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ORIGINAL ARTICLE

Effects of tarragon (*Artemisia dracunculus*) powder on broiler performance parameters and histopathology of internal organs

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ABSTRACT. The aim of this study is to evaluate whether the addition of tarragon in the diet of broiler chickens affects their performance and histological structures of internal organs. A total of 240 day-old Ross 308 male broiler chickens were used. The experiment included four treatment groups, with six replications per treatment. The experiment lasted 42 days and the chickens were provided with feed and water *ad libitum*. Experimental groups were given basal diet only (control group), basal diet + 0.1% tarragon powder (T1 group), basal diet + 0.2% tarragon powder (T2 group) and basal diet+ 0.5% tarragon powder (T3 group). The tarragon additive did not affect the values of the daily feed intake (DFI) and feed conversion rate (FCR) during the trial periods, while the highest daily weight gain (DWG) was recorded in the control group ($P<0.05$) on days 29-35 and 36-42. The longest jejunum villi was observed in the T2 group ($P<0.05$). The results indicate that different amounts of tarragon powder additive did not affect the DFI and FCR as performance parameters, while they had a negative impact on DWG. In addition, the livers, kidneys and intestinal tissue structures did not change. Therefore, the tarragon powder had no negative effects on the health of chickens.

Key words: blood, broiler, histopathology, tarragon, villus.

INTRODUCTION

Feed additives have been defined as substances safely added to animal feed to accelerate their development, increasing both the quality and quantity of the products, without negatively affecting the health of those animals (Yavuz 2001). The use of feed additives is an important strategy for enhancing livestock performance and health. Many organic and inorganic substances have been used as feed additives. For example, antibiotics have been added to provide antimicrobial effects and to increase the feed conversion rate (Church and Pont 1988), but the use of antibiotics as a yield-enhancing feed additive is prohibited because of their possible risks to human health (Newman 2002).

In this sense, the use of aromatic plants as natural feed additives, providing both nutritional and medical features, has gained importance (Pereira *et al* 2015). Tarragon, for example, is often cited for its therapeutic and anti-inflammatory properties which protect against certain infections and liver disease. Tarragon belongs to the genus *Artemisia*, which include about 500 species, with different aromatic flavours and different biological properties (Nurzy Ěska-Wierdak and ZawiĞlak 2014). One of the most significant of these species is *Artemisia dracunculus* (Karimia *et al* 2015), which can be found on the steppes of Mongolia and Siberia (Aglarova *et al* 2008). In Anatolia, Turkey, it is known as “Tarhun” (Kordali *et al* 2005[b]) .

The essential oils found in tarragon contain phenolic compounds, carotenoids, coumarin compounds, tannins, polyacetylene, sesquiterpene, and mineral compounds. In addition, tarragon has unique biological activity and phytochemicals (Daly *et al* 2010, Obolskiy *et al* 2011, Tak *et al* 2014, Kumlay *et al* 2015). Tarragon is known to have antibacterial, antifungal, and antitumor properties and has been used in antidiarrheal, analgesic and anti-inflammatory treatments (Obolskiy *et al* 2011, Meepagala *et al* 2002, Kordali *et al* 2005[a], Lopes-Lutz *et al* 2008, Jalilzadeh-Amin and Qarehdarvishlu 2014, Eidi *et al* 2015). For example, due to its level of terpene, tarragon has been used to treat gastrointestinal complaints, such as diarrhoea (Kumlay *et al* 2015, Jalilzadeh-Amin and Maham 2015). There are a few studies about the use of tarragon as a feed additive in poultry nutrition (Yildirim and Tunç 2018, Gharetappe *et al* 2015, Sen *et al* 2012, Incharoen *et al* 2009), but this study provides more extensive research in terms of nutrients and health. The purpose of this study is to investigate the effect of tarragon powder on performance and histological changes of organs in broiler chickens.

MATERIAL AND METHODS

This study was performed in accordance with the guidelines approved by the Local Ethics Council of Animal Experiments at Ataturk University (Protocol Number 20/2014).

