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Comparison of Different Levels of Thyme and Rosemary Ether Extracts on Growth Performance and Carcass Characteristics of Broiler Chickens

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Abstract

An experiment was conducted to compare the effects of different levels of thyme and rosemary ether extract on growth performance and carcass characteristics of broiler chickens. 336 male sexy chicks were used in a randomized complete design with 7 treatments and 4 replications cages (12 birds per cage). The experimental diets consisted of: 1: Control treatment: Basal diet based on corn-soybean meal without supplementation with medicinal plants, 2: base ration + 0.25% of rosemary ether extract, 3: base ration + 0.5% of rosemary ether extract, 4: base diet + 0.75% Rosemary ether extract, 5: base diet + 0.25% Thyme ether extract, 6: base diet + 0.5% Thyme ether extract and 7: base diet + 0.75% Thyme ether extract. Results showed that tratments 4, 6 and 7 (which contained 0.75% Rosemary ether extract, 50% extract of Thyme extract and 0.75% Thyme ether extract) average body weight and daily gain increased. At the end of the experiment, there was no significant difference between the treatments in feed intake. The best feed conversion coefficient in treatment was 0.75% of thyme extract and the other treatments also had less feed conversion than control treatment. Characteristics of carcasses were not significantly affected by experimental treatments. The level of 0.75% of rosemary ether extract showed better performance than the other two levels and its yield was similar to 0.75% of thyme ether extract. Supplementation of dietary of broiler chicks with Thyme extract at the level of 0.50% and 0.75% was the same results.

Keywords: Thyme; Broiler chicks; Rosemary; Medicinal plants

Introduction

For more than half a century antibiotics have been used as growth promoting feed supplements to enhance yields in poultry production [1]. However, the routine use of antibiotics in the diet of broilers is now considered to cause an increase in antimicrobial resistance of human and animal bacteria [2]. For this purpose, various compounds such as probiotics, prebiotics, organic acids, plant extracts and essential oils have been extensively studied as alternatives. Recent studies show that medicinal plants, extracts or active compounds in their perfume can have antimicrobial properties, and used as a suitable alternative to antibiotics. However, it has been suggested that their lipophilic property and chemical structure can play a role. It was suggested that terpenoids and phenylpropanoids can penetrate the membranes of the bacteria and reach the inner part of the cell because of their lipophilicity [3]. Also, researchers in several studies have shown that some of the active oils in perfumes stimulate the gastrointestinal tract and increase the production of digestive enzymes, improve the use of digestive products and the body's immune response [4].

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Thymus vulgaris (thyme) is an aromatic plant of the *Lamiaceae* family and has received major attention as both a pharmaceutical and therapeutic agent across the globe [5]. Thymol, carvacrol, parasimol, linalool and cineol are the main components of thyme essential oil. Grigore et al. reported the antioxidant capacity of thyme extract is equivalent to ascorbic acid [5]. The antioxidant ability of thyme essential oils is attributed to the phenolic compounds thymol, carvacrol and thymohydroquinone [6]. While some studies suggest that the supplementation of feed with thyme improves the performance parameters of poultry [7,8] some other studies suggest that thyme has no effect [9,1]. Furthermore, thyme essential oil has also been reported that significantly reducing in levels of triglyceride, total cholesterol and glucose levels [10].

Rosemary is a perennial shrub with ascending branches, fragrant and belongs to Lamiaceae family.The leaves and flowers of this plant contain active ingredients. The active ingredients of this plant are essential oil, tannins and bitter substances. The amount of essential oil in dried leaves is between 0.5 to 1.5 percent. The most important components of rosemary essential oil are cinnamon, camphor, bornyl stato, rosemary acid [11]. Polat et al. investigated the dietary supplementation effects of rosemary plant (57, 86 and 115 g/kg) and its volatile oil (100, 150 and 200 mg/kg) in broilers [12]. They showed that supplementation of 100 mg/kg rosemary volatile oils or 8.6 g/kg rosemary plant increases the plasma superoxide dismutase (SOD) activity. In the other study, feeding 5, 10 and 15 mL/L rosemary essential oil increased the serum serum superoxide dismutase (SOD) activity in broilers under oxidative stress [13].

The objective of this study was to compare the effect of different levels of thyme and rosemary ether extracts on growth performance and carcass characteristics of broiler chickens.

