Performance of broilers fed diets supplemented with dry peppermint (*Mentha piperita* L.) or thyme (*Thymus vulgaris* L.) leaves as growth promoter source

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ABSTRACT: A study was conducted to determine the performance, carcase and gastrointestinal tract (gut) characteristics of broilers fed diets supplemented with dry peppermint (*Mentha piperita* L.) or thyme (*Thymus vulgaris* L.) leaves, which are among the alternative growth promoters. In the study, 312 one-week-old broilers (Ross-308) were used. There were 3 dietary treatments, each consisting of 4 replications (13 males and 13 females in each replication). The control group was fed basal diet, while the peppermint and thyme groups were fed diets supplemented with 0.2% peppermint or thyme (w/w) as menthol and thymol (70 mg per kg diet) sources, respectively. From 7 days to 35 days of age, the body weight gain was higher ($P < 0.05$) in broilers fed the peppermint-supplemented diet compared to the control, but the effect of peppermint on body weight gain disappeared at 42 days of age. Feed intake, feed to gain ratio, carcase weight, carcase yield, and the relative weights of the edible inner organs and whole gut, and the relative length of the whole gut were not significantly affected by peppermint and thyme contents. The peppermint or thyme leaves increased ($P < 0.05$) the abdominal fat pad at 42 days of age. Thus, the dry peppermint leaves had a higher growth promoting efficacy than the dry thyme leaves at an early stage of broilers' life, but an increase in abdominal fat should be taken into account for carcase quality and processing.

Keywords: broiler; growth promoter; herb leaf; growth performance; digestive tract

Recently most of the antibacterial performance promoters have been banned because the feeding of antibiotics is risky (Neu, 1992) 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 (Regulation 1831/2003/EC) and the potential for a ban in the United States have prompted the search for alternative feed supplements in animal production. Prebiotics, probiotics and organic acids are three of several approaches that have the potential to reduce enteric diseases and improve performance in poultry and to decrease subsequent contamination of poultry products (Patterson and Burkholder, 2003; Ricke, 2003). On the other hand, herbs or 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 (Williams and Losa, 2001; Lee et al., 2003; Acamovic and Broker, 2005; Bampidis et al., 2005; Griggs and Jacob, 2005).

Various dietary herbs, plant extracts, especially essential oils, have been studied for their antimicrobial and growth promoter abilities (Cross et al., 2002, 2007; Demir et al., 2003; Acamovic and Broker, 2005; Bampidis et al., 2005; Griggs and Jacob, 2005). Nevertheless, it has been indicated that the outcome of a test can be affected by factors such as the method used to extract the essential oil from herb (Hernandez et al., 2004), and

the chemical composition of the extract appears to be important in obtaining the optimal effects (Cross et al., 2002, 2007). Furthermore, Cross et al. (2007) reported that dietary thyme had a different effect when used as a herb or oil on weight gain and body mass. However, there is only limited evidence about whether the inclusion as a solid herb material would have the growth promoting effects in live birds. Therefore, in conducting the current experiment, an approach was taken so that the results could have practical application. If the results of this study were successful, the use of whole herbs as leaves could have the potential for diminishing the adverse effect of factors which could affect the degree of growth promotion of plant extracts, essential oil and/or the main components of the essential oil in broilers. They would also have the advantage of helping reduce feed costs involved in broiler production, since they are more expensive and less easily available than the herbs (Bampidis et al., 2005).

To our knowledge, the effect of supplementation of dry peppermint (*Mentha piperita* L.) or thyme (*Thymus vulgaris* L.) leaves, which are among the alternative growth promoters, into compound feed on growth, and carcase and gastrointestinal tract characteristics of broilers has not been reported. The present study was conducted to describe the effects of dietary dry peppermint or thyme leaves as growth promoter supplementation on growth performance, carcase and gastrointestinal tract characteristics in broilers.