EXPERIMENTAL BIRDS, DESIGN, PLANT AND TREATMENTS

Two hundred and forty one day old male commercial Ross 308 broiler chickens were used in this study. The chickens were divided into four dietary treatment groups

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with six replications per treatment. The chickens were provided feed and water *ad libitum* until the end of the experiment. In the study, iron floored cages of 150 x 200 cm were used. The diet was prepared according to the standard diets for male Ross 308 chickens; table 1 shows the dietary components for all stages of breeding. The commercial diet was used in this experiment. Tarragon additive was mixed homogeneously into the feed mixers of the commercial feed mill. The experimental groups were fed as follows: the control group was only fed the basal diet, group T1 was fed the basal diet + 0.1% tarragon powder, group T2 was fed the basal diet + 0.2% tarragon powder and group T3 was fed the basal diet + 0.5% tarragon powder.

The tarragon powder used in this study came from plants obtained from the region of Erzurum in Eastern Turkey. After the cleaning and removal of the unusable parts, the plants were dried at ambient temperature. The tarragon was then converted into powder and added to the experimental diets. Tarragon doses were determined with reference to other studies.

EVALUATED CHARACTERISTICS

Performance. The data for performance parameters were collected weekly and calculated daily. During the study, chickens in all cages were weighed every week, and the average live weight gain was calculated. The average feed consumption of the chickens was calculated by weighing the feed in the cages every week. The feed conversion rate was calculated by dividing the average feed intake by the average live weight gain (feed conversion rate = daily feed intake ÷ daily weight gain). At the end of the experiment, the chickens were slaughtered.

Histopathology examination. At the end of the study, the livers, kidneys and intestines were taken from 30 animals from each group. Liver, kidney and jejunum tissues were immediately excised for histological examination and immersed in 10% neutral formalin solution for stabilisation. Sections were taken from the diaphragmatic lobe of the livers, from the same region of the kidneys and from the ileum of the intestines for examination. Biopsies were embedded in paraffin, and then sectioned and stained with hematoxylin and eosin (H&E). All tissues were examined both microscopically and with ZEN imaging software.

STATISTICAL ANALYSIS

Data were expressed as mean (M) ± standard deviation (SD). A statistical package for the SPSS system was used to analyse the data with the GLM procedure. Group effects were tested first, and then post-hoc Tukey's tests were used to compare the group differences. A $P<0.05$ was considered the lowest level of significance.

Table 1. Composition of the experimental diets (%).

Feeds Ingredients	Starting (1-14 d)	Growing (15-35 d)	Finishing (36-42 d)
Corn	43.41	40.13	38
Soybean meal (%48)	34.4	26.5	20.5
Wheat	15.25	25.28	32.11
Vegetable oil	2	3.5	4.8
Dicalcium phosphate	2.3	2	2
DL-methionine	0.2	0.22	0.24
Lysine hydrochloride	0.27	0.22	0.2
Limestone	0.87	0.85	0.85
Salt	0.3	0.3	0.3
Mineral and Vitamin Premix	1	1	1
Nutritional composition (% of the diet)			
ME (kcal/kg)	2930	3110	3220
Crude protein	22.5	20	18
Crude fiber	3.15	3.5	3.7
Calcium	0.97	0.86	0.85
Available phosphorus	0.51	0.48	0.47
Lysine	1.45	1.30	1.22
Methionine	0.52	0.50	0.48
Methionine + cysteine	0.90	0.81	0.73

Supplied per kilogram of diet 10,000 IU vitamin A, 12 mg vitamin E, 2000 IU vitamin D, 36 mg niacin, 10 mg D-pantothenic acid, 3.61 mg riboflavin, 3.52 mg pyridoxine, 2.41 mg thiamine, 1.39 mg folic acid, 0.16 mg biotin and 0.03 mg vitamin B, 59 mg manganese, 41 mg zinc, 1281 mg iron, 7,9 mg copper, 0.31 mg iodine and 0.22 mg selenium.

RESULTS

In this study, we evaluated the effect of adding three different levels of tarragon to standard chicken feed on the performance of the chickens and the histological appearance of their internal organs. The greatest weight gains were observed in the control group on days 29-35 and days 36-42, whereas the lowest gain ($P<0.05$) was observed in the T3 group. Weights for the T1 and T2 groups were similar to those of the T3 group. A significant difference among the groups and periods was not observed for daily feed intake and the feed conversion rate (table 2). In this study, the longest jejunum villi was observed in the T2 group ($P<0.05$; table 3).

In this study, no changes were observed in the appearance of the liver, kidney and intestinal tissues obtained from the experimental groups (figures 1, 2 and 3).

