 ♂) each. Treatments were as follows: (i) basal diet (control), (ii) basal diet+1000 mg/kg LLP, (iii) basal diet+5000 mg/kg LLP and (iv) basal diet+10000 mg/kg LLP. Control and all other treatments diets did not contain any additive. Broiler chicks fed on starter diet for 0-21 day and finisher diet for 22-41 day. The basal diets were formulated in line with NRC (1994). Chemical composition and ingredients of basal (starter and finisher phases) diets are presented in Table 1.

Water and experimental diets were provided *ad-li-*

Table 1. Chemical composition and feed ingredients of basal diets (starter and finisher phases)

Feed Ingredients, %	Starter Diets (1-21 day)	Finisher Diets (22-41 day)
Corn	48	51.9
Full fat soya	20	15
Soybean meal	13	14.3
Corn gluten meal	8	3.3
Boncalit	-	6
Fish meal	5	-
Vegetable oil	2	5
DCP	1.5	2
Lysine	0.3	0.2
Methionine	0.4	0.3
$CaCO_3$	0.5	0.7
NaCl	0.4	0.4
$NaHCO_3$	0.4	0.4
Vitamin premix*	0.3	0.2
Mineral premix**	0.2	0.3
Calculated Composition		
ME (kcal kg^{-1})	3041	3223
Lysine, %	1.44	1.08
Methionine + cystine, %	1.15	0.90
Ca, %	1.05	0.86
P (available), %	0.51	0.44
Analyzed Values, %		
Dry matter	90.56	89.50
Crude protein	23.17	20.05
Crude ash	5.45	4.12
Crude fiber	1.21	1.76
Ether extract	8.60	11.70

** Provides per kg of diet: Vitamin A 8000 IU, Vitamin D_3 800 IU, Vitamin E 15 mg, Vitamin K_3 2 mg, Vitamin B_1 2 mg, Vitamin B_2 4 mg, Vitamin B_{12} 10 mg, ** Provides per kg of diet: Mn 80 mg, Zn 60 mg, Fe 25 mg, Cu 15 mg, Co 0.25 mg, I 1 mg, Se 0.2 mg, Mo 1 mg, Mg 50 mg.*

bitum to the birds for 0-41 d. Broiler chicks were reared in group cages a constant 1/23-hour dark/light cycle and were subjected to standard temperature regimes that gradually decreased from 33 to 25 °C.

LLP (laurel leaf powder) treated to feeds as a phytogenic additive was purchased from the herbal market in the form of dry leaf. It was grounded to a 1 mm sieve, and its chemical composition assayed according to AOAC (1999). Also, as above, it has been homogeneously added to the basal starter and finisher diets at different levels and has not been treated with any other additives. Crude ash, crude protein and dry matter contents of LLP are presented in Table 2.

Table 2. Dry matter, crude protein, and crude ash contents of LLP

Parameters	LLP
Dry matter, %	93.86
Crude protein, % DM	7.91
Crude Ash, % DM	6.45

LLP: Laurel leaf powder; DM: Dry matter

Performance parameters

Feed intake and body weight of birds were monitored weekly. Feed conversion ratio (FCR) and body weight gain were calculated according to wk. 0-3wk, 4-6 wk and 0-6 wk for each replication. Body weight gain (BWG) of birds was calculated as weight differences between two weighing intervals.

BWG = Body weight – Initial weight

FCR = Total feed intake / Total body weight gain

Carcass traits and TBARS analysis

On day 42, eight broilers from each treatment were randomly selected, weighed, and slaughtered to determine body components (weights of carcass, thigh, wing, breast, liver, heart, pancreas, abdominal fat, gizzard, crop; lengths of proventriculus and crop) and digestive tract parts (weights and lengths of duodenum, ileum+jejunum, colon, and caecum).

After slaughtering, breast and thigh meat samples collected from aforesaid birds. For the oxidative deterioration were measured for Thiobarbituric acid reacting substances (TBARS) values on the 3rd day after keeping at +4 °C in refrigerator (Tarladgis et al., 1960). Chemical composition (dry matter, crude ash and crude protein) of breast and thigh meat of birds were assayed as reported by AOAC (1999).

Some blood parameters

Blood collection was performed on the 42nd day of the trial with eight birds from each treatment using heparinized syringes. Blood samples were taken from the aforementioned birds during slaughter. Blood was taken in clean tubes containing Ethylenediaminetetraacetic acid (EDTA). Serum was separated by centrifugation for 5 min. at 10.000 rpm and were kept at -18 °C. Total cholesterol, total triglycerides, total glucose, high-density lipoprotein cholesterol (HDL) and low-density lipoprotein cholesterol (LDL) concentration of these serum samples were analyzed calorimetrically using commercial kits.

