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Performance of broilers fed dry peppermint (*Mentha piperita* L.) or thyme (*Thymus vulgaris* L.) leaf supplemented diet

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Abstract: A study was conducted to determine the performance, carcass and gastrointestinal tract characteristics of broilers fed dry peppermint (*Mentha piperita* L.) or thyme (*Thymus vulgaris* L.) leaf as menthol and thymol sources supplemented diet. In the study, 312, one-wk-old broilers (Ross-308) were used. There were 3 dietary treatments, each consisting of 4 replicates (13 male and 13 female in each replicate). Control group was fed basal diet, while peppermint and thyme groups were fed a diet containing 0.2% peppermint or thyme (w/w), respectively. From 7 d to 35 d of age, the body weight gain was higher ($P < 0.05$) in broilers fed peppermint-supplemented diet compared to control, but the effect of peppermint on BW gain had disappeared at 42 d of age. Feed intake, feed conversion ratio and the characteristics of carcass and gastrointestinal tract were not significantly different among the 3 treatments. The peppermint or thyme increased ($P < 0.05$) abdominal fat pad at 42 d of age. The present study shows that the feeding of either peppermint or thyme did not affect growth performance, feed efficiency, and carcass and gastrointestinal tract characteristics of broilers, but an increase in abdominal fat should be taken into account for carcass quality and processing.
Key Words: Broiler, growth, digestive tract, essential oil, peppermint, thyme

Introduction

Recently most of antibacterial performance promoters have been banned, because feeding of antibiotics is risky (1) due to not only cross-resistance but also to multiple resistances. The ban on the use of antibiotics as growth promoters in the European Union and the potential for a ban in the United States has prompted the search for alternative feed supplements in animal production. Prebiotics, probiotics and organic acids are three of several approaches that have potential to reduce enteric disease and improve performance in poultry and subsequent contamination of poultry products (2-4). On the other hand, products containing plant extracts, essential oils or main components of the essential oil are among the alternative growth promoters that are already being used in practice (5, 6).

The antimicrobial effect of essential oils *in vitro* is well established (7-11). However, all these tests were performed *in vitro* with only a limited number of tests performed in animals (12, 13). There is a very limited number of controlled studies on the effects of essential oil components on growth performance and gastrointestinal tract characteristics in broiler chickens (6, 14). The observed effects of essential oils on growth performance in chickens are either positive (15, 16) or non-significant (6, 17-19). To our knowledge, the effect of dry peppermint (*Mentha piperita* L.) or thyme (*Thymus vulgaris* L.) leaf supplementation into compound feed as menthol and thymol source, respectively on growth, and carcass and gastrointestinal tract characteristics of broiler has not been reported.

The present study was conducted to describe the effects of dietary dry peppermint and thyme leaf supplementation on growth performance, carcass and gastrointestinal tract characteristics in broilers.

Materials and Methods

A total of 312, 1-wk-old broilers (Ross-308) were purchased from a local hatchery. On arrival, they were wing-banded, weighed and randomly housed in floor pens with wood shavings. Continuous lighting was provided throughout the experiment. Ambient temperature was gradually decreased from 30°C on d 7 to 25°C on d 21 and was then kept constant. There were 3 dietary treatments, each consisting of 4 replicates. A replicate was a pen with 13 female and 13 male birds so that each treatment had 104 animals. The ingredients and composition of the basal diet (starter; from 7 to 21 d of age, grower; from 21 to 35 d of age and finisher; from 36 to 42 d of age) are presented in Table 1.

Table 1. Ingredients and composition of the basal diet

Ingredients	Starter	Grower	Finisher
Maize, yellow	355.5	330.4	256.8
Soybean meal, 480 g CP/kg	275.3	204.5	171.5
Sunflower meal, 350 g CP/kg	110.0	150.0	111.5
Wheat	99.0	130.0	330.0
Wheat bran	-	38.0	-
Meat-bone meal	64.4	56.0	49.2
Vegetable oil	73.7	85.0	73.6
Limestone	13.6	-	-
Premix[1]	3.5	3.5	3.1
Sodium chloride	3.0	2.5	2.5
L-Lysine	0.4	-	0.1
DL-Methionine	1.6	0.1	1.7
Total	1000.0	1000.0	1000.0
Calculated chemical composition (per kg of diet)			
ME, kcal	3,150.0	3,200.0	3,200.0
Crude protein, g	231.2	212.0	189.8
Calcium, g	15.0	9.0	8.0
Available phosphor, g	5.0	4.7	3.9
Lysine, g	12.0	10.0	8.5
Methionine, g	5.6	4.0	5.2
Methionine + cystine, g	9.3	7.6	8.4
Sodium chloride, g	3.4	2.9	2.9