Materials and Methods

Animal, management, and diets

A total of 336 (Ross 308) one-day-old male chicks were randomly allocated to one of seven dietary treatment groups of four replicates each with 12 chicks. The chicks were maintained on a 24-h light. The birds were reared in floor pens using sawdust as litter at Birjand Azad university poultry farm, Birjand, Iran. The temperature was set at 35°C to 32°C during the first week and gradually declined by 2°C per week. A relative humidity was about 60 to 65%. Routine vaccination and health care was given when it was necessary. Each group was fed for 42 days with isocaloric and iso-nitrogenous diets *ad libitum* (Table 1) that were formulated based on standard recommendation. Seven dietary treatments used: 1- Control treatment: Basal diet based on corn-soybean meal without adding ether extract, 2- Basal diet + 25% ether extract of rosemary, 3- Basal diet + 50% ether extract of rosemary, 4- Basal diet + 75% ether extract of rosemary, 5- Basal diet + 25% ether extract of thyme, 6- Basal diet + 50% ether extract of thyme and 7- Basal diet + 75% ether extract of thyme.

All animal experiments were approved by the state committee on animal ethics, Karaj Branch, Islamic Azad University, Karaj, Iran (IACUC no:4687; 4/10/2018). The recommendations of the European Council Directive (2010/63/EU) of September 22, 2010, regarding the standards in the protection of animals used for experimental purposes were also followed.

Sample collection and measurements

The birds were weighed at the beginning of the experiment (1 days-old) and on days 7, 14, 21, 28, 35 and 42 of age after two hours of starvation to empty the gastrointestinal tract. Body weight gain was calculated on weekly basis throughout the experimental period of 1-42 days of age. In order to determine the daily feed consumption of the animals, throughout the experimental period, weighed quantities of feed were provided in the morning and evening

Table 1: Ingredients and chemical composition of used diets at (1-21 d)

Experimental group	Control diet (1-21 d)	Control diet (22-42 d)
Ingredients (g/1000kg as-fed)		
Corn	558.66	653
Soybean meal	312	268
Fish meal	49	19.54
bran	10	10.25
Calcium phosphate	16.05	9.25
shell	8.25	9.7
Lysine	1.53	1.64
Methionine	2.1	2.12
Vitamin mineral premix1	5	5
Na chloride	1	1
Calculated chemical composition		
Metabolizable energy (MJ/kg)	3000	3000
Crude protein (%)	22	19
Fat (%)	6.57	4.95
Ca (%0	1.03	0.85
Available P(%)	0.44	0.4

1One kilogram of premix contained: calcium pantothenate, 4000 mg; niacin, 15,000 mg; vitamin B6, 13,000 mg;

Cu, 3000mg; Zn, 15,000mg;Mn, 20,000mg; Fe, 10,000mg;K, 300mg; vitamin A, 5 × 106 IU; vitamin D3, 5 ×

105 IU; vitamin E, 3000 mg; vitamin K3, 1.5 mg/g; vitamin B2, 1000 mg

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and the remainder collected the following day was weighed and subtracted from the amount of feed provided. As the subgroups included 12 chicks, individual daily feed intake was calculated by dividing the daily feed intake values by 12. The feed conversion ratio (FCR) was calculated as g feed per g body weight gain. On day 21 and 42 of the trail, two birds from each pen were randomly selected for estimation of carcass characteristics. Chickens slaughtered by displacing the neck. Breast, drumsticks, spleen, and abdominal fat were removed and weighed; the empty or edible carcass weights were recorded (Shabani et al. 2015). Thighs were also weighed. Relative weights (RW) were calculated as follows: weight of cut or organ (g)/100 g of body weight. Broiler digestive enzymes gradually complete by the end of three weeks. Therefore, at the end of 21 days, slaughter was performed to determined difference of the effect of diet experiment.

Statistical analysis

Data were subjected to analysis of variance procedures appropriate for a completely randomized design and analyzed by one-way ANOVA using the General Linear Model procedures of SAS (SAS Inst. Inc., Cary, NC). Mean separation was accomplished using Duncan post hoc test. All significance level was set at $P < 0.05$.

