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Highly effective dietary inclusion of laurel (*Laurus nobilis*) leaves on productive traits of broiler chickens

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ABSTRACT. Laurel leaves characterized with interesting antioxidant effects, which have often used to improve the immunity with positive consequences on growth and performance This study was conducted to assess the effect of adding crushed laurel leaves to the diet on the productive traits of broiler chickens. A total of 180 broiler chickens, were randomly assigned to four dietary treatments, with a rate of 45 birds per treatment; each treatment consisted of three replicates. The first treatment, or control, was generated without adding laurel leaves to the diet, second, third, and fourth treatments were generated by adding laurel leaves with amounts of 1, 2, and 3 g kg^{-1} feed, respectively. Nine productive traits were evaluated in this study, including the average of live body weight, weight gain, feed consumption, feed conversion ratio, percentage of mortality, productive index, length of the villus, depth of crypts, and villus length/crypts length ratio. Results indicated that the addition of laurel leaves led to a significant improvement in all productive traits, signifying highly essential participation of laurel leaves to enhance growth and performance. In conclusion, it can be stated that adding 3 g kg^{-1} of crushed laurel leaves to the diet can improve the productive traits of broiler chickens.

Keywords: broiler chickens; consumption; diet; crushed laurel leaves; productive traits.

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Introduction

The poultry industry is one of the most crucial sectors that hold great importance in improving the livings standards for human beings. These commercial applications are being increasingly involved in the production of the daily needs of foods, such as white meat, eggs, and other mandatory by-products (Karaalp & Genc, 2013; Hashim, Al-Shuhaib, & Ewadh, 2019). Poultry has excellent food conversion efficiency compared to other farm animals as it has a remarkable impact on the amount of feed consumed and the average weight gain of the body (Rezaei, Yngvesson, Gunnarsson, Jönsson, & Wallenbeck, 2017). Accumulated data of recent innovations have suggested several natural alternatives to classical feeding strategy for broilers chickens (Mahanta, Borgohain, Sarma, Sapcota, & Hussain, 2017; Wang et al., 2017; Movahhedkhah et al., 2019). The introduction of many medicinal plants in the feeding of broiler chickens and laying hens has increasingly been witnessed. The involvement of a large spectrum of known medicinal plants in the diet of poultry is attributed to the presence of a high antioxidant, anti-inflammatory, anti-microbial, and antidiarrheal effects of many compounds included within these powders (Zeng, Zhang, Wang, & Piao, 2015; Ahmad et al., 2017). Thus, a series of variable medicinal plant resources have recently been utilized in poultry diet to improve the feeding strategy and its consequent growth performance, such as ginkgo biloba leaves (Zhang et al., 2013), moringa leaves (Mahfuz & Piao, 2019), white tea leaves (Ali, Fadhil, Imad, & Al-Nassry, 2019), morinda (Diarra, Amosa, & Lameta, 2019), or mixed proportions of these medicinal supplements (Aroche et al., 2018). One of these highly important medicinal plants is *Laurus nobilis* or bay laurel. Leaves growing on the Bay tree, which is also called sweet bay tree or Grecian tree, which has been characterized by olive-like fruits that can be distinguished with its unique dark brown color with clusters forms. It is classified as an evergreen herbal medicinal plant belonging to the Lauraceae family, where it is used in treating gastrointestinal diseases and stomach ulcers (Kivcak & Mert, 2002). It is found in Asia Minor and growing in North Africa. Leaves are extracted from the fruits of laurel volatile oil (Eugenol). The percentage of eugenol has been estimated at 1 to 3% in addition to possessing many active substances such as monoterpenes, cinnamaldehyde, thymol, and carvacrol (new reference is required). Likewise, it has antioxidant characteristics due to the presence of several phenolic and antibacterial compounds (Erturk, Ozbucak, & Bayrak, 2006). The laurel leaves are used

as fresh or dried aromatic plants, and it's being utilized as a spice in cooking to take advantage of its distinctive aroma and flavor (Chaudhry & Tariq, 2006). Lowering the concentrations of malondialdehyde in the serum of the quails treated with laurel leaves were reported in comparison with the control treatment. Meanwhile, quails treated with laurel leaves have been exhibited noticeable improvements in several productive traits, such as egg production, egg weight, and concentrations of cholesterol and triglyceride (Karaalp & Genc, 2013). However, no attention has yet been paid to the possible utilization of this plant in poultry diets. Therefore, this study aimed to determine the effect of leaves of laurel plant added to the diet on the productive traits of broilers chickens (Ross 308) and to know the best percentages that can be used in the diet.