DISCUSSION

PERFORMANCE PARAMETERS

Another study added peppermint and tarragon to the broiler diets, and the effect of the tarragon additive was not significant on average body weight (ABW), average daily gain (ADG) or feed conversion rate (FCR). The feed intake only increased during days 0-4 (Gharetappe *et al* 2015). It is thought that the use of the terpenes in these plants on chickens becomes useless, and they may be trapped in plant secretory glands due to the rapid passage times in the digestive system (Dorman and Deans 2000).

In similar studies, it was found that adding tarragon to the chicken feed in different amounts did not influence the food consumption rate, and that the highest rate of feed utilisation (for days 1-21 and days 1-42) also took place in the group receiving the 0.5% tarragon portion. At the same time, the lowest ($P<0.05$) mean body weights of the chickens were noticed in the group receiving a 0.5% portion of tarragon during days 1-42, when there was no significant difference between the control group and the group receiving 0.125% of tarragon in days 1-21 (Hosseinzadeh *et al* 2014). The addition of a 5% tarragon mix appears to have a negative effect on mean body weight and on the FCR (Hosseinzadeh and Moghaddam 2014). During the tarragon drying process, it is possible to destroy all the useful combinations making them lose their effectiveness (Arabhosseini *et al* 2007).

Table 2. Effect tarragon additive performance values of broilers (M±SD).

Treatment	Starting	Growing		Finishing	
	Days				
	7-14	15-21	22-28	29-35	36-42
	Daily feed intake (g)				
C	67.09±1.73	113.54±3.95	180.65±4.10	191.10±7.07	178.58±11.02
T1	65.43±1.13	112.49±1.59	181.42±2.85	178.94±14.71	170.85±11.98
T2	65.40±1.50	114.11±1.77	181.97±4.56	179.63±7.53	172.11±13.68
T3	67.87±2.49	115.33±3.46	179.82±8.62	182.06±3.72	170.63±11.94
p	0.064	0.408	0.332	0.086	0.261
	Daily weight gain (g)				
C	33.20±2.39	61.34±5.70	92.61±8.69	95.15±5.79[a]	90.55±6.53[a]
T1	32.20±0.69	60.30±1.54	89.77±1.66	88.19±9.63[b]	84.08±9.49[b]
T2	33.07±0.67	60.48±1.43	90.66±6.30	89.21±5.84[b]	85.62±9.31[b]
T3	34.51±0.71	61.63±1.04	91.72±8.06	88.16±5.91[b]	84.04±4.35[b]
p	0.109	0.903	0.769	0.034	0.043
	Feed conversion rate				
C	2.02±0.14	1.85±0.13	1.95±0.20	2.00±0.06	1.97±0.11
T1	2.03±0.04	1.86±0.04	2.02±0.06	2.03±0.09	2.03±0.09
T2	1.98±0.03	1.89±0.05	2.02±0.17	2.01±0.06	2.01±0.19
T3	1.97±0.06	1.87±0.08	1.96±0.16	2.06±0.14	2.03±0.14
p	0.142	0.498	0.902	0.106	0.893

C (Control group): The basal diet.
T1: The basal diet + 0.1% tarragon powder.
T2: The basal diet + 0.2% tarragon powder.
T3: The basal diet + 0.5% tarragon powder.
[a-c]Means with different superscript within the same column are statistically different ($P<0.05$).

Table 3. Jejunum villi lengths (M±SD).

Treatment	0-42 days
	JVL (μm)
C	514.50±3.00[b]
T1	519.52±2.30[ab]
T2	523.01±3.01[a]
T3	516.21±3.28[b]
p	0.043

JVL: Jejunum villi lengths.
C (Control group): The basal diet.
T1: The basal diet + 0.1% tarragon powder.
T2: The basal diet + 0.2% tarragon powder.
T3: The basal diet + 0.5% tarragon powder.
[a-c]Means with different superscript within the same column are statistically different (*P*<0.05).