Results

The results of the WG and DWG were shown in the tables 2 and 3. At the end of the second week of the experiment, the control treatment showed the lowest BW and its difference with other treatments except the treatment 2 was significant ($P<0.05$) Similar to the first week of the experiment, chickens fed the treatment 7 showed the highest BW, but the difference with treatments 4 and 6 was not significant ($P>0.05$). At the

Table 2: Effect of experimental diets on live weight of broiler chickens (g)

Age (d)	1	7	14	21	28	35	42
Experimental diet	Live weight (g)						
11	42.20^{a}	107.69^{c}	249.38^{c}	593.99^{c}	885.15^{c}	1309.61^{c}	1816.03^{c}
2	42.15^{a}	118.65^{b}	258.54^{bc}	608.83^{bc}	904.98^{b}	1388.48^{b}	1922.50^{b}
3	42.06^{a}	115.31^{b}	260.85^{b}	615.51^{b}	922.87^{b}	1393.36^{b}	1966.45^{b}
4	42.15^{a}	128.65^{a}	288.54^{a}	680.83^{a}	1015.96^{a}	1488.48^{a}	2010.50^{a}
5	42.19^{a}	103.33^{b}	118.54^{b}	614.89^{b}	900.98^{b}	1372.69^{b}	1959.50^{b}
6	42.22^{a}	108.84^{a}	132.63^{a}	696.27^{a}	1017.07^{a}	1490.01^{a}	2026.95^{a}
7	42.10^{a}	103.07^{a}	134.26^{a}	701.84^{a}	1024.74^{a}	1502.23^{b}	2033.53^{b}
± SEM[2]	0.3	2.38	5.73	10.21	13.54	18.98	24.31
P-value							
	NS	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001

1: 1- Control treatment: Basal diet based on corn-soybean meal without supplementation with medicinal plants, 2: base ration + 0.25% of rosemary ether extract, 3: base ration + 0.5% of rosemary ether extract , 4: base diet + 0.75% Rosemary ether extract, 5: base diet + 0.25% Thyme ether extract, 6: base diet + 0.5% Thyme ether extract and 7: base diet + 0.75% Thyme ether extract.
2: Mean error standard
Column means with common superscripts do not differ ($P > 0.05$).

Table 3: Effect of experimental diets on daily weight gain of broiler chickens (g/d)

Age (d)	1-7	8-14	15-21	22-28	29-35	36-42
Experimental diet	Daily weight gain (g/d)					
11	9.32^{c}	19.60^{c}	49.39^{c}	40.34^{c}	60.39^{c}	71.82^{c}
2	10.46^{b}	20.79^{b}	50.67^{c}	41.95^{bc}	62.31^{bc}	71.61^{bc}
3	10.92^{b}	20.94^{b}	50.38^{c}	42.29^{b}	65.59^{b}	77.05^{b}
4	10.99^{b}	21.62^{ab}	53.95^{b}	46.88^{a}	68.93^{a}	78.39^{a}
5	12.15^{a}	22.99^{a}	56.16^{ab}	46.85^{a}	64.31^{b}	71.61^{b}
6	12.33^{a}	23.11^{a}	56.16^{ab}	46.88^{a}	68.21^{ab}	81.86^{ab}
7	12.99^{a}	22.87^{a}	57.27^{a}	46.97^{a}	69.53^{a}	84.13^{a}
± SEM[2]	0.33	0.58	0.92	1.43	1.56	2.61
P-value						
	0.0001	0.0018	0.0001	0.0188	0.024	0.0023

1: 1- Control treatment: Basal diet based on corn-soybean meal without supplementation with medicinal plants, 2: base ration + 0.25% of rosemary ether extract, 3: base ration + 0.5% of rosemary ether extract , 4: base diet + 0.75% Rosemary ether extract, 5: base diet + 0.25% Thyme ether extract, 6: base diet + 0.5% Thyme ether extract and 7: base diet + 0.75% Thyme ether extract.
2: Mean error standard
Column means with common superscripts do not differ ($P > 0.05$).

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end of the third week, a process similar to the second week of the experiment was observed. A similar trend was observed in the fourth, fifth and sixth weeks of the experiment. Chickens fed with control treatment showed the lowest BW and its difference with other experimental treatments was significant (P<0.05) Treatments four, six and seven had the BW. The difference between these three treatments was not statistically significant (P>0.05). But they showed a significant difference with other experimental treatments (P<0.05).