Statistical analyses

After all data obtained from the experiment were subjected to One-Way ANOVA analysis, the means of all treatment groups were compared with Duncan's Multiple Range Test. Statistical significance was considered at $p<0.05$. SPSS 16.0 was used to conduct all statistical analyses (SPSS, 2007).

RESULTS

Effects of different dietary concentrations of LLP on performance of broiler chicks are given in Table 3.

The data in Table 3 stated that over the entire experimental period (0-3, 4-6 and 0-6 wk), body weight ($p<0.01$) and body weight gain ($p<0.001$) increased significantly from LLP concentration. Feed intake of birds was not affected during starter phase (0-3 wk) ($p>0.05$). However, significant increases in feed intake were observed in the treatments fed with 10000 mg/kg LLP compared to the control group during the experimental period (0-6 wk) and finisher phase (4-6 wk) ($p<0.05$). Feed conversion ratio was not affected by LLP concentration ($p>0.05$).

Table 4 shows the effects of LLP dietary concentrations on broiler body components, some internal organs and digestive tract parts of broilers.

The present study showed that carcass, thigh, wing, breast, heart, pancreas, abdominal fat, proventriculus length, gizzard, gizzard length, crop and crop length did not appear to have a significant effect of LLP supplementation ($p>0.05$) but 10000 mg/kg LLP supplementation resulted in the enlargement of the liver. There were no significant differences in duodenum weight, duodenum length, ileum+jejunum length, colon weight, colon length, caecum weight and caecum length of birds fed different levels of LLP compared

Table 3. The effects of LLP on performance of broiler chickens

Parameters	LLP, mg/kg				P
	Control	1000	5000	10000	
Body weight, g					
0-3 weeks	650^{b}	682^{a}	685^{a}	692^{a}	0.03
4-6 weeks	1347^{c}	1476^{b}	1518^{ab}	1609^{a}	0.003
0-6 weeks	1997^{c}	2158^{b}	2203^{ab}	2301^{a}	0.002
Body weight gain, g					
0-3. weeks	610^{b}	642^{a}	645^{a}	652^{a}	0.04
4-6. weeks	1307^{c}	1437^{b}	1478^{ab}	1569^{a}	0.003
0-6. weeks	1957^{c}	2119^{b}	2163^{ab}	2261^{a}	0.002
Feed intake, g					
0-3. weeks	874.97	865.22	904.62	917.65	0.24
4-6. weeks	2353.20^{b}	2507.47^{ab}	2588.19^{ab}	2729.95^{a}	0.03
0-6. weeks	3228.17^{b}	3372.70^{ab}	3492.81^{ab}	3647.60^{a}	0.04
Feed conversion ratio					
0-3. weeks	1.43	1.35	1.40	1.41	0.44
4-6. weeks	1.80	1.75	1.75	1.76	0.42
0-6. weeks	1.65	1.59	1.62	1.61	0.57

LLP: Laurel leaf powder

$^{a-c}$: The differences between the averages indicated by different letters on the same line are statistically significant. ($p<0.01$).

$^{a-b}$: The differences between the averages indicated by different letters on the same line are statistically significant. ($p<0.05$).

to control group ($p>0.05$). However, ileum+jejunum weight tended to increase as the concentration of LLP in diet increased ($p<0.01$).

Table 5 reported the data on some chemical composition and TBARS values of breast and thigh meats. Treatment of LLP to the basal diet dramatically depressed breast dry matter contents compare to control group ($p<0.05$) whilst breast crude protein contents increased ($p<0.01$). However, no effects of LLP treatments were observed on breast crude ash,

Table 4. The effects of LLP on body components, some internal organs and digestive tract parts of broilers