Material and methods

The research project was carried out and approved by the Ethical and Animal Welfare Committee of Al-Qasim Green University. A total of 180 unsexed broiler chickens (Ross 380 strain), with the average weight, amounted to (40 g chick^{-1}), were investigated in the study. The experimental design was completely randomized with four treatments, each one consisted of 3 replicates. Each replicate contained 15 chicks. Feeds and water were provided *ad libitum*, where two diets were fed, initiator diet from 1 to 21 days, and final diet from 22 to 35 days (Table 1).

The crushed laurel leaves were manually added to the diet from the first day of rearing. The first treatment and control groups were grown without being treated with crushed laurel leaves to the diet. The second treatment, in which crushed laurel leaves were added with an amount of 1 g kg^{-1} feed. The third treatment, in which crushed laurel leaves were added with an amount of 2 g kg^{-1} feed. The fourth treatment, in which crushed laurel leaves were added with an amount of 3 g kg^{-1} feed. Subsequently, a variety of productive traits were estimated weekly, namely the average of live body weight, weight gain, feed consumption, feed conversion ratio, percentage of mortality, productive index, length of the villus, depth of crypts, and villus length/crypts length ratio. The completely randomized design was used to study the effect of different treatments on the studied traits. Significant differences between the averages were compared using the Statistical Package for social sciences (Statistical Analysis System [SAS], 2012) was used to analyze the data. All values were expressed in mean standard error (SE) using a significant level of $p < 0.05$ and $p < 0.01$ respectively.

Results and discussion

The effect of adding crushed laurel leaves in the diet on the average of weekly live body weight for broiler chickens did not show significant differences between all treatments in the first week of the chicks age (Table 2).

Table 1. Percentage of feed materials and chemical composition included in the formation of the initial and final diets.

Feed ingredients	starter diet (1-21 days) %	finisher diet (22-35 days) %
Yellow corn	48.2	58.7
Local wheat	8	7.5
Soybean meal (44% protein)	28.5	20.5
The concentrated protein*	10	10
Vegetable oil (sunflower)	4	2.5
Limestone	1	0.5
Food salt	0.3	0.3
Total Nutrients Analysis	100	100
The calculated chemical analysis*		
Metabolic energy (kcal kg^{-1})	3079.85	3102.6
Crude protein (%)	21.56	18.87
Lysine (%)	1.04	0.85
Methionine + Cysteine (%)	0.455	0.42
Crude fiber (%)	3.54	3.2
Calcium (%)	1.28	1.07
Available phosphorus (%)	0.42	0.41

*Vitamin and mineral premix, (each kg contained) vitamin A, 1800000 IU; vitamin D3, 400000 IU; vitamin E, 3600 IU; vitamin K3, 400 mg; thiamine, 360 mg; riboflavin, 1320 mg; niacin, 6000 mg; vitamin B6, 600 mg; vitamin B5, 2000; vitamin B12, 3 mg; Folic acid, 200 mg; biotin, 20 mg. Choline 80 g; zinc, 17 g; iron, 10 g; copper, 2 g; manganese, 20 g; selenium, 40 mg; iodine, 200 mg. The chemical composition was calculated according to the analysis of the feed materials mentioned in (National Research Council [NRC], 1994).

Table 2. Effect of adding crushed laurel leaves to diet on the average of weekly live body weight (g bird^{-1}) during 5 weeks of rearing in broiler chicken.