[1]Provides per kg of diet: Mn, 80 mg; Zn, 60 mg; Fe, 60 mg; Cu, 5 mg; Co, 0.2 mg; I, 1 mg; Se, 0.15 mg; choline chloride, 200 mg.; vitamin A, 12 000 IU; vitamin D3, 2 400 IU; vitamin E, 50 mg; vitamin K3, 4 mg; vitamin B1, 3 mg; vitamin B2, 6 mg; niacin, 25 mg; calcium-D-pantothenate, 10 mg; vitamin B6, 5 mg; vitamin B12, 0.03 mg; D-biotin, 0.05 mg; folic acid, 1 mg.

In this study, peppermint containing 40% of menthol or thyme containing 40% of thymol, respectively in the essential oil were used. The peppermint and thyme leafs were supplemented to diets when preparing the two experimental diets and so that the basal diet contained 2 g supplements or 70 ppm of menthol or thymol/kg (8-10). All diets were fed in mash form. Feed and water were provided for *ad libitum* consumption. Prior to feeding, feed leftovers were removed and weighed. Feed intake per pen were calculated for periods of one week and used to calculate feed:gain ratio. Individual body weight (BW) was recorded each week. Mortality was recorded as it occurred.

Four birds (2 female and 2 male) from each replicate were slaughtered at day 42 to determine carcass weight, dressing percentage, abdominal fat pad, empty gizzard weight, full gut weight, length of gut and weight of edible inner organs (heart + liver + gizzard).

Weight of digestive tract was weighed with its content (full gut), while gizzard was weighed after removing its content digesta. Dressing percentage, weights of organs as a proportion of BW (g/100 g BW) were calculated.

All data for each variable were subjected to one-way analysis of variance. All percentage data were converted to arcsines prior to analysis and untransformed means are presented. When significant treatment effects were observed, differences among treatment means were tested by the multiple range test of Duncan (20). The level of statistical significance was pre-set at $P < 0.05$.

Results

There was no difference among groups in terms of mortality during the experiment. However, three birds from the control group dead between 7 to 28 d of age, and two birds from the group given peppermint and one bird from the group given thyme developed leg abnormalities. These three animals were excluded from the experiment.

From 7 to 21 d or 7 to 35 d of age, BW gain of broilers in the peppermint group was higher ($P < 0.05$) than those of in the control group, but the effect of peppermint on BW gain had disappeared at 42 d of age. Feed intake and feed conversion ratio were not significantly different among the 3 treatments (Table 2). Table 3 shows that, at 42 d of age, the carcass weight, dressing percentage, weight and length of full gut and edible inner organs were not different among the 3 treatments, while the abdominal fat pad of broiler in the peppermint or thyme group was higher ($P < 0.05$) compared to control group.

Table 2. Body weight gain, feed intake and feed:gain ratio in broilers given the experimental diets

Measure	Age, d	Control	Peppermint	Thyme	SEM
Initial body weight, g	7	145.8	146.3	147.7	0.94
Body weight gain, g					
	7-21	503.2 a	540.3 b	519.2 ab	4.54
	7-35	1299.2 a	1366.1 b	1329.0 ab	11.06
	7-42	1875.3	1895.3	1898.7	16.07
Feed intake, g					
	7-21	760.7	868.6	822.9	28.97
	7-35	2305.7	2476.2	2354.5	38.68
	7-42	3485.4	3539.8	3387.9	40.23
Feed:gain, g:g					
	7-21	1.51	1.62	1.58	0.133
	7-35	1.77	1.82	1.76	0.076
	7-42	1.86	1.87	1.78	0.057

a,b: Values in the same row not sharing a common superscript differ significantly ($P<0.05$).
SEM: standard error of the mean.

Discussion

The results of present study indicated that the supplements as source of menthol and thymol did not influence weight gain, feed intake or feed conversion, carcass weight, dressing percentage and characteristics of digestive tract, but they increased abdominal fat pad compared to control, The results reported here agree with the observation of Lee et al. (6), Bostoglou et al. (17, 18) and Basmacıoğlu et al. (19) who showed that the essential oil did not affect BW gain, feed intake or feed conversion, although it was expected that supplementing the antimicrobial principles would stimulate growth performance in the broilers. In contrast, Alçiçek et al. (15, 16) reported that a combination of essential oils

improved chicken performance. This discrepancy may be attributed to differences in the inclusion level of products containing plant extracts and essential oils or in the main components of the essential oil used in the present and previous studies.