MATERIAL AND METHODS

A total of 312 one-week-old broilers (Ross-308) were purchased from a local hatchery. On ar-

Table 1. Ingredients and composition of the basal diet (as fed bases)

Ingredients (g per kg of diet)	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	–	–
Mineral-vitamin 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
Calculated chemical composition (per kg of diet)[2]			
ME (MJ)	13.2	13.4	13.4
Crude protein (g)	231.2	212.0	189.8
Calcium (g)	15.0	9.0	8.0
Available phosphorus (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
[2]calculated from NRC values (1994)

rival, they were wing-banded, weighed and randomly housed in floor pens with wood shavings. Continuous lighting was provided throughout the experiment. The ambient temperature was gradually decreased from 30°C on day 7 to 25°C on day 21 and was then kept constant. There were 3 dietary treatments, each consisting of 4 replications. The replication 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 days of age, grower from 21 to 35 days of age and finisher from 36 to 42 days of age) are presented in Table 1. All birds used in the experiment were cared for according to applicable recommendations of the National Research Council (NRC, 1994).

The peppermint (*Mentha piperita* L.) or thyme (*Thymus vulgaris* L.) leaves were purchased commercially as dried herb supplements. In this study, the leaves were assumed to contain up to about 87.5 g essential oil per kg, and the oils were assumed to contain up to about 400 g menthol or thymol per kg (Karkim, Karadeniz Kimya, Samsun, Turkey). The peppermint and thyme leaves were supplemented to diets during the preparation of the two experimental diets and so that the basal diet contained 2 g supplements or 70 mg of menthol or thymol per kg of diet (Helander et al., 1998; Cosentino et al., 1999). All diets were fed in mash form. Feed and water were provided for *ad libitum* consumption. Feed intake per pen was calculated for one-week periods and used to calculate the feed to gain ratio. Individual body weight was recorded each week. Mortality was recorded as it occurred.

Four birds (2 females and 2 males) from each replication with body weight within 1 standard deviation of the mean treatment weight (16 birds per treatment) were slaughtered at day 42 to determine carcase weight, dressing percentage, and weights of whole gut, empty gizzard, pancreas, edible inner organs and abdominal fat pad, and the length of the whole gut. The gut, from the oesophagus to the cloaca, and the organs were carefully excised. Any digesta remaining in the whole gut were emptied by gentle pressure. Weights of gizzard, weights of heart and liver were recorded as the weight of edible inner organs. Weights of gut and edible inner organs (g/100 g body weight), length of gut (cm/100 g body weight) were expressed as a portion of body weight.

The complete randomized model was used to analyze data for weight gain, feed intake, feed efficiency and characteristics of carcase and gut. All data were analyzed according to the ANOVA model, using the GLM procedure of the Statistical Package for the Social Sciences (SPSS, 1999). When significant treatment effects were observed, differences between treatment means were tested by Duncan's multiple range test (SPSS, 1999). The level of statistical significance was pre-set at $P < 0.05$. All percentage data were converted to arcsines prior to analysis and untransformed means are presented. For performance data, pen means served as the

Table 2. Body weight gain, feed intake and feed to gain ratio in broilers given diets without or with peppermint or thyme

Measure	Age (day)	Control	Peppermint	Thyme	SEM
Initial body weight (g)	7	145.8	146.3	147.7	0.94
Body weight gain (g)	7 to 21	503.2[a]	540.3[b]	519.2[a,b]	4.54
	7 to 35	1 299.2[a]	1 366.1[b]	1 329.0[a,b]	11.06
	7 to 42	1 875.3	1 895.3	1 898.7	16.07
Feed intake (g)	7 to 21	760.7	868.6	822.9	28.97
	7 to 35	2 305.7	2 476.2	2 354.5	38.68
	7 to 42	3 485.4	3 539.8	3 387.9	40.23
Feed:gain (g:g)	7 to 21	1.51	1.62	1.58	0.133
	7 to 35	1.77	1.82	1.76	0.076
	7 to 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 means

experimental unit for statistical analysis. For data on relative weights and length of the gut, individual birds were considered as the experimental unit.