The control treatment had the least daily weight gain throughout the experiment. In the first week, treatments 5, 6 and 7 had the highest DWG. There was no significant difference between these three treatments (P >0.05). In the second week, a similar trend was observed in the first week. With the difference that rosemary ether extract at the level of 0.75% or treatments 4 did not show significant differences with treatments with levels of 0.25 and 0.50% of this extract (P >0.05). In the third week, treatment 7 which had 0.75% of thyme ether extract showed the highest DWG and the difference with other levels of this extract, ie 0.25 and 0.50% (treatments 5 and 6) was not statistically significant (P >0.05). The high level of rosemary ether extract (0.75%) showed more DWG than other levels of this extract and it was not different from the levels of 0.25 and 50% of thyme ether extract (treatment 5 and 6 were significant). During the fourth week of the experiment, treatment 7 also showed the highest DWG numerically and the difference was significant only with the control treatment, 2 and 3(P>0.05). The results showed a similar trend in the fifth and sixth weeks of the experiment. During these two weeks, similar to the previous week, the control treatment experiment had the lowest DWG, but the difference with treatments two and three was not statistically significant (P <0.05). The treatment 7 showed the highest DWG numerically and the difference with treatments 4 and 6 was not significant (P <0.05).

The results of the FI were shown in the table 4. In the first week, experimental treatments showed a statistically significant difference in feed intake (P <0.05). During this period, treatments supplemented with rosemary ether extract at all levels along with control treatment significantly increased the feed intake of broiler chickens compared to treatments with thyme ether extract (P <0.05). Supplements supplemented with thyme ether extract did not show a statistically significant difference in feed intake (P <0.05) and reduced feed intake compared to other treatments. During the second week of the experiment, the control treatment showed the highest number of feed intakes Treatments six and seven had the lowest feed intake and their differences were not significant (P <0.05). The results of the experiment during the third week were similar to the second week, except that the difference between treatments three and four was not significant (P <0.05). During the fourth, fifth and sixth weeks of the experiment, no significant difference was observed between the experimental treatments in terms of feed intake (P <0.05).

The results of the FCR were shown in the table 5. The first week of the experiment showed control treatment and 2 highest FCR and their differences were not significant (P >0.05). Treatment 7 had the lowest FCR and its difference with other experimental treatments was significant (P <0.05). The second week of the experiment, treatments 4, 6 and 7 showed the lowest FCR and the numerical difference between the three treatments was not significant (P >0.05). The highest FCR was observed in control and treatment 2 which were significantly different from other experimental treatments (P <0.05). In the last three weeks, control and

Table 4: Effect of experimental diets on feed intake of broiler chickens (g/d)

Age (d)	7-Jan	14-Aug	15-21	22-28	29-35	36-42
Experimental diet	Feed intake (g/d)					
11	17.33^{a}	45.92^{a}	79.32^{a}	93.40^{a}	121.25^{a}	150.72^{a}
2	17.30^{a}	44.16^{a}	79.06^{a}	93.28^{a}	123.27^{a}	151.33^{a}
3	17.35^{a}	44.25^{a}	79.02^{ab}	93.32^{a}	122.27^{a}	151.92^{a}
4	17.31^{a}	43.77^{b}	78.38^{b}	92.74^{a}	121.23^{a}	151.10^{a}
5	17.22^{b}	42.33^{c}	75.78^{c}	93.69^{a}	122.45^{a}	151.16^{a}
6	17.21^{b}	43.01^{d}	75.39^{d}	93.06^{a}	122.80^{a}	150.78^{a}
7	17.24^{b}	43.14^{d}	75.51^{d}	93.25^{a}	122.58^{a}	151.85^{a}
± SEM[2]	0.02	0.68	0.22	0.41	0.77	0.44
P-value						
	0.0001	0.0001	0.0016	NS	NS	NS

1: 1- Control treatment: Basal diet based on corn-soybean meal without supplementation with medicinal plants, 2: base ration + 0.25% of rosemary ether extract, 3: base ration + 0.5% of rosemary ether extract , 4: base diet + 0.75% Rosemary ether extract, 5: base diet + 0.25% Thyme ether extract, 6: base diet + 0.5% Thyme ether extract and 7: base diet + 0.75% Thyme ether extract.
2: Mean error standard
Column means with common superscripts do not differ (P > 0.05).