Treatments	Week-1	Week-2	Week-3	Week-4	Week-5
First treatment (the control)	119.47±1.17	327.15±3.11^{c}	701.81±7.12^{d}	1159.1211.40d	1739.63±16.72^{d}
Second treatment (added 1 g laurel leaves)	121.73±1.22	350.11±2.87^{b}	768.04±6.54^{c}	1286.70±11.57c	2012.90±16.88^{c}
Third treatment (added 2 g laurel leaves)	122.82±1.09	355.24±2.52^{ab}	779.52±7.03^{b}	1311.06±12.01b	2064.65±17.30^{b}
Fourth treatment (added 3 g laurel leaves)	123.77±1.11	365.93±2.60^{a}	796.93±6.83^{a}	1368.17±11.73	2175.39±17.51^{a}
p-value	0.782$^{N.S.}$	0.004	0.003	0.006	0.004

^{a,b,c}Means in a column with different superscripts are significantly different ($p < 0.05$) by Duncan's test. $^{N.S.}$refers to non-significant.

Whereas significant differences were detected in the second week, on which the fourth treatment (3 g laurel leaf kg^{-1} feed) exhibited the highest values of the weekly live weights. Furthermore, the emergence of significant superiority ($p < 0.05$) during the last three weeks in favor of the fourth treatment over the rest of the treatments was observed. Considering the effect of adding crushed laurel leaves in broiler chicken diet, the first week showed no significant differences among all treatments. Meanwhile, a significant improvement ($p \leqslant 0.05$) was observed in favor of the fourth treatment in the second week (Table 3). However, significant differences ($p \leqslant 0.05$) between the first and third treatments and between the second treatment and control for the same age were revealed.

In the last two weeks of the experiment, the fourth treatment was found significantly ($p \leqslant 0.05$) better than the other treatments. The third treatment showed better values than the second and control treatment respectively at the significant level of ($p \leqslant 0.05$). The second treatment was significantly ($p \leqslant 0.05$) surpassed the first treatment at the same age. The effect of adding crushed laurel leaves in the diet on the average of weekly feed consumption for broiler chickens showed no significant differences between all treatments during the first week of the chick's age. Whereas in the second week, significant superiority in the average of feed consumption was observed (Table 4). The fourth treatment showed significant ($p < 0.05$) superiority over the second and the first treatments respectively.

Meanwhile, no significant differences were observed between the third and fourth treatments and between the second and third treatments. In the third week of the experiment, a significant increase in the average of feed consumption for the fourth, third, and second treatments over the first treatment was observed. However, a significant superiority for the last two weeks was detected in favor of the fourth treatment, which showed significant advantage ($p \leqslant 0.05$) over the other treatments. Whereas no significant differences between the second and third treatments were detected over the control treatment in the same analyzed period. With regard to the average feed conversion ratio, no significant differences were observed among all treatments of crushed laurel leaves in the first week of the experiment (Table 5).

In the second week of the experiments, the treatment of diet with the crushed laurel leaf showed a significant effect on feed conversion ($p \leqslant 0.05$). In the third, fourth, and fifth weeks, a significant improvement ($p \leqslant 0.05$) in favor of the fourth treatment was observed. The effect of adding crushed laurel leaves to the diet on the percentage of mortality and the productive index for broiler chickens was presented in Table 6.

Table 3. Effect of adding crushed laurel leaves to diet on average weight gain (g bird^{-1}) during 5 weeks of rearing in broiler chicken.

First treatment (the control)	Week-1	Week-2	Week-3	Week-4	Week-5	Total weight gain
First treatment (the control)	79.47±0.71	207.68±1.90^{c}	374.66±3.27^{c}	457.31±4.47	580.51±5.57^{d}	1699.63±17.03^{d}
Second treatment (added 1 g laurel leaves)	81.73±0.79	222.38±1.7^{b}	417.93±3.18^{b}	518.66±4.82^{c}	726.20±6.29^{c}	1972.90±18.22^{c}
Third treatment (added 2 g laurel leaves)	82.81±0.77	232.42±1.81^{ab}	424.28±3.33^{ab}	531.54±5.03^{b}	753.59±5.80^{b}	2024.65±17.18^{b}
Fourth treatment (added 3 g laurel leaves)	83.77±0.69	241.16±2.04^{a}	431.70±2.96^{a}	571.54±4.73^{a}	807.22±5.74^{a}	2135.39±18.06^{a}
p-value	0.943$^{N.S.}$	0.007	0.004	0.006	0.009	0.007

^{a,b,c}Means in a column with different superscripts are significantly different ($p < 0.05$) by Duncan's test. $^{N.S.}$refers to non-significant.