Parameters	LLP, mg/kg				P
	Control	1000	5000	10000	
Body components					
Carcass, g	1565.83	1574.17	1578.75	1613.64	0.78
Thigh, g	472.08	464.00	445.00	456.50	0.44
Wing, g	158.33	166.25	159.58	173.64	0.14
Breast, g	520.42	510.00	530.42	527.27	0.88
Liver, g	35.10^{b}	32.78^{b}	34.87^{b}	40.84^{a}	0.0001
Heart, g	9.88	9.04	9.94	10.42	0.17
Pancreas, g	3.98	4.44	4.23	4.93	0.10
Abdominal fat, g	38.91	38.92	34.73	35.75	0.75
Proventriculus, cm	6.50	6.92	6.51	7.57	0.37
Gizzard, g	20.29	19.93	18.08	21.34	0.39
Gizzard, cm	4.98	4.57	4.85	5.52	0.18
Crop, g	7.39	8.27	9.24	9.97	0.15
Crop, cm	15.65	16.62	16.25	16.75	0.77
Digestive Tract Parts					
Duodenum, g	7.94	7.30	8.84	8.84	0.21
Duodenum, cm	15.12	13.65	14.55	14.38	0.41
Ileum + Jejunum, g	35.13^{b}	35.35^{b}	40.48^{a}	41.86^{a}	0.01
Ileum + Jejunum, cm	134.84	145.40	134.17	137.98	0.18
Colon, g	2.04	2.49	1.97	2.56	0.69
Colon, cm	9.59	9.78	9.08	9.45	0.94
Caecum, g	5.65	6.04	6.05	6.77	0.27
Caecum, cm	16.72	17.12	17.77	17.42	0.73

LLP: Laurel leaf powder
$^{a-c}$: The differences between the averages indicated by different letters on the same line are statistically significant. ($p<0.01$).
$^{a-c}$: The differences between the averages indicated by different letters on the same line are statistically significant. ($p<0.001$).

Table 5. The effects of LLP on TBARS values and some chemical composition of breast and thigh meat of broilers

Parameters	LLP, mg/kg				P
	Control	1000	5000	10000	
Meat composition, %					
Breast Dry Matter	29.11^{a}	26.02^{b}	26.71^{b}	26.49^{b}	0.02
Breast Crude Protein	21.39^{c}	24.51^{b}	28.49^{a}	28.70^{a}	0.01
Breast Crude Ash	1.44	1.53	1.46	1.46	0.56
Thigh Dry Matter	26.06	27.89	25.91	27.96	0.74
Thigh Crude Protein	29.93	29.77	30.43	32.85	0.72
Thigh Crude Ash	1.36	1.40	1.36	1.27	0.45
TBARS Values					
Breast TBA, d 3	0.089^{a}	0.064^{b}	0.068^{b}	0.063^{b}	0.001
Thigh TBA, d 3	0.125^{a}	0.095^{b}	0.069^{c}	0.069^{c}	0.0001

LLP: Laurel leaf powder
$^{a-b}$: The differences between the averages indicated by different letters on the same line are statistically significant. ($p<0.05$).
$^{a-b}$: The differences between the averages indicated by different letters on the same line are statistically significant. ($p<0.01$).
$^{a-c}$: The differences between the averages indicated by different letters on the same line are statistically significant. ($p<0.001$).

Table 6. The effects of LLP on some blood serum parameters of broiler

Parameters (mg/dL)	LLP, mg/kg				P
	Control	1000	5000	10000	
Cholesterol	115.0	104.8	121.3	121.0	0.26
Triglycerides	43.0	45.0	45.6	46.5	0.89
Glucose	266.0^{a}	223.3^{b}	204.0^{b}	197.8^{b}	0.02
HDL	82.7	75.4	76.6	77.9	0.75
LDL	38.5	38.0	38.8	37.2	0.33

LLP: Laurel leaf powder; HDL: High-density lipoprotein cholesterol; LDL: Low-density lipoprotein cholesterol.
$^{a-b}$: The differences between the averages indicated by different letters on the same line are statistically significant (*p<0.05*)

thigh dry matter, thigh crude protein and thigh crude ash (*p>0.05*). According to Table 5, TBARS values of breast and thigh meat of birds revealed a difference between LLP treatments and the control group (*p<0.001*). LLP decreased TBARS values in breast and thigh meat of broilers compared to the control group.

The mean values of cholesterol, triglycerides, glucose, low-density lipoprotein cholesterol and high-density lipoprotein cholesterol from birds fed the experimental diets are presented in Table 6. According to table, cholesterol, triglycerides, low-density lipoprotein cholesterol and high-density lipoprotein cholesterol of broiler chicks were not affected by LLP concentration at the end of the study (*p>0.05*) but glucose was reduced by LLP treatment (*p<0.05*).

DISCUSSION

In the current study, it was hypothesized that bioactive compounds contents of LLP may improve the health status of broilers reflecting to performance, meat lipid oxidation, body components, digestive tract parts and some blood parameters. There are few studies on the use of LLP in poultry but there are many studies conducted with leaves of herbal sources rich in bioactive compounds in broilers. According to us, unlike previous studies, no study was found on the antioxidant activity of the use of laurel leaf powder alone in breast and thigh meat.