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Table 5: Effect of experimental diets on feed: gain of broiler chickens.

Age (d)	1-7	8-14	15-21	22-28	29-35	36-42
Experimental diet	Feed: gain					
11	1.92[a]	2.08[a]	1.63[a]	1.97[a]	2.01[a]	2.19[a]
2	1.88[a]	2.03[a]	1.72[a]	1.89[b]	1.83[b]	1.98[b]
3	1.67[b]	1.90[b]	1.54[b]	1.74[c]	1.86[b]	1.02[b]
4	1.67[b]	1.75[c]	1.50[b]	1.72[c]	1.89[b]	1.92[b]
5	1.60[b]	1.85[b]	1.46[b]	1.74[c]	1.82[b]	1.01[b]
6	1.50[b]	1.73[c]	1.35[c]	1.79[c]	1.80[b]	1.95[b]
7	1.44[c]	1.68[c]	1.31[c]	1.63[d]	1.75[c]	1.72[c]
± SEM[2]	0.19	0.06	0.02	0.06	0.09	0.08
P-value						
	0.0001	0.001	0.0001	0.025	0.048	0.013

1: 1- Control treatment: Basal diet based on corn-soybean meal without supplementation with medicinal plants, 2: base ration + 0.25% of rosemary ether extract, 3: base ration + 0.5% of rosemary ether extract , 4: base diet + 0.75% Rosemary ether extract, 5: base diet + 0.25% Thyme ether extract, 6: base diet + 0.5% Thyme ether extract and 7: base diet + 0.75% Thyme ether extract.

2: Mean error standard

Column means with common superscripts do not differ (P > 0.05).

Table 6: Effect of experimental diets on carcass and some organs relative to the body weight of Ross 308 broilers at 21 days of age.

	Carcass yeild	Thighs	Breast	Liver	Heart	Spleen	Pancreas	Abdominal fat	Fabricius
Experimental diets									
11	62.64[a]	28.57[a]	27.48[a]	3.03[a]	0.65[a]	0.09[a]	0.19[a]	1.47[a]	0.24[a]
2	64.29[a]	28.78[a]	27.47[a]	2.81[a]	0.65[a]	0.08[a]	0.36[a]	1.35[a]	0.25[a]
3	62.88[a]	28.15[a]	27.74[a]	3.03[a]	0.67[a]	0.10[a]	0.27[a]	1.36[a]	0.25[a]
4	64.57[a]	28.85[a]	27.10[a]	3.04[a]	0.67[a]	0.09[a]	0.25[a]	1.45[a]	0.28[a]
5	62.70[a]	28.09[a]	28.24[a]	3.20[a]	0.68[a]	0.09[a]	0.21[a]	1.64[a]	0.24[a]
6	62.88[a]	28.15[a]	28.25[a]	3.03[a]	0.67[a]	0.10[a]	0.27[a]	1.36[a]	0.25[a]
7	63.56[a]	29.07[a]	27.80[a]	2.96[a]	0.66[a]	0.11[a]	0.27[a]	1.37[a]	0.26[a]
± SEM[2]	1.51	0.82	0.91	0.08	0.02	0.05	0.14	0.09	0.02
P value									
	NS	NS	NS	NS	NS	NS	NS	NS	NS

1: 1- Control treatment: Basal diet based on corn-soybean meal without supplementation with medicinal plants, 2: base ration + 0.25% of rosemary ether extract, 3: base ration + 0.5% of rosemary ether extract , 4: base diet + 0.75% Rosemary ether extract, 5: base diet + 0.25% Thyme ether extract, 6: base diet + 0.5% Thyme ether extract and 7: base diet + 0.75% Thyme ether extract.

2: Mean error standard

Column means with common superscripts do not differ (P > 0.05).

treatment 7 caused the highest and lowest FCR, respectively, and their differences with other experimental treatments were significant (P <0.05). The results of carcass characteristics are shown in tables 6 and 7. The results showed that experimental treatments did not have a significant effect on the relative carcass yield of carcass components (P >0.05).