Table 4. Effect of adding crushed laurel leaves to diet on the average of weekly feed consumption (g bird^{-1}) during 5 weeks of rearing in broiler chicken.

Treatments	Week-1	Week-2	Week-3	Week-4	Week-5	Total feed consumption
First treatment (the control)	127.15±1.20	342.67±3.57^{c}	640.67±6.58^{b}	827.73±8.87^{c}	1102.97±11.09^{c}	3041.19±30.70^{d}
Second treatment (added 1 g laurel leaves)	128.32±1.30	358.03±3.39^{b}	693.76±6.72^{a}	912.84±8.59^{b}	1327.30±11.46^{b}	3418.25±29.24^{c}
Third treatment (added 2 g laurel leaves)	129.20±1.26	371.87±3.42^{ab}	695.82±6.66^{a}	930.20±8.46^{b}	1363.99±11.39^{b}	3491.08±30.18^{b}
Fourth treatment (added 3 g laurel leaves)	129.84±1.22	383.44±3.70^{a}	699.35±6.46^{a}	983.05±8.77^{a}	1428.78±11.15^{a}	3624.46±30.56^{a}
p-value	0.300$^{N.S.}$	0.006	0.006	0.007	0.009	0.005

^{a,b,c}Means in a column with different superscripts are significantly different ($p < 0.05$) by Duncan's test. $^{N.S.}$refers to non-significant.

Table 5. Effect of adding crushed laurel leaves on the average of feed conversion ratio (g bird^{-1}) during 5 weeks of rearing in broiler chicken.

Treatments	Week-1	Week-2	Week-3	Week-4	Week-5	Cumulative feed conversion ratio
First treatment (the control)	1.60 ±0.03	1.65±0.03^{b}	1.71±0.02^{c}	1.81±0.03^{c}	1.90±0.03^{d}	1.79±0.03^{b}
Second treatment (added 1 g laurel leaves)	1.57±0.01	1.61±0.03^{a}	1.66±0.02^{b}	1.76±0.02^{b}	1.83±0.03^{c}	1.73±0.03^{a}
Third treatment (added 2 g laurel leaves)	1.56±0.03	1.60±0.02^{a}	1.64±0.01^{ab}	1.75±0.02^{ab}	1.81±0.02^{b}	1.72±0.02^{a}
Fourth treatment (added 3 g laurel leaves)	1.55±0.01	1.59±0.02^{a}	1.62±0.01^{a}	1.72±0.02^{a}	1.77±0.01^{a}	1.70±0.02^{a}
p-value	0.451$^{N.S.}$	0.005	0.007	0.009	0.006	0.007

^{a,b,c}Means in a column with different superscripts are significantly different ($p < 0.05$) by Duncan's test. $^{N.S.}$refers to non-significant.

Table 6. Effect of adding crushed laurel leaves to diet on the percentage of mortality and productive index during 5 weeks of rearing in broiler chicken.

Treatments	Percentage of mortality (%)	Productive index
First treatment (the control)	3.33±0.37^{a}	268.43±2.84^{c}
Second treatment (added 1 g laurel leaves)	1.67±0.18^{b}	326.88±2.63^{b}
Third treatment (added 2 g laurel leaves)	1.67±0.16^{b}	337.24±3.02^{b}
Fourth treatment (added 3 g laurel leaves)	1.67±0.13^{b}	359.51±2.48^{a}
p-value	0.004	0.006

^{a,b,c}Means in a column with different superscripts are significantly different ($p < 0.05$) by Duncan's test.

Second – fourth treatments of the diet with laurel leaves showed a significant effect in reducing the percentage of mortality. With regard to the effect of adding crushed laurel leaves to the diet on the length of the villus, depth of crypts, and villus length/crypts length ratio in the jejunum for broiler chickens, a significant superiority of the fourth treatment was observed in the length of villus, depth of crypts, and villus length/crypts length ratio over the rest of treatments (Table 7). Furthermore, a significant superiority of the second and third treatments over the first treatment on the same analyzed traits was revealed.