The highest (*P*<0.05) feed intake in a study on Japanese quail was noticed in the group receiving a 1.5% portion of tarragon and the group treated with antibiotics (control group) in the fifth week. On the other hand, the lowest (*P*<0.05) feed intake was noticed in the group receiving a 2% portion of tarragon. The highest (*P*<0.05) live weight gain and FCR were noticed in the group treated with antibiotics (the control group) in the second and sixth weeks, whereas the lowest (*P*<0.05) live weight gain was noticed in the group receiving only a 1.5% portion of tarragon (Angas *et al* 2015). Tarragon additive results in a reduction in the number of pathogenic bacteria and an increase in the number of beneficial bacteria in the gut, stimulating an increase in the secretion of digestive latex (Ebrahimi 2011). For this reason, performance may have improved performance. In this study, the tarragon additive had a negative effect for days 29-35 and 36-42 in the area of daily weight gain. It is possible that this is due to the bioactive compounds in the structure, the plant drying and its rapid digestion by the birds.

HISTOPATHOLOGY AND LENGTH OF INTESTINAL VILLUS

Tarragon is thought to have no effect on the pathology of the liver, kidneys, and intestines due to its beneficial effects (Ebrahımı *et al* 2013). In many nutritional studies, villus length is related to the balance between the increase in the number of intestinal cells, destruction and cell death. In many nutrition studies, villus length has been shown to be a determinant of both nutrient absorption and intestinal health (Uni *et al* 1998, Laudadio *et al* 2012, Sen *et al* 2012, Incharoen *et al* 2009, Ariyadi and Harimurti 2015). Natural additives improve the structure of epithelial cells in the intestinal mucosa and extend the size of the suction cells (Wang and Peng 2008, Incharoen *et al* 2010, Fonseca-Garcíaa *et al* 2017). Therefore, in the experiment, villus length increased in the group where 0.2% tarragon powder was added to the feed. Olnood *et al* (2015) stated that additives could support bacterial growth and the development of anatomical structures.

It has been noted that there are different conclusions on the effects of tarragon as a feed additive for poultry, and it is believed that this diversity results from differences in the essential oils, acids, bioactive compounds, and terpene compositions of tarragon plants (Eisenman *et al* 2013). Differences in the composition of the structure of the plant can influence both the endogenous secretions and the performance values in chickens (Cross *et al* 2007).

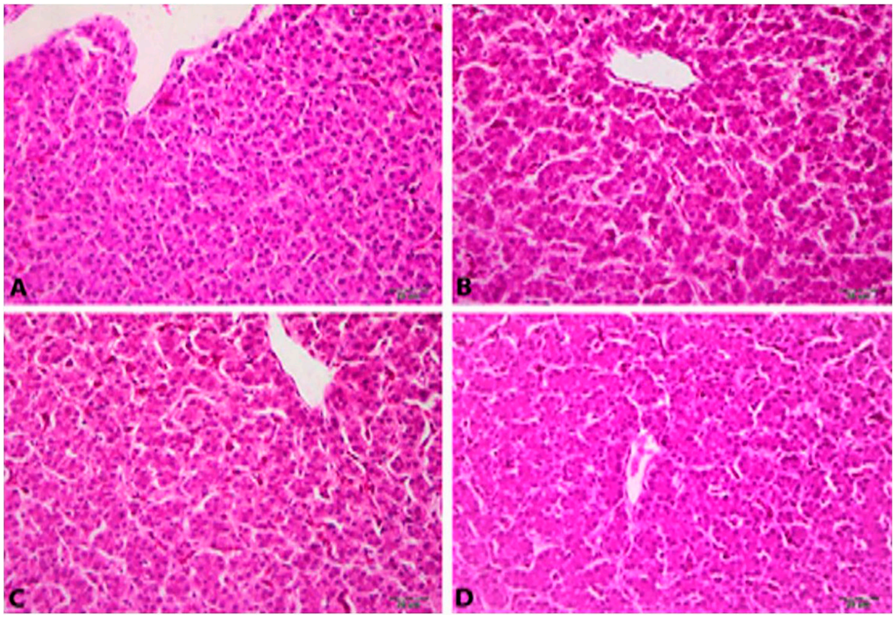

Figure 1. Control group (A); Liver tissues structure normal histological, Group T1 (B); Liver tissues structure normal histological, Group T2 (C); Liver tissues structure normal histological, Group T3 (D); Liver tissues structure normal histological, H&E, Bar: 20 μm.