RESULTS AND DISCUSSION

Mortality was lower in birds fed the peppermint and thyme diets than in birds fed control diets for the entire growing periods (0.00 and 0.00 vs. 2.88%, respectively). Three birds from the control died between 7 and 28 days of age, while two birds from the peppermint and one bird from the thyme group developed leg abnormalities between 14 and 21 days of age. There was no clear effect of dry peppermint or thyme leaves on mortality and number of birds removed with leg problems. Body weight gains, feed intake and feed to gain ratio in broilers fed the control diet and diets supplemented with dry peppermint or thyme leaves as growth promoter sources are presented in Table 2. In general, no differences in body weight gain, feed intake or feed to gain ratio were observed in broilers fed the different experimental diets. Although it was expected that supplementing the dietary herbs (Cross et al., 2002, 2007; Bampidis et al., 2005) or plant extracts (Demir et al., 2003; Lee et al., 2003) would stimulate the growth performance of broilers, research on herbs, plant extracts, essential oil and/or the main components of the essential oil yielded contradicting results (Alcicek et al., 2003, 2004; Acamovic and Broker, 2005; Bampidis et al., 2005; Griggs and Jacob, 2005). However, the results of the present study are in agreement with previous observations that indicated herbs, plant extracts, essential oil and/or the main components of the essential oil that did not affect body weight gain, feed intake or feed efficiency in broilers (Cross et al., 2002, 2007; Demir et al., 2003; Botsoglou et al., 2004; Hernandez et al., 2004; Bampidis et al., 2005).

From 7 to 21 or 35 days of age, broilers fed the peppermint diet grew faster ($P < 0.05$) than broilers fed the control diets, but not broilers fed the thyme diet (48.8 vs. 46.4 and 47.5 g/day, respectively). In the last week of the trial, no differences in body weight gain were observed, and subsequently, the effect of peppermint on body weight gain disappeared at 42 days of age (Table 2). These results indicate that the peppermint had higher growth promoting efficacy than the thyme at an early stage of the bird's life. Indeed, a small growth promoter effect of the thyme was observed compared to the control. This result agrees with those reported by Cross et al. (2007), who noted that the broilers given a diet with thyme herb (7 to 28 days) had a similar body weight gain to those given the control diet. Nevertheless, it has been suggested that thyme appears to be the most potential tool in combating bacterial diseases in poultry (Acamovic and Broker, 2005; Griggs and Jacob, 2005). The higher body weight gain observed in broilers fed the peppermint diet may be related to the reported properties of menthol (Lovkova et al., 2001). 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 (Lovkova et al., 2001; Williams and Losa, 2001; Cross et al., 2007). Therefore, the main compound of peppermint may probably improve the digestibility of diet as a digestion stimulant, and hence increase the nutrient entry rate at an early stage of bird's life without affecting feed conversion.

The differences in body weight gain between the control and peppermint group at an early stage of the bird's life were not reflected in the body weights at slaughter age. Such a case can firstly be explained by the fact that the older birds were better able to perform with finisher basal diet due to the fact that nutrient requirements decrease with age (NRC, 1994), and also they may be better able to digest the finisher diet due to the development of the digestive tract and organs (Lilja, 1983). In fact, the effect of supplements was not significant on the relative weights of the whole gut, pancreas and edible inner organs, including gizzard at slaughter age (Table 3). However, the smaller length of the whole gut and lower weight of pancreas in the groups given peppermint or thyme compared to the control, although the reduction did not reach statistical significance, may support the idea that the active principles of herbs act as a digestibility enhancer, stimulating the secretion of endogenous digestive enzymes (Williams and Losa, 2001; Bampidis et al., 2005). The second reason for the lack of effects of supplements may be related to the environmental conditions. The fact that none of the supplements caused a growth promoter effect at slaughter age indicates that the present trial was conducted in ideal conditions, which could affect the degree of growth promotion (Hernandez et al., 2004). It is known that well-nourished, healthy chicks do not respond to antibiotic supplements provided that they are housed under clean and disinfected condi-

Table 3. Carcase weight (g), dressing percentage and organ weights (g or cm/100 g body) in broilers given diets without or with peppermint or thyme

	Control	Peppermint	Thyme	SEM
Carcase weight	1 400.40	1 461.30	1 469.90	18.750
Dressing percentage	69.30	71.58	71.83	0.970
Gut length	12.30	11.72	11.86	0.101
Gut weight	10.25	9.77	9.90	0.142
Pancreas weight	0.33	0.30	0.30	0.007
Edible inner organs	4.88	4.81	4.76	0.050
Abdominal fat pad	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 means

tions. The result with respect to mortality shows that broilers in the present study were kept in a clean environment, possibly leading to diminished efficacy, if any, of the dietary additives (Lee et al., 2003; Hernandez et al., 2004).