Feed intake, body weight and body weight gain tended to increase as the concentration of LLP in the diet of the birds increased compared to the control group, but FCR did not improve. Feed intake increased as a result of the LLP treatment, and similar increases in body weight and weight gains were seen. Because these similar increases were mirrored in the FCR, no change was discovered. It's also probable that the muscle-building effects of LLP increased carcass and breast meat weights, leading in an increase in body weight and bulk. This means that 1000mg/kg or more LLP supplement can be used as a growth promoter in broilers. Furthermore, no adverse effects on the performance and health of the animals were observed with the treatment of LLP. On the other hand, the effects of LLP treatment on animal diets are inconclusive. Duru (2016) stated that dietary LLP (0, 1, 2 and 4 g/kg) had no significantly effects on body weight gain, feed intake and FCR in broiler chickens. Karaalp et al (2011) indicted that the adding0, 2 and 4 g/kg bay laurel leaves to Japanese quails diets had no effect on performance. Alçiçek et al (2003) reported that essential oil combination (Oregano oil (*Origanum* sp.), laurel leaf oil (*Laurus nobilis* L.), sage leaf oil (*Salvia triloba* L.), myrtle leaf oil (*Myrtus communis*), fennel seeds oil (*Foeniculum vulgare*) and citrus peel oil (*Citrus* sp.)) had a significant effect on body weight and FCR of broilers. 0, 1, 2 and 3 g/kg the inclusion of laurel leaf improved the body weight, body weight gain, feed intake, FCR, and mortality rate of broiler chickens according to Ali and Al-Shuhaib (2020). Salim et al. (2021) stated that rabbits had an increase in body weight gain and a decrease in FCR with 0, 1, 2, ve 4 g/kg adding of dried laurel leaves to their diet. The supplementation of bay laurel has been shown to increase the body weights of quails (0%, 1%, 2%, 3% laurel leaf), rats (200 mg/kg LLP), and catfish (0%, 0.5%, 1%, 1.5% laurel leaf extract) (Turan et al., 2016; Alrubaee, 2018; Mohammed et al., 2021)

In terms of carcass characteristics, it was found that the influence of LLP did not cause a meaningful difference. It may be argued that enhancing the growth of beneficial bacteria in the digestive tract, such as eugenol and Lactobacillus found in the bay laurel leaves, suppresses the development of undesired microbes, and improves the health and performance of the animals.

Internal organs of animals fed diets containing 10000 mg/kg LLP showed an increase in liver weight; the length of the ileum + jejunum from the digestive tract components of animals fed diets containing 5000 and 10000 mg/kg LLP exhibited an increase. In the evaluation of immunological status in broilers, measurements of immune system organs are widely acknowledged as an important criterion (Heckert et al., 2002). Immunoglobulin synthesis depends on the development of these organs (Glick, 1977). Within the framework of the study, it may be concluded that animals fed 10000 mg/kg LLP have improved immunity than the other groups. However, because the amount of fat in broiler chicken livers could not be quantified, it was inferred that the higher fat content was due to other factors. Although the abdominal fat content did not appear to be impacted by the LLP treatment in the current study, it was revealed that the LLP doses of 5000 and 10000 mg/kg significantly reduced abdominal fat content, albeit quantitatively. In the poultry industry, fat deposits in the abdomen of broiler chickens are considered waste. Abdominal fat is not only a financial loss for the company, but it also leads to the increase of treating wastewater generated during broiler processing. Another finding of this study is that by lowering the fat content in the abdomen of broiler chickens using bay leaf supplementation, which has a lipid-lowering impact, such wastes can be decreased. Laurel leaves supplementation in broiler diets had no effect on carcass traits, internal organs, or digestive tract components of broiler chickens, according to Duru (2016). Bulbul et al. (2015) stated that the effects of bay laurel oil, sage oil and their combinations on quail diets on liver, heart, gizzard and carcass weights were not significant. Alrubaee (2018) indicated that adding bay laurel leaves powder at 0% (control), 1%, 2% and 3% levels to quail diets increased the percentage of carcass weight, drumstick, thigh, wing, and breast weights; observed that there was no change in neck, back, crop and heart weights, but liver weight decreased. Although liver fat content was not determined in this study, decreased liver weight is likely associated with lower fat content, as this study showed a significant correlation between proportional liver weight and plasma cholesterol and proportional abdominal fat weight.