Discussion

The results of this experiment showed that rosemary ether extract at the level of 0.75% can show similar performance to thyme ether extract at this level. On the other hand, chickens fed with thyme ether extract at the levels of 0.5 and 0.75% showed the same result in the BW. In fact, the use of this extracts at the level of 0.5%, although numerically showed a lower BW, but its difference with the level of 0.75% was not significant (P>0.05). Also, rosemary ether extract at the levels of 0.25 and 0.5% showed the same result in BW and the difference with the level of 0.25% thyme ether extract was the same and was not statistically significant (P<0.05). The results of the present study was consistent with the results of researchers such as Al-Mashhadani et al. [15], Saki et al. [16], Faizi et al. [8], Hoffman and Wu [17], Yasilbeg et al. [18] and Ghazal and Ali [19]. Ertas et al. reported Chickens fed diets containing 200 parts per million of a mixture of etheric oil and antibiotic diets had a higher live weight than the control diet and it was suggested that essential oils have a positive effect on nutrient digestibility [20]. However performance improvement by the plants used in the forthcoming experiment can be due to the antimicrobial compounds and antibiotic properties of the substances in the mentioned plants

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Table 7: Effect of experimental diets on carcass and some organs relative to the body weight of Ross 308 broilers at 42 days of age.

	Carcass yeild	Thighs	Breast	Liver	Heart	Spleen	Pancreas	Abdominal fat	Fabricius
Experimental diets									
11	64.93[a]	32.78[a]	31.28[a]	4.92[a]	1.13[a]	0.15[a]	0.54[a]	1.01[a]	0.25[a]
2	64.80[a]	30.54[a]	32.20[a]	4.38[a]	1.08[a]	0.12[a]	0.55[a]	1.38[a]	0.29[a]
3	63.82[a]	29.57[a]	33.20[a]	4.73[a]	1.00[a]	0.17[a]	0.61[a]	1.75[a]	0.26[a]
4	61.78[a]	32.48[a]	31.62[a]	4.48[a]	1.03[a]	0.14[a]	0.51[a]	1.46[a]	0.22[a]
5	66.20[a]	29.62[a]	34.60[a]	5.04[a]	1.08[a]	0.17[a]	0.52[a]	1.08[a]	0.25[a]
6	67.18[a]	29.69[a]	31.28[a]	4.92[a]	1.13[a]	0.15[a]	0.54[a]	1.01[a]	0.25[a]
7	66.59[a]	32.70[a]	33.85[a]	4.53[a]	1.07[a]	0.15[a]	0.52[a]	1.39[a]	0.23[a]
± SEM[2]	3.54	2.58	1.28	0.29	0.07	0.04	0.08	0.25	0.03
P value									
	NS	NS	NS	NS	NS	NS	NS	NS	NS

1: 1- Control treatment: Basal diet based on corn-soybean meal without supplementation with medicinal plants, 2: base ration + 0.25% of rosemary ether extract, 3: base ration + 0.5% of rosemary ether extract , 4: base diet + 0.75% Rosemary ether extract, 5: base diet + 0.25% Thyme ether extract, 6: base diet + 0.5% Thyme ether extract and 7: base diet + 0.75% Thyme ether extract.
2: Mean error standard
Column means with common superscripts do not differ (P > 0.05).

on the harmful bacteria of the gastrointestinal tract, which ultimately improves the use of nutrients and digestibility in chickens. However, the results of experiments of Ocak et al. showed that adding dried thyme leaves up to 0.20% had no significant effect on poultry performance [21]. Also, the addition of thyme in Sadeghi et al. and Cross et al. experiments had no significant effect on poultry performance [22,23]. On the other hand, Stein et al. reported no significant effect of rosemary extract up to 0.25%. The difference between the results of these researchers and the results of the present experiment may be in the form of the use of thyme and rosemary or the level of its supplementation.

