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Effects of Dietary Rosemary Essential Oil on Growth Performance, Carcass Traits and Some Hematological Values of Chukar Partridge

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ABSTRACT

The aim of this study was to determine effects of different dietary rosemary essential oil levels on growth performance, carcass traits and haematological values of breeder chukar partridge. Eighty (60 females and 20 males), 32-week-old breeder chukar partridge were randomly divided in five treatments, with four replicate pens with 4 birds each. Five experimental diets were formulated according to rosemary essential oil inclusion rates 0 mg/kg, 24 mg/kg, 48 mg/kg, 72 mg/kg and 96 mg/kg, respectively. The experiment lasted for 8 weeks. The chukar partridges had free access to ad libitum feed and water. At the end of the trial, 1 male and 1 female partridge were slaughtered for blood analysis. The obtained results showed that there was no significant difference in feed intake, body weight gain between the control and treatment groups. Dietary rosemary essential oil supplementation did not affect blood serum glucose, urea, triglyceride, total cholesterol, HDL-C and LDL-C levels in breeder Chukar partridges. It could be concluded that supplementing rosemary essential oil into Chukar partridges diet show no negative effect on growth performance.

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Introduction

The Chukar partridge is the best-adapted partridge species to the intensive rearing in Turkey as well as in the world (Özek, 2001; Simsek et al., 2020). Especially, researches on increasing the partridge population and breeding performance of the Chukar partridge gain prominence in recent years (Yilmaz and Tepeli, 2009). Reaching maximum egg production level per hen and achieving higher quality chicks having better growth performance is essential for breeder poultry production (Cufadar, 2015). Therefore, nutrition and dietary feed additives in the pre-layer and layer period is, also, vital for poultry to have better egg quality and production (Rodrigues et al., 2013).

Feed cost is the single most considerable expense in poultry production for up to 60-70 % of the total production cost per bird. Feed additives are used in animal nutrition to improve the livestock's performance by increasing their growth rate, improving feed conversion ratio, and lower mobility (Onu, 2010). Different herbal feed additives have been used in poultry nutrition since the European Commission's ban of antibiotics as growth promoters in 2006 (Onu, 2010; Polat et al., 2011).

Essential oils are one of the prominent alternative feed additives can be used instead of antibiotics; due to their ability to enhancing the production of digestive secretions, stimulating bloodstream, improving oxidant stability of the tissues and decreasing bacterial pathogen activity in the digestive system and enhancing immune mechanism (Brenes et al., 2010). It is also stated the essential oils could also improve growth performance (Polat et al., 2011).

Rosemary is a widely used aromatic and medicinal plant, well known for its antioxidant capacity (Yesilbag et al.,

2011). Apart from the antioxidant effect, several studies have shown that rosemary volatile oil has a positive effect on the performance of broilers (Yesilbag et al., 2011), laying hens (Torki et al., 2018) and quails (Çiftçi et al., 2013).

Buğdaycı and Ergün (2011) reported 200 mg/kg rosemary essential oil supplementation in broiler diets caused a decrease in feed intake; besides some researchers studied effects of different levels of fennel and rosemary essential oils (125, 200, 250, 500 ppm) on performance and antioxidant properties (Çiftçi et al., 2013; Türk et al., 2016). Gharejanloo et al. (2017) observed no beneficial effect of addition of rosemary and turmeric essential oil; though, they stated this feed additives had great potential to enhance breast meat oxidative stability. Yesilbag (2018), reported rosemary and fennel essential oils could be used as natural feed additives to improve performance and egg quality in quail diets.

Although there have been many studies effects of rosemary products on broiler, laying and quail performance, the information on chukar partridge has been minimal. This study aimed to investigate the effect of rosemary essential oil on performance, haematological values, and blood hormone levels of breeder Chukar partridges in the pre-layer phase.

Materials and Methods

The study was conducted on 60 females and 20 males, a total number of 80, 32-week-old Chukar partridges. The Chukar partridges obtained from Bahri Dagdas International Agricultural Research Institute, Konya, Turkey. The Chukar partridges were weight between 2.000–2.150 g and randomly separated to a control and 4 experimental groups (16 in each). Each group were separated to 4 replicates of 3 females and 1 male Chukar partridges. The animals were kept in a windowed poultry house with light regimen of 12-hour light and 12-hour dark. Feed and water were offered as *ad libitum*. The experiment lasted 8 weeks. The initial weight (g), final weight (g), feed intake (g feed/bird/day), blood parameters, and carcass characteristics were determined.