An important factor in the sensory quality of meat is its juiciness. LLP treatment was influenced by the link between the juiciness of meat and its chemical composition (dry matter, crude protein, and crude ash). The juiciness of breast and thigh meat was found to increase with LLP supplementation in current study. LLP supplement reduced the dry matter contents of breast meat and increased the crude protein contents, but no significant effect was observed in thigh meat. However, there is no available reports on the chemical composition of breast and thigh meat of poultry species treated with LLP. Turan et al. (2016) reported that bay laurel leaf supplementation increased the protein content of the whole body of the catfish, and moisture and crude ash did not change. Giannenas et al. (2016) stated that thyme oil, laurel oil and their combinations on breast and thigh meat did not affect crude protein and moisture content of broiler chickens.

Lipid oxidation is a chain reaction. Continuous supply of free radicals, involving the oxidation of polyunsaturated fatty acids, contributes to the loss of cellular functions through inactivation of membrane enzymes and even cytoplasmic proteins, resulting in cell damage. At the molecular level of lipid oxidation, the importance of oxidative membrane damage is twofold (Stark, 2005). In addition, increased antioxidant capacity is a very important phenomenon for broilers, as low antioxidant capacity may be associated with cellular damage, immune system compromise and metabolic disorders. In present study, lipid oxidation in the thigh and breast is reduced with LLP supplementation compared to control. Furthermore, presence of phenolic compounds with antioxidant activity in the LLP led to a decrease in the lipid oxidation of breast and thigh meat. The negative effects of meat lipid oxidation can be overcome by the use of natural antioxidants in the basal diets. Also, LLP treatment prolongs the shelf life of breast and thigh meat by preventing lipid oxidation. There was a sparing effect indicating by the closely associated between thigh and breast muscle with different levels of LLP supplementation to feeds. Karaalp and Genç (2013) stated that 4 g bay laurel leaves supplementation per kg feed could reduce the MDA (an index of lipid peroxidation) content of chilled breast meat in just 8 days. Palazzo et al. (2020) noted that dried bay laurel leaves did not improve the oxidative stability of the rabbit meat during refrigerated storage at 4°C.Bulbul et al (2016) reported that adding 400 mg/kg bay laurel oil to quail breast meat reduced oxidative stress.

The values of glucose considerably dropped on the broiler chickens served LLP compared to control whilst there was not significant effect on the values of cholesterol, triglycerides, low-density lipoprotein cholesterol (LDL) and high-density lipoprotein cholesterol (HDL). It can be said that a possible mechanism of the hypoglycemic effect of bay laurel leaf is that it raises insulin levels in the blood. In the present study, the decrease in blood glucose levels seen may be due to the fact that laurel, which has been used in the treatment of diabetes for years, reduces blood glucose levels by stimulating insulin secretion from β-cells or regenerated β-cells, leading to regeneration of pancreatic β-cells and enhanced insulin secretion from surviving β-cells. In a study on diabetic rats, Mohammad et al. (2021) reported that bay laurel leaves have a therapeutic impact on reducing blood glucose and regenerating the pancreas. Karaalp et al. (2011) stated that the addition of 4 g/kg bay leaf to the diet of Japanese laying quails reduced the triglyceride content of egg yolk, but the total cholesterol did not change. The addition of 400 mg/kg bay laurel oil to quail diets had no effect on serum total cholesterol, triglyceride, and total protein concentrations (Bulbul et al., 2016). Bay laurel leaf and its isolates lowered total cholesterol, triglyceride, HDL, and LDL concentrations in female rabbits, according to Al-Samarrai et al. (2017).

CONCLUSIONS

Bay laurel leaves can be considered a possible growth promoter derived from the findings of the current study. Laurel leaves supplementation to poultry feeds may affect performance, lipid oxidation in meat, immunity, blood parameters and intestinal flora, depending on various stress factors, bioactive components, treatment to optimal diets, amount of added dose, diet components, nutrient density, and variable management conditions. More research is needed to establish how yield affects quantity and quality. However, after analyzing the results of this study, it was concluded that adding LLP to the diet of broiler chickens may have a positive impact on performance and carcass characteristics, increasing breast meat juiciness and crude protein content, decreasing serum glucose levels, and especially meat lipid oxidation levels. It may be advisable to further increase the concentration of dried laurel leaf powder and/or investigate the use of laurel leaves obtained by different methods in the diets of broiler chickens.

ACKNOWLEDGMENTS

This study is a part of Ali Osman Gölcü's master thesis.