This study was designed to evaluate the potential effects of laurel leaves on the productive traits in broilers chickens. The significant increase in the body weight and the weight gain in the treatment of laurel leaves at different levels compared to the control treatment were potentially attributed to the role of active substances in leaves such as flavonoids, linalool, and phenols, which were known to stimulate and improve digestion (Cabuk, Bozkurt, Alçiçek, Akbaş, & Küçükyılmaz, 2006). These highly active compounds may function in concert with each other to provide a remarkable antioxidant defense mechanism (Giannenas et al., 2010). The collaboration of these compounds in laurel leaves may lead to increased production of digestive enzymes such as chymotrypsin lipase, amylase, and trypsin (Milan, Dholakia, Kaultiku, & Vishveshwaraiah, 2008). Thus, the digestion process increases the benefit of a bird from a fed diet. This finding is reflected in better growth of birds and the final return is positive on the average weight gain and the final weight too (Lee, Everts, & Beynen, 2004). The significant superiority of feed consumption in favor of laurel leaves treatments was attributed to the role of a variety of substances in leaves, which can be considered as natural antibiotics, as their utilization would act against the survival of pathogenic bacteria and other harmful microorganisms (Botsoglou, Fletouris, Florou-Paneri, Christaki, & Spais, 2003). The significant improvement in the feed conversion ratio in laurel leaf treatments belongs to the exceptional role of laurel leaves in improving digestion and absorption capacity of digested feed. This is due to the increase in the depth of crypts and the length of villi, which increases the utilization of nutrients with a comparable reduction in the amount of undigested feed within the digestive system. The reduction in the percentage of mortality for the laurel leaf treatments could be explained by the fact that the active substances such as tannins, flavonoids, phenolic acids, act as natural antioxidants and antimicrobial agents with noticeable action against *Salmonella typhimurium* and *Escherichia coli* (M'hiri, Ioannou, Ghoul, & Boudhrioua, 2014). These agents inhibit or even kill pathogenic organisms by inhibiting their internal enzymatic system (Wang, Chen, & Hou, 2019). This mechanism has positively reflected on the birds' vitality and health, which leads to lower mortality rates. The improvement in productivity is easily notified of the values of the productive index being one of the most crucial indicators in assessing the performance of productive broiler chickens (Martins et al., 2016). The emergence of significant superiority in the diet on the length of the villus, depth of crypts, and villus length/crypts length ratio for the treatments of laurel leaf belongs to the role laurel leaves in stimulating the digestive system (Cross, McDevitt, Hillman, & Acamovic, 2007) on growth and division, thus improving the morphological traits of the intestine, such as increasing the length of villi and increasing the depth of the crypts in small intestine parts (García, Catalá-Gregori, Hernández, Megías, & Madrid, 2007). It is also attributed to the contribution of active substances to increasing the beneficial bacteria, which are a source of energy for the intestinal cells and increase the activity of cells and its divisions, thus increasing the length of villi (Ghazanfari, Moradi, & Bardzardi, 2014). However, more studies are mandatory to explore the specified molecules that lie behind such observed activity in laurel leaves.

Table 7. Effect of adding crushed laurel leaves to diet on the length of the villus, depth of crypts, and villus length/crypts length ratio in the jejunum during 5 weeks of rearing in broiler chicken.

Treatments	Jejunum		
	Length of the villus	Depth of crypts	Villus length/crypts length ratio
First treatment (the control)	97.95±0.93[d]	14.60±0.15[d]	6.71±0.07[d]
Second treatment (added 1 g laurel leaves)	105.6±1.05[c]	14.71±0.13[c]	7.18±0.07[c]
Third treatment (added 2 g laurel leaves)	108.83±1.11[b]	14.86±0.14[b]	7.32±0.06[b]
Fourth treatment (added 3 g laurel leaves)	112.75±1.09[a]	14.99±0.13[a]	7.52±0.06[a]
p-value	0.009	0.007	0.006

[a,b,c]Means in a column with different superscripts are significantly different ($p < 0.05$) by Duncan's test.

Conclusion

The results indicate that leaves of *Laurus nobilis* contain highly effective compounds that can accelerate growth traits upon being added to the diet. The significant improvements in the production characteristics of broiler chickens were achieved. Therefore, it is recommended to isolate its active compounds of this medicinal plant and perform other tests to provide much more details concerning each ingredient in the final chemical composition of these analyzed leaves.

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