The third reason may be the antimicrobial effect of the herb and the composition of the basal diet (Lee et al., 2003; Bampidis et al., 2005). There are lots of researches related to the antimicrobial effects of many plants and plant extracts (Helander et al., 1998; Dorman and Deans, 2000; Mitsch et al., 2004; Cross et al., 2007), although the antimicrobial effects of peppermint and thyme were not determined in the present study. Therefore, there is enough evidence to suggest that plant extracts, essential oil and/or the main components of the essential oil may have a role in combating bacterial diseases in poultry (Griggs and Jacob, 2005). The dietary inclusion levels of peppermint and thyme were considered to supply menthol and thymol levels (70 mg per kg diet) on the basis of *in vitro* experiments which can exert antimicrobial effects (Helander et al., 1998; Cosentino et al., 1999; Dorman and Deans, 2000). Thus, the results with respect to growth performance show that either the level of the active principles supplied from dry leaves to birds in the present study has no beneficial effect on antimicrobial activity or it was not such a level that would cause a beneficial effect on antimicrobial activity. On the other hand, antimicrobial agents may have a greater impact when the diet used is less digestible, and the diet contained highly digestible ingredients so that the bacterial growth in the intestine may probably be limited (Lee et al., 2003). However, the digestibility of the basal diet, especially of finisher diet used in the current study, was not probably as high as that in the study of Lee et al. (2003) due to wheat and sunflower meal contents. In fact, it has been shown that dietary antibiotics appear to stimulate the activities of amylase and chymotrypsin in the pancreatic tissue from broilers fed wheat-soybean meal based diet (Enberg et al., 2000) or barley-soybean meal based diet (Hofshagen and Kaldhusdal, 1992). In a recent study, Cross et al. (2007) reported that the dietary inclusion (10 g per kg diet) of five culinary herbs including thyme had no effect on the intestinal microflora, metabolizable energy or the coefficients of digestibility.

Table 3 shows that the carcase weight and dressing percentage were not significantly affected by peppermint or thyme, while the abdominal fat pad of broilers in the peppermint or thyme group was higher ($P < 0.05$) compared to the control. From 7 to 35 days of age, although a beneficial effect of peppermint as menthol source on body weight gain in broilers, the higher abdominal fat in the peppermint birds may be a problem. The higher abdominal fat may be due to the fast growth rate from 7 days to 35 days of age because the fast growth rate is accompanied by increased body fat deposition (Zubair and Leeson, 1996). Therefore, it may be said that the peppermint or thyme supplemented diet has a disadvantage in slaughter performance although no significant differences in carcase weight and dressing percentage were observed between treatments.

CONCLUSIONS

Our data indicated that neither peppermint nor thyme affected the growth performance, but the peppermint leaves had a higher growth promoter

effect than the thyme at an early stage of the bird's life. It cannot be excluded that beneficial effects of the supplements would be seen under less hygienic housing conditions and/or when using diets with leaves to be supplied enough the menthol or thymol. Consequently, it can be suggested that dry peppermint leaves can be used particularly in diets of chick birds where digestion problems at growing lead to scouring and a growth check. However, the peppermint- or thyme-induced increase in the abdominal fat pad should be taken into account for carcase quality and processing and deserves further study. Moreover, different active principles of aromatic plants may have different efficiencies in this respect. Further studies on the effects of higher levels of peppermint or thyme on toxins, colonization and proliferation of microorganisms in the broiler intestine, and weight gain and feed efficiency are necessary.

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