REFERENCES

Abdelatty AM, Mandouh MI, Mohamed SA, Busato S, Badr OAM, Bionaz M, Elolimy AA, Moustafa MMA, Farid OAA, Al-Mokaddem AK (2021). Azolla leaf meal at 5% of the diet improves growth performance, intestinal morphology and p70S6K1 activation, and affects cecal microbiota in broiler chicken. Animal. 15 (10): 100362.

Abdul Basit M, Abdul Kadir A, Loh TC, Abdul Aziz S, Salleh A, Kaka U, Banke Idris S (2020). Effects of inclusion of different doses of *Persicaria odorata* leaf meal (POLM) in broiler chicken feed on biochemical and haematological blood indicators and liver histomorphological changes. Animals 10 (7):1209.

Adam K, Sivripoulou A, Kokkini S, Lanaras T, Arsenakis M (1998). Antifungal activities of *Origanum vulgare* subsp. hitrum, *Mentha spicata*, *Lavandula angustifolia*, and *Salvia fruticosa* essential oils against human pathogenic fungi. J Agric Food Chem 46: 1739-1745.

Aderemi FA, Alabi OM, Agbaje M, Adeleke AG, Ayoola MO (2018). Research article utilization of duckweed meal as replacement for fish meal by broiler chickens. Insight Poultry Research 8 (1): 1-9.

Akcan T, Estevez M, Serdaroglu M (2017). Antioxidant protection of cooked meatballs during frozen storage by whey protein edible films with phytochemicals from *Laurus nobilis* L. and *Salvia officinalis*, LWT (Lebensm.-Wiss. & Technol.) 77: 323–331.

Alagbe JO (2018). Effects of Dried *Centella Asiatica* Leaf Meal as a Herbal Feed Additive on the Growth Performance, Heamatology And Serum Biochemistry of Broiler Chicken. Int J of Ani Res 3.

Alçiçek A, Bozkurt M, Çabuk M (2003). The Effect of a Mixture of Herbal Essential Oils, an Organic Acid or a Probiotic on Broiler Performance. South Afr J of Ani Sci 34 (4), 217-222.

Ali NA, Al-Shuhaib MBS (2020). Highly effective dietary inclusion of laurel (*Laurus nobilis*) leaves on productive traits of broiler chickens. Acta Sci Ani Sci 43: e52198.

Al-Samarrai RO, Naji AN, Hameed RR (2017). Effect of Bay leaf (*Laurus nobilis* L.) and its isolated (flavonoids and glycosides) on the lipids profile in the local Iraqi female rabbits. Tikrit J of Pure Sci 22 (6):72-75

Alrubaee MAM (2018). Effect of bay laurel (*Laurus nobilis* L.) leaf powder dietary supplementation on dressing percents, carcass trait, carcass cuts and some internal organs of meat type quail. Indian J. Sci. Technol*,* 11 (37).

AOAC (1999). Official Methods of Analysis. Assocation of Official Analytical Chemists, 16th Ed., Arlington VA.

Arslan Duru A (2019). Effect of dietary goji berry (*Lycium barbarum* L.) leaf meal on performance, egg quality and egg yolk cholesterol levels of laying hens. Biologia (Pakistan). 2: 1-8.

Baratta MT, Damien Dorman HJ, Deans SG, Biondi DM, Ruberto G (1998). Chemical composition, antimicrobial and antioxidative activity of laurel, sage, rosemary, oregano and coriander essential oils. J Essent Oil *Res* 10: 618-627.

Barla A, Topcu G, Oksuz S, Tumen G, David G, Kingston I (2017). Identification of cytotoxic sesquiterpenes from *Laurus nobilis* L. Food Chem. 104: 1478-1484.

Borges, P., Pin, J. and Sanchez, E. (1992). Isolation and chemical characterization of laurel leaf oil. Nahrung, 36: 494-496.

Bulbul T, Ozdemir V, Bulbul A (2015). Use of sage (*Salvia triloba* L.) and laurel (*Laurus nobilis* L.) oils in quail diets. Euraisan J of Vet Sci 31 (2): 95-101.

Bulbul A, Evcimen M, Sevimli S, Ulutaş E, Bülbül T (2016). Use of sage *(Salvia triloba L.)* and laurel *(Laurus nobilis L.)* oils in quail diets II. The effect on the oxidative status of serum and breast meat and on some serum biochemical parameters. Eurasian J of Vet Sci 32(3): 167.173.