The basal diet of the study was provided from a local feed mill (Table 1). It was formulated to be isocaloric and isonitrogenous and meet all nutritional requirements (NRC, 1994). No antioxidant was given to the birds in the control group except the vitamin E and selenium in vitamin-mineral premix. The treatment groups were given the same basal diet, with supplementation of 24, 48, 72 and 96 mg/kg rosemary essential oil, respectively. The levels of the essential oil added to the feed were determined from a previous research conducted in broilers (Alçiçek et al., 2004). Rosemary essential oil was purchased from a local medical company (Ecodab-İnan Agricultural Products) (Table 2).

Birds were weighed at the start and the end of the study. Feed intake was recorded at the end of the research. 56th day of the experiment, 1 male and 1 female bird from each cage (30 partridges total) were selected and killed after determining live weight of the birds. The Chukar partridge carcasses were dissected according to the method outlined by Jones (1984). During the process, carcass, liver, heart and gizzard weights were determined as absolute and relative to live weight.

Six ml blood was drawn from jugular vein of the slaughtered animals to determinate blood parameters. Blood samples were collected to the vacuumed test tubes and centrifuged at 5.000 g for 10 min at room temperature to separate serum and. The serum samples were analyzed immediately for glucose (mg/dL), urea (mg/dL), triglycerides (mg/dL), cholesterol (mg/dL), high-density lipoprotein cholestrol (HDL-C) (mg/dL) and low-density of lipoprotein cholesterol (LDL-C) (mg/dL) by an Architect C8000 Automatic Biochemical Analyzer (Abbott, Inc., Chicago, IL) using standard commercial kits of the same company.

Table 1. The ingredients and chemical composition of experimental diet.

Ingredients	%
Maize	51.50
Barley	11.00
Soybean meal (47% CP)	24.50
Vegetable oil	2.30
Limestone	8.25
Dicalcium phosphate	1.75
Salt	0.35
Vitamin-Mineral Premix[1]	0.25
DL-methionine	0.10
Total	100.00
Calculated nutrient concentration	
ME (Kcal / kg)	2756
CP %	16.55
Calcium %	3.50
Available phosphorus %	0.41
Lysine %	0.89
Methionine %	0.35
Methionine + Cystine %	0.60

[1]Premix provided the following per kg of diet:Vitamin A: 8.800 IU, vitamin D3: 2.200 IU, vitamin E: 11 mg, nicotinic acid: 44 mg, Cal-DPantotenat: 8.8 mg, riboflavin: 4.4 mg, thiamine: 2.5 mg, vitamin B12: 6.6 mg, folic acid: 1 mg, D-Biotin: 0.11 mg, colin: 220 mg, Mn: 80 mg, Cu: 5 mg, Fe: 60 mg, Zn: 60 mg, Co: 0.20 mg, iodine: 1 mg, Se: 0.15 mg

Table 2. Active components of rosemary essential oil used in the study

Active components	%
1,8 Cineol	36.73
α-Pinen	18.17
Borneol	6.51
Camphor	9.10
Camphene	4.28
Para Cymen	2.95
Verbenene	2.11
Terpinone	2.10
Mirsene	1.60
β-Pinen	1.10
Limonene	3.84
Trans Caryophyilene	4.16
Linalool	2,11
α-Terpineol	2.04
β-Myrcene	1.65
Bornylacetate	1.29
Delta 3 Carene	0.90
Terpinen-4-ol	0.78
Pinocamphon (Cis/Tris)	0.69
Total	100.00

The data were subjected to GLM (General Linear Model) procedure of the statistical package program was applied (SAS Institute, 2011). All data were given as mean ± standard error, and the differences between means were shown by Duncan Multiple Comparison Test at 5% significance level.

Results

The effect of dietary different levels of rosemary essential oil on the performance in Chukar partridges are given in Table 3. In the present study, increasing dietary levels of rosemary essential oil had no effect on final body weight and feed intake in chukar partridge (P>0.05).

As shown in Table 4, dietary supplementation rosemary essential oil did not differ between groups significantly on slaughter weight, carcass weight, carcass yield, organ weights and yields (P>0.05) yet, it was found that the effect of sex on carcass weight, heart weight, percent of liver and gizzard were statistically significant (P<0.05).

No significant differences observed between control and treatment groups for serum glucose, triglycerides, urea, LDL-cholesterol levels in the present study (P>0.05) (Table 5). On the other hand, the effect of sex on total cholesterol, triglyceride, HDL-cholesterol was significant in current study (P<0.05).

Discussion

Basic phenolic components of rosemary oil that was used in current study were detected as 1,8-cineole (%36.7) and α-Pinene (%18.1) (Table 2). Yesilbag et al. (2012) also reported the basic components of the rosemary essential oil that was used in the study were 1,8-cineole (%43.96) and α-Pinene (%25.33).