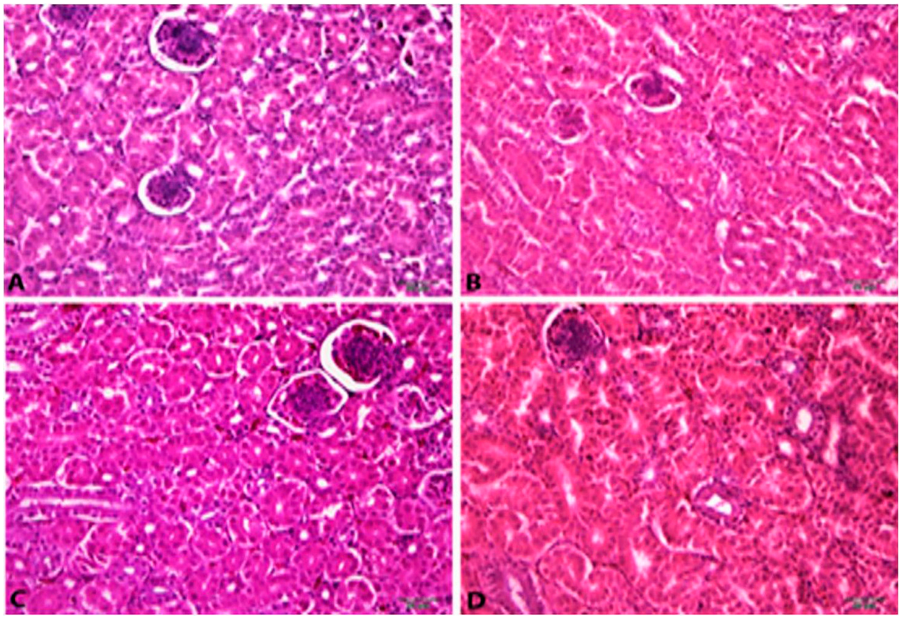

Figure 2. Control group (A); Kidney tissues structure normal histologic, Group T1 (B); Kidney tissues structure normal histologic, Group T2 (C); Kidney tissues structure normal histologic, Group T3 (D); Kidney tissues structure normal histologic, H&E, Bar: 20 μm.

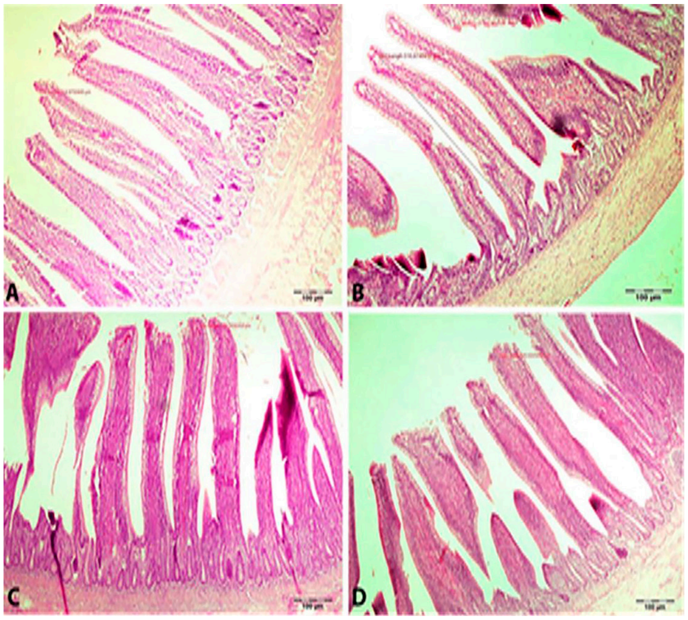

Figure 3. Control group (A); Jejunum tissues structure normal histological, Group T1 (B); Jejunum tissues structure normal histological, Group T2 (C); Jejunum tissues structure normal histological, Group T3 (D), Jejunum tissues structure normal histological, H&E, Bar: 100 μm.

Furthermore, these results may have also been influenced by differences in the digestive speed and physical environment of the test subjects, as well as the climate conditions under which the tarragon was grown (Omer *et al* 2013).

The results of this study indicate that although the tarragon additive in the broiler diet did not have any effect on DFI and FCR values in the study for all periods, the tarragon additive decreased DWG on days 29-35 and 36-42 in the period studied ($P<0.05$). Therefore, the tarragon additive had a negative effect on performance in these two periods. The tarragon additive did not alter the structure of the liver, kidney or intestinal tissues, but the longest bowel villus was in the T2 group. Adding different levels of tarragon powder to chicken feed appeared to produce different changes in the performance parameters of broiler chickens. Additional studies should be conducted to further confirm this relationship.

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