Casamassima D, Palazzo M, Vizzarri F, Coppola R, Costagliola C, Corino C, Di Costanzo A (2017). Dietary effect of dried bay leaves (*Laurus nobilis*) meal on some biochemical parameters and on plasma oxidative status in New Zealand white growing rabbit. J Anim Physiol An N 101 (5): e175–e184.

Derwich E, Benziane Z, Boukir A (2009). Chemical composition and antibacterial activity of leaves essential oil of *Laurus nobilis* from Morocco. Australian J of Basic and App Sci 3: 3818-3824.

Diarra SS, Anand S (2020). Impact of commercial feed dilution with copra meal or cassava leaf meal and enzyme supplementation on broiler performance. Poultry Sci 99 (11): 5867-5873.

Diarra (2021). Prospects for the utilization of *Senna obtusifolia* products as protein supplements for poultry. Poultry Sci 100 (8): 101245.

Duru M (2016). Defne (*Laurus nobilis L.*) Yaprağı Tozunun Etlik Piliçlerde Büyüme Performansı, Karkas **Özellikleri** ve Sindirim Sistemi **Üzerine** Etkisi. International Conference on Natural Science and Engineering (ICNASE'16). Kilis, Türkiye pp:1517-1525.

Elmastas M, Gülçin İ, Işıldak Ö, Küfrevioğlu *Öİ, İbaoğlu* K, Aboul-Enein HY (2006). Radical scavenging activity and antioxidant capacity of bay leaf extracts. J of the Iranian Chem Soc 3: 258-266.

Fang F, Sang S, Chen KY, Gosslau A, Ho CT, Rosen A (2004). Isolation and identification of cytotoxic compounds from Bay leaf (*Laurus nobilis*). Food Chem 93: 497–501.

Giannenas I, Troza A, Sarakatsianos I, Karamoutsios A, Skoufos S, Papaioannou N, Anastasiou I, Skofuos I (2016). The effectiveness of the use of oregano and laurel essential oils in chicken feeding. Ann Anim Sci 16 (3): 779–796.

Glick B (1997). The bursa of Fabricius and immunoglobulin synthesis. Intl Rev Cytol 48: 345-402.

Gulizia JP, Downs KM (2020). Comparison of dietary kudzu leaf meal (*Pueraria montana* Var. *lobata*) and alfalfa meal supplementation effect on broiler (*Gallus gallus domesticus*) performance, carcass characteristics, and organ parameters. Animals 10 (1): 147.

Heckert RA, Estevez I, Russek-Cohen E, Pettit-Riley R (2002). Effects of density and perch availability on the immune status of broilers. Poultry Sci 81: 451-457.

Kaila VC, Shim WY, Patel SKS, Gong C, Lee JK (2022). Recent developments in antimicrobial growth promoters in chicken health: Opportunities and challenges, Scie of The Total Env 834 (155300).

Kamel CA (2000). Novel look at a classic approach of plant extracts. Feed Mix. 19-21 syf.

Karaalp M, Elmasta M, Genc N, Sezer M, Yavuz M, Ozkan M (2011). Bay Laurel (*Laurus nobilus* L.) in Japanese quails feding 1. Performance and egg quality parameters. J Anim Vet Adv 10: 1883-1889.

Karaalp M, Genç N (2013). Bay laurel (*Laurus nobilis* L.) In Japanese quails feeding. 2. Fatty acid content and oxidative stability of breast meat. Bulg J Agric Sci 19: 606-610.

Li TSC (2000). Medicinal Plants, Culture Utilization Phytopharmonolgy. CRC Press.New York, ABD.

Mohammed RR, Omer AK, Yener Z, Uyar A, Ahmed AK (2021). Biomedical effects of *Laurus nobilis* L. leaf extract on vital organs in streptozotocin-induced diabetic rats: Experimental research. Annals of Medicine and Surgery 61: 188-197.

Ncube S, Halimani TE, Chikosi EVI, Saidi, PT (2018). Effect of *Acacia angustissima* leaf meal on performance, yield of carcass components and meat quality of broilers. South Afr J of Ani Sci *48*(2): 271-283.

NRC (1994). Nutrient requirements of poultry. 9th Rev. Ed. National Academy Press Washington DC (USA).

Oloruntola OD, Agbede JO, Ayodele SO, Oloruntola DA (2019). Neem, pawpaw and bamboo leaf meal dietary supplementation in broiler chickens: Effect on performance and health status. J of Food Bio *43*(2): e12723.

Ogwuegbu MC, Oyeagu CE, Edeh HO, Dim CE, Ani AO, Lewu FB (2021). Effects of sodium butyrate and rosemary leaf meal on general performance, carcass traits, organ sizes and nutrient digestibility of broiler chickens. Iranian J of App Ani Sci 11(2): 365-379.