In the present study, dietary supplementation of rosemary essential oil had no effect on feed intake in chukar partridge. Similarly, body weights did not differ significantly between animals whose body weights were between 2047 to 2103 g in the beginning of the experiment.

Table 3. The effect of dietary different levels of rosemary essential oils on the performance in Chukar partridges

Parameters	Dietary rosemary essential oil supplementation (ppm/kg/day)					
	Control (0 ppm)	24 ppm	48 ppm	72 ppm	96 ppm	P Value
Initial body weight, g	2075.0±22.8*	2100.0±21.6	2054.5±31.9	2047.0±16.4	2103.5±15.6	0.311
Final body weight, g	1872.5±24.1	1973.3±57.7	1884.0±34.6	1852.3±17.0	1873.3±61.0	0.340
Feed intake, g	5644.0±124.0	5170.3±87.4	5237.0±126.0	5394.0±269.0	5180.0±113.0	0.224

*P>0.05

Table 4. The effect of dietary different levels of rosemary essential oils on the carcass parameters in Chukar partridges

Parameters	Sex	Dietary rosemary essential oil supplementation (ppm/kg/day)					Sex
		Control (0 ppm)	24 ppm	48 ppm	72 ppm	96 ppm	Mean±SE
Slaughter weight, g	F	466.50±13.70	492.50±25.10	439.25±7.42	433.75±3.35	455.25±9.01	457.45±7.33^{b}
	M	547.50±13.10	558.80±21.60	522.30±14.20	554.30±17.20	525.00±10.80	541.55±7.18^{a}
	R	507.00±17.60^{ab}	525.60±19.80^{a}	480.80±17.30^{b}	494.00±24.20^{ab}	490.10±14.70^{ab}	
Carcass weight, g	F	357.90±11.60	370.10±32.30	337.75±8.81	338.24±4.33	359.87±3.96	352.79±7.03^{b}
	M	425.70±12.10	417.10±27.90	406.10±11.10	435.00±15.80	401.99±8.02	417.16±7.13^{a}
	R	391.80±15.00	393.60±21.70	371.90±14.50	386.60±19.80	380.93±8.97	
Carcass yield (%)	F	76.72±0.70	74.70±3.07	76.87±1.12	77.97±0.47	79.09±0.75	77.07±0.70
	M	77.73±0.71	74.57±3.44	77.77±0.25	78.44±0.42	76.57±0.34	77.02±0.71
	R	77.23±0.50	74.63±2.14	77.32±0.56	78.21±0.30	77.83±0.61	
Heard weight, g	F	1.99±0.14	2.02±0.22	2.22±0.06	1.97±0.20	2.19±0.10	2.08±0.07^{b}
	M	2.25±0.06	2.43±0.12	2.22±0.07	2.31±0.12	2.40±0.06	2.32±0.04^{a}
	R	2.12±0.09	2.22±0.14	2.22±0.04	2.14±0.13	2.29±0.07	
Heart yield (%)	F	0.43±0.04	0.41±0.03	0.51±0.02	0.45±0.04	0.48±0.03	0.46±0.02
	M	0.41±0.02	0.44±0.03	0.43±0.01	0.42±0.03	0.46±0.01	0.43±0.01
	R	0.42±0.02	0.42±0.02	0.47±0.02	0.44±0.02	0.47±0.02	
Liver weight, g	F	6.01±0.36	5.82±0.79	5.77±0.68	5.49±0.12	5.68±0.47	5.75±0.22
	M	6.38±0.30	5.60±0.68	5.96±0.28	6.19±0.18	6.11±0.16	6.05±0.16
	R	6.20±0.23	5.71±0.48	5.86±0.34	5.84±0.17	5.90±0.25	
Liver yield (%)	F	1.29±0.08	1.17±0.12	1.32±0.16	1.26±0.02	1.25±0.12	1.26±0.05^{a}
	M	1.17±0.08	0.10±0.11	1.14±0.07	1.12±0.04	1.16±0.02	1.12±0.03^{b}
	R	1.23±0.06	1.09±0.08	1.23±0.09	1.20±0.03	1.21±0.06	
Gizzard weight, g	F	8.76±0.47	8.21±0.78	8.25±0.44	7.72±0.48	7.94±0.43	8.18±0.23
	M	8.32±0.49	8.03±0.32	8.04±0.33	8.44±0.33	9.11±0.99	8.39±0.24
	R	8.54±0.32	8.12±0.39	8.14±0.26	8.08±0.30	8.53±0.55	
Gizzard yield (%)	F	1.89±0.14	1.66±0.08	1.88±0.08	1.78±0.12	1.75±0.13	1.79±0.05^{a}
	M	1.52±0.06	1.44±0.06	1.54±0.05	1.52±0.04	1.74±0.19	1.55±0.05^{b}
	R	1.70±0.10	1.55±0.06	1.71±0.08	1.65±0.08	1.74±0.11	