The results of this experiment on rosemary ether extract indicated that the use of this extract at a level of 0.75% in the diet of Ross broilers improves DWG and can be a result similar to the use of thyme ether extract at the level of 0.50 and 0.75 percent. On the other hand, supplementing the diet of broilers with rosemary ether extract at the level of 0.25 and 50.50% causes the same result. The results of thyme ether extract showed that the best level of its use in this experiment was 0.75%, which, although with a level of 0.50% showed a numerical difference in daily weight gain, but this difference was not statistically significant (P> 0.05). The results of the research in agreement with the results of Al-Mashhadani, Faizi, and Hoffman and Wu. Thyme improves the final weight gain up to 50%. Faizi et al. reported DWG improved in diets containing thyme extract. They attributed the improvement to the effect of thyme extract on the intestinal digestive system, increased secretion of enzymes such as amylase and chymotrypsin, and increased intestinal absorption. They also stated that thymol and carvacrol have antibacterial properties and cause pathogens to leave the intestine. Regarding supplementing the diet of broilers with rosemary, our results were in agreement with the results of Bulbul et al. [24] and Norouzi et al. [25]. Rosemary is a plant with strong antioxidant properties, which can reduce potential stresses in the breeding period of broilers and improve their weight gain [26,27].

Only in the first weeks of the diet supplementation of broilers by ether extract of rosemary or thyme changed the amount of feed consumption and during the last three weeks this change was not seen, which could indicate the habituation of broilers To test diets. Also, thyme ether extract significantly reduced feed intake during the first weeks of the experiment compared to rosemary ether extract. Between days 1-21, feed intake decreased linearly with increasing supplementation level. It is possible that the increase in the level of supplementation has led to an unpleasant taste for the chickens. The results of this experiment on reducing food consumption in the first weeks of the experiment were consistent with the results of Ghazaleh, Ali, Saki, and Faizi et al. The researchers also reported that changing the taste of feed by adding rosemary or thyme extract reduced feed intake in the first weeks and broilers' habituation to this change did not significantly affect the effect of these extracts in the final weeks on feed intake.

The results of L-Mashhadani, Hernandez, and Feizi et al. also improved FCR in broilers fed diets with thyme extract to the surface 0.5%. Al-Mashhadani et al. reported that supplementation of essential oils of thyme in the diet of broilers improved FCR compared to control treatment. The reasons for this improvement can be the destruction of pathogens in the digestive system, increased secretion of digestive enzymes and increased liver function. Saki et al. also stated that the main components of thyme extract are thymol and carvacrol, which stimulate the secretion of small intestinal mucus, pancreas and liver compounds, and ultimately improve digestion and feed conversion ratio.

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However, Cross et al. reported that the addition of thyme at 1% level did not have a significant effect on poultry feed conversion ratio, which may be due to the difference in the level used.

Also Ocak, and Sadeghi et al. reported no significant effect of thyme on feed conversion ratio. The results of Al-Kasi, Yasilbeg, and Ghazal and Ali also showed that the use of rosemary extract in the diet of broilers can significantly improve the FCR. Rosemary extract contains a wide range of different phenolic compounds such as carnosic acid, carnosol, resmanol and epispermanol. Carnosic acid is the most active antioxidant in rosemary, which has about three times more antioxidant activity than carnosel and seven times more than butyl hydroxytoluene and hydroxyenosyl. These antioxidants stabilize the breeding conditions to make better use of feed and improve conversion ratio.

Conclusion

The results showed that statistically, treatments 4, 6 and 7 (containing 0.75% of rosemary ether extract, 0.50% of thyme ether extract and 0.75% of thyme ether extract) caused BW and more DBW (respectively) ($P < 0.05$). At the end of the experiment, there was no significant difference between the treatments in the amount of feed intake ($P> 0.05$) .The best feed conversion ratio was related to the treatment containing 0.75% of thyme ether extract ($P <0.05$) while other treatments containing different amounts of extract. They had a lower feed conversion ratio compared to the control treatment ($P <0.05$). Supplementation of diets with a level of 0.75% of rosemary ether extract or levels of 0.5 and 0.75% of thyme extract leads to an improvement in the conversion ratio of broiler herds. Therefore, it is recommended to use the extracts of these plants in poultry diets to improve the growth performance of broiler flocks. However, considering the positive effect of plant extracts on the digestibility of nutrients and the immune system of chickens, for better comparison of these two plant extracts, these parameters should also be considered.

Ethics Committee Approval

All animal experiments were approved by the state committee on animal ethics, Karaj Branch, Islamic Azad University, Karaj, Iran (IACUC no:4687; 4/10/2018). The recommendations of the European Council Directive (2010/63/EU) of September 22, 2010, regarding the standards in the protection of animals used for experimental purposes were also followed.

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Author Contributions

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Conflict of interest

The authors have no conflicts of interest to declare.

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