Table 3. Carcass weight, dressing percentage and organ weights in broilers given the experimental diets

Measure	Control	Peppermint	Thyme	SEM
Carcass weight, g	1400.4	1461.3	1449.5	18.75
Dressing percentage, g/100 g BW	69.30	71.58	71.83	0.970
Full gut length, cm/100 g BW	12.30	11.72	11.86	0.101
Full gut weight, g/100 g BW	10.25	9.77	9.90	0.142
Pancreas weight, g/100 g BW	0.33	0.30	0.30	0.007
Edible inner organs, g/100 g BW	4.88	4.81	4.76	0.050
Abdominal fat pad, g/100 g BW	1.47 a	1.70 b	1.62 b	0.067

a,b: Values in the same row not sharing a common superscript differ significantly ($P< 0.05$).
SEM: standard error of the mean.

The active principles of essential oils act as a digestibility enhancer, balancing the gut microbial ecosystem and stimulating the secretion of endogenous digestive enzymes and thus improving growth performance in poultry (5). There is much research reported on the antimicrobial effects of many plant extracts (7, 9, 11), although the antimicrobial effects of peppermint and thyme were not determined in present study. Therefore, the lack of expected beneficial effect of the supplements may firstly be related to the level of menthol or thymol content of supplements. The dietary inclusion level of peppermint or thyme was considered to be supply in sufficient level of menthol and thymol on the basis of *in vitro* experiments in which peppermint and thyme had an antimicrobial activity (8, 9-11), although the essential oil content of peppermint or thyme can vary depending on raised area which may affect the amount of the active principles. Thus, results with respect to growth performance show that either the level of the active principles in the present study has no beneficial effect on antimicrobial activity or was not such a level that would cause a beneficial affect on antimicrobial activity. Second reason for the lack of effect of supplements may be related to the environmental conditions. It is known that well-nourished, healthy chicks do not respond to antibiotic supplements provided that they are housed under clean and disinfected conditions. The result with respect to mortality show that broilers in the present study were kept in a clean environment, possibly leading to diminished efficacy, if any, of the dietary additives (6). Indeed, Giannenas et al. (21) reported that the positive effect of plant extracts has been obtained only under unhygienic conditions.

A third reason may be the composition of the basal diet. Antimicrobial agents may have more impact when the diet used is less digestible, and the diet contained highly digestible ingredients so that bacterial growth in the intestine probably may be limited (6). However, the digestibility of the basal diet, especially of finisher diet used in current study was not probably as high as that in the study of Lee et al. (6) due to wheat and sunflower meal contents. In fact, it has been show that dietary antibiotics appear to stimulate the activities of amylase and chymotrypsin in pancreatic tissue from broilers fed on wheat-soybean meal based diet (22) or barley-soybean meal based diet (23). Francesch et al. (14) noted improved feed efficiency in broilers on a wheat and barley-based diet with addition of thymol containing supplement. The full gut length and pancreas weight were lower in the groups given peppermint or thyme, although the reduction did not reach statistical significance (Table 3). A difference in full gut length and pancreas weight would support

the idea that the active principles of essential oils act as a digestibility enhancer, stimulating the secretion of endogenous digestive enzymes (5).

From 7 to 35 d of age, the higher BW gain in broiler given peppermint may also explain a beneficial effect of menthol on the digestibility of diet. However, at 42 d of age, abdominal fat pad of the birds on menthol or thymol group was higher than those of control group. The higher abdominal fat pad in peppermint, which excessive abdominal fat deposition is a problem, may be due to fast growth rate from 7 d to 35 d of age, because the fast growth rate is accompanied with increased body fat deposition (24). Therefore, it may be said that feeding peppermint or thyme-supplemented diet has disadvantage in slaughter performance although no significant differences in carcass weight and dressing percentage were observed among the 3 treatment groups.

In conclusion, the present study shows that the feeding of either peppermint or thyme did not affect growth performance. It cannot be excluded that beneficial effects of the supplements would be seen under less hygienic housing conditions and/or when using diet containing the 70 ppm of menthol or thymol. However, the observed peppermint or thyme-induced increase in abdominal fat pad should be taken into account for carcass quality and processing and deserves further study. Moreover different active principles of aromatic plants may have different efficiencies in this respect. However, further studies on effects of higher levels of peppermint or thyme on toxins, colonisation and proliferation of microorganisms in the broiler intestine, and weight gain and feed efficiency are necessary.

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