F: Female; M: Male; R: Rosemary Mean±SE; *P<0.05; a,ab,b)

Table 5. The effect of dietary different levels of rosemary essential oils oil on some blood biochemical parameters of the Chukar Partridges

Parameters	Sex	Dietary rosemary essential oil supplementation (ppm/kg/day)					Sex
		Control (0 ppm)	24 ppm	48 ppm	72 ppm	96 ppm	Mean±SE
Glucose (mg/dL)	F	426.00±9.30	409.00±18.80	406.30±13.40	387.00±17.80	401.30±33.10	406.05±8.50
	M	384.00±6.23	435.40±9.21	425.50±35.60	423.80±22.80	369.30±10.90	408.90±9.68
	R	405.00±9.48	422.20±10.8	415.9±18.00	405.40±15.10	385.30±17.20	
Urea (mg/dL)	F	3.75±0.75	3.60±0.87	3.75±0.85	4.25±0.63	4.25±0.48	3.91±0.31
	M	4.50±0.65	4.80±0.37	3.00±0.41	4.75±0.75	5.25±0.48	4.48±0.27
	R	4.13±0.48	4.20±0.49	3.38±0.46	4.50±0.46	4.75±0.37	
Triglyceride (mg/dL)	F	80.75±6.18	125.00±60.00	113.50±44.20	77.25±8.08	78.50±7.82	96.40±15.90
	M	62.25±3.71	75.60±5.84	75.30±11.80	73.00±7.15	62.25±3.54	69.95±3.11
	R	71.50±4.83	100.30±29.60	94.40±22.40	75.13±5.06	70.38±5.02	
Total Cholesterol (mg/dL)	F	174.50±21.40	161.40±27.70	185.80±28.60	195.00±7.45	212.00±16.00	184.57±9.87[b]
	M	189.80±13.50	228.00±16.20	213.80±12.00	235.30±10.30	212.30±21.30	216.38±7.06[a]
	R	182.10±12.10	194.70±18.80	199.80±15.30	215.13±9.61	212.10±12.30	
HDL-C (mg/dL)	F	121.80±13.20	103.20±18.40	117.50±22.50	139.50±0.50	135.00±5.00	122.43±6.72[b]
	M	133.00±4.12	140.00±0.00	139.00±1.00	140.00±0.00	140.00±0.00	138.48±0.94[a]
	R	127.38±6.75	121.60±10.60	128.30±11.20	139.75±0.25	137.50±2.50	
LDL-C (mg/dL)	F	30.75±4.29	31.40±7.28	32.00±5.90	30.00±2.94	35.00±2.12	31.81±2.14
	M	32.50±3.23	34.00±3.86	32.00±3.81	39.50±2.99	35.00±7.49	34.57±1.90
	R	31.63±2.51	32.70±3.91	32.00±3.25	34.75±2.64	35.00±3.61	

F: Female; M: Male; R: Rosemary Mean±SE; (*P<0.05; a,b)

Similar to our findings, Florou-Paneri et al. (2006) reported dietary supplementation of rosemary at a concentration of 10 g/kg did not affect feed intake significantly in layers; Yesilbag et al. (2011) didn't find any significant difference between groups on feed intake in broilers. Gharejanloo et al. (2017) also informed different dietary levels of rosemary essential oil (0, 100 ppm and 200 ppm) did not affect feed intake in broilers like reported in the present study. Ghozlan et al. (2017) found similar results. Contrary to our findings, some researches indicated that rosemary and rosemary essential oil supplementation has significant effect on feed intake (Abd El-Latif et al., 2013; Attia, 2018). When the studies on dietary supplementation of herbal essential oils in broilers were examined, it was seen that the findings on performance of very varied. This is thought to be due to physiological situation of the animals, environmental conditions, diseases, composition of the diets, active components of essential oils etc (Windisch et al., 2008).

When compared to control group, dietary supplementation of rosemary essential oil did not differ between groups significantly on slaughter weight, carcass weight, carcass yield, organ weights and yields in the present study. Although the effect of sex on carcass weight, heart weight, percent of liver and gizzard were statistically significant.