Ozcan M, Chalcat JC (2005). Effect of different locations on the chemical composition of essential oils of laurel (*Laurus nobilis* L.) leaves groving wild in Turkey. 36th International Symposium on Essential Oils Budapest, Hungary.

Palazzo M, Vizzarri F, Arvay J, D'Alessandro A, Martemucci G, Casamassima D, Ratti S, Corino C, Rossi R (2020). Dietary effect of dried bay leaves (*Laurus nobilis*) meal on selected productive performances and on quality meat traits in growing rabbits. Livestock Sci *242*, 104301.

Polovka M, Suhaj **M:** (2010). Detection of caraway and bay leaves irradiation based on their extracts' antioxidant properties evaluation. Food Chem 119: 391–401.

Rahman, M., Yang, D.K. (2018). Effects of *Ananas comosus* leaf powder on broiler performance, haematology, biochemistry, and gut microbial population. Revista Brasileira de Zootecnia, 47.

Salim IH, El-Ayazem EHA, Bassiouni HA (2021). Effect of dietary supplementation of *Laurus nobilis* leaves meal on growth performance, carcass traits and blood antioxidant status of growing Nzw rabbits. Egypt Poultry Sci J 41 (3): 549-563.

Santoyo S, Llorı´a R, Jaime L, Iban˜ez E, Sen˜ora´ns FJ, Reglero G (2006). Supercritical fluid extraction of antioxidant and antimicrobial compounds from *Laurus nobilis* L. chemical and functional characterization. Eur Food Res and Techn 222: 565–571.

Sayyah **M,** Saroukhani **G,** Peirovi **A,** Kamalinejad **M** (2003). Analgesic and anti-inflammatory activity of the leaf essential oil of *Laurus nobilis* Linn. Phytotherapy Res 17: 733–736.

Sebola NA, Mlambo V, Mokoboki HK (2019). Chemical characterisation of *Moringa oleifera* (MO) leaves and the apparent digestibility of MO leaf meal-based diets offered to three chicken strains. Agroforestry Sys *93* (1): 149-160.

Seidavi AR, Tavakoli M, Asroosh F, Scanes CG, Abd El Hack ME, Naiel MAE, Taha AE, Aleya L, El-Tarabily KA, Swelum AA (2022). Antioxidant and antimicrobial activities of phytonutrients as antibiotic substitutes in poultry feed. Envir Sci Poll Res 29(4): 5006-5031.

Simić M, Kundaković T, Kovačević N (2003). Preliminary assay on the antioxidative activity of *Laurus nobilis* extracts. Fitoterapia, 74: 613-616.

SPSS (2007). SPSS 16.01 for Windows, release 16.01. Chicago, IL, USA.

Stark HG (2005). Wavelets and Signal Processing—An Application-Based Introduction Springer, Aschaffenburg.

Taban A, Saharkhiz MJ, Niakousari M (2018). Sweet bay (*Laurus nobilis* L.) essential oil and its chemical composition, antioxidant activity and leaf micromorphology under different extraction methods, Sustain Chem Pharm 9:12–18.

Tarladgis BG, Watts BM, Younathan MT (1960). A distillation method for the quantitative determination of malonaldehyde in rancid foods. J Am Oil Chem Soc 37: 44-48.

Turan F, Ganpolat E, Aygen U (2016). Effect of bay laurel (*Laurus nobilis*) extract on growth of the African Catfish, *Clarias gariepınus* (Burchell, 1822). Pakistan J of Zoology 48 (2): 489-492.

Ullah A, Anjum AA, Rabbani M, Nawaz M, Ashraf M, Ijaz M, Ali A, Rashid A, Najeeb I, Pervez A (2021). Phytochemical composition and In-vitro activity of ethanolic extract of *Eucalyptus globulus* leaves against multidrug resistant poultry pathogens. Cellular and Molecular Bio *67*(1):159–164.

Zaker-Esteghamati H, Seidavi AR, Bouyeh M (2021). The effects of *Cynara scolymus* and *Silybum marianum* on growth, carcass and organ characteristics, immunity, blood constitutes, liver enzymes, jejunum morphology, and fatty acid profile of breast meat in broilers. Food Sci & Nutr 9(12): 6692-6706.

Zeković ZP, Lepojević ŽD, Mujić IO (2009). Laurel extracts obtained by steam distillation, supercritical fluid and solvent extraction. J of Natural Products 2: 104-109.