The carcass weights in groups were varying between 371.90 to 393.60 g in our experiment; besides male partridges (417.16 g) were heavier significantly than female ones (352.79 g) (P<0.01). In other study carried out in partridges, it detected that live weights and carcass weights were higher in males than females; whereas carcass yield did not change according to sex (Yamak et al., 2016). On the contrary, Kırıkçı et al. (2017) stated female partridges had better carcass yield (%76.07) than male ones (%76.07) however, not significantly different, only numerically. Other studies indicated dietary rosemary supplementation didn't differ carcass weight statistically (Ghazalah and Ali, 2008; Çetin et al., 2017; El-Gogary et al., 2018; Petričević et al., 2018)

In the present experiment, carcass yield was found in a range from %74.70 to 79.09, %77.07 averagely in female chukar partridges and %74.57 to %78.44, %77.02 averagely in male animals. Kokoszyński et al. (2013) and Wnux et al. (2014) also found no difference between male and female partridges in terms of carcass yields. Whereas, Bolacali et al. (2018) reported hot carcass yields of partridges were between %72.07 to 74.94.

As the results obtained from this study, heart weights were determined between 2.12 to 2.29 g in the groups fed with rosemary essential oil supplementation. Effect of sex on heart weight was found statistically significant (P<0.05). Although liver weight did not differ between the groups, relative weight of liver was found significantly higher in female chukar partridges than male ones (P<0.05). Whereas, relative weight of gizzard was found significantly higher in females (%1.79) than males (%1.55) (P<0.05).

In a study conducted in broilers, researchers reported rosemary essential oil supplementation didn't affect carcass yield, relative weights of breast, thigh, pancreas, abdominal fat, proventriculus, gizzard and crop, yet relative weight of liver was affected significantly (Gharejanloo et al., 2017). Besides, Norouzi et al. (2015) and Petričević et al. (2018) notified addition of the dietary rosemary didn't affect liver, heart and gizzard weights significantly. In contrary, there are some studies that stated rosemary oil supplementation affected liver and heart weight statistically in poultry (El-Gogary et al., 2018).

Although no significant effect of supplementation of rosemary essential oil in breeder partridge diets on serum glucose, triglycerides, urea, LDL-cholesterol levels were found; effect of sex on total cholesterol, triglyceride, HDL-cholesterol was significant in current study. Biochemical blood measurements commonly used to monitor the health status of an animal and important indicators of the

physiological and nutritional condition of them (Alagawany and Abd El-Hack, 2015). In the present study, dietary rosemary essential oil supplementation did not affect blood serum glucose, urea, triglyceride, total cholesterol, HDL-C and LDL-C levels in breeder Chukar partridges. However, the effect of gender was found significantly except LDL-C ($P<0.05$). Some researchers found similar results dietary supplementation of herbal essential oils such as sage (Yurtseven et al., 2008) and black seed oil (Çetin et al., 2008) in biochemical blood parameters of partridges. Çiftçi et al. (2013) also didn't find any effect of rosemary oil supplementation on serum lipid values in quails.

In contrast to our experiment, many researchers found the effects of rosemary products on lipid profile of blood serum were controversial. Some of them remarked dietary rosemary supplementation reduce lipid parameters in blood serum in laying hens (Bölükbaşı et al., 2008; Alagawany and Abd El-Hack, 2015) and broilers (Ghazalah and Ali, 2008; Polat et al., 2011). Furthermore, some studies found hyperlipidemic effects of rosemary supplementation in broilers (Polat et al., 2011; Abd El-Latif et al., 2013). El-Gogary et al. (2018) stated dietary rosemary essential oil supplementation did not differ blood plasma LDL-C levels but affected HDL-C levels significantly.

Urea or uric acid content in blood serum might be an important clue for to identify renal problems humans and animals. Our outcomes for urea level in blood serum were also compatible with other dietary rosemary product experiments in laying hens (Alagawany and Abd El-Hack, 2015) and broilers (Polat et al., 2011; Abd El-Latif et al., 2013). In contrary, (Rostami et al., 2015) and (Ghazalah and Ali, 2008) found that %0.5 rosemary powder supplementation to diets decreased blood uric acid levels in broilers. The discrepancies between the studies might be due to the variety of the rosemary product (essential oil, phenolic compounds, powder etc), doses, experimental conditions and animal type.

As a conclusion, dietary supplementation of rosemary essential oil to breeder chukar partridges in different levels had no significant effect on feed intake, glucose, urea, triglyceride, total cholesterol, HDL-Cholesterol, LDL-Cholesterol in blood serum. However, gender of animals had significantly effective on some parameters.

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