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DIETETRY ROSEMAY AND α-TOCOPHERYL ACETATE ON MEAT QUALITY AND SENSORY CHARACHTERISTICS OF FINISHING TURKEYS

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ABSTRACT

The present study investigated the antioxidative activity of ground rosemary plant and α-tocopherol acetate on technological (pH, drip loss, cooking loss and WHC), organoleptic (L, a*, b*) and sensory turkey meat quality stored for long term. A total of 1200 Hybride male turkeys (16 weeks aged) were randomly allocated to 5 dietary treatments, which were set up with 1 control group and 4 experimental groups. The control group (VitE1) was given a basal diet including 50 mg/kg α-tocopherol acetate, while the experimental groups were supplied with 5 g/kg ground rosemary plant(ROS1), 10 g/kg plant (ROS2), 150mg/kg (VitE2) or 300 mg/kg α-tocopherol acetate (VitE3). Significant differences were seen between the control and experimental groups for meat pH values, meat colour and maximum shear force as well as for sensory analyses. Results showed that the incorporation of rosemary in turkey diets increased the pH ($P < 0.05$). Dietary rosemary 5 g/kg were more effective ($P < 0.0001$) in inhibiting lighteness compared to 10 g/kg and to the supplementation with α-tocopheryl acetate/kg. For shear force, α-tocopheryl acetate supplementation at 150 mg/kg was similar to rosemary at 5 g/kg but inferior to rosemary at 10 g/kg. Diet supplementation with a-tocopheryl acetate or rosemary had no effect on drip loss, cooking loss and water holding capacity. The rosemary diet made meat softer, tastier and had akeen smell. During long term of storage, the rosemary increased the abnormal flavour intensity score. Furthermore, the meat had the higher overall acceptability score during storage. In conclusion, dietary supplementation with rosemary during finishing period improved

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turkey meat quality. Moreover sensory attributes were positively affected by the rosemary supplementations.

Keywords: α-Tocopherol, Antioxidant, Turkey, Rosemary, meat quality

1. INTRODUCTION

Oxidation processes are responsible for changes in nutritive value by reduction in meat's polyunsaturated fatty acid and fat-soluble vitamin content and even for appearance of components which are potentially harmful to health, such as cholesterol oxides (Barroeta et al., 2012). To overcome these problems, the incorporation of antioxidants into the diet of poultry is recommended. Olivo et al. (2001) showed the possibility of using an additional vitamin E supplement to reduce the appearance of PSE meat in chickens. The beneficial effects of including high dosages of α-tocopherol acetate in feed on the oxidative stability and sensory quality of meat have been extensively researched. Besides, there are signs that vitamin E requirements increase under conditions of stress. In chickens subjected to excessive temperatures, positive physiological reponses have been shown, such as a smaller rise in body temperature, reduced mortality, and a large increase of the hormone triiodothyronine in plasma (kan et al., 1993; Qureshi et al., 2000).

The antioxidant property of many phytogenic compounds may be assumed to contribute to protection of feed lipids from oxidative damage, such as the antioxidants usually added to diets (e.g., α-tocopheryl acetate or butylated hydroxytoluene).Although this aspect has not been explicitly investigated for piglet and poultry feeds, there is a wide practice of successfully using essential oils, especially those from the Labiatae plant family,as natural antioxidants in human food (Cuppett and Hall, 1998), as well as in the feed of companion animals. The principal potential of feed additives from the Labiatae plant family containing herbal phenolic compounds to improve the oxidative stability of animal derived products has been demonstrated for poultry meat (Botsoglou et al., 2002, 2003 a, b; Papageorgiou et al., 2003; Young et al., 2003; Basmacioglu et al., 2004; Govaris et al., 2004; Giannenas et al., 2005; FlorouPanerietal., 2006), pork (Janz et al., 2007), rabbit meat (Botsoglou et al., 2004 b), and eggs (Botsoglou et al., 2005). Oxidative stability was also shown to be improved with other herbal products (Botsoglou et al., 2004a; Schiavone et al., 2007).

Rosemary is currently a widely used aromatic and medicinal plant which has been recognised to have high antioxidant activity (Huisman et al., 1994; Lopez-Bote et al., 1998; Basmacioglu et al., 2004; Carvalho et al., 2005). The substances associated with the antioxidant activity of rosemary are the phenolic diterpenes, such as carnasol, rosmanol, 7-methyl-epirosmanol, isorosmanol and carnosoic acid, and the phenolic acids, such as rosmarinic and caffeic acids (yesilbag et al.,

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2011). Nevertheless, it remains unclear whether these phytogenic antioxidants are able to replace the antioxidants usually added to the feeds (e.g., α-tocopherols) to a quantitatively relevant extent under conditions of common feeding practice. The objective of this study was to evaluate the effect of dietary rosemary and α-tocopherol acetate supplementation on post-mortem metabolism meat of market-aged turkeys and on the susceptibility of turkey breast meat to lipid oxidation during different storage periods by sensory evaluation.

2. MATERIAL AND METHODS

2.1 Animal diets

A total of 1200 HYBRIDE turkeys male were used in this study. The turkeys were randomly allocated into a control group and 4 experimental groups (240 in each). Each of the 5 dietary treatments contained 3 replicates of 80 chicks each. A basal diet including a basic level of vitamin E (as α-tocopherol acetate 50 mg/kg) was given to birds in the group VitE1 (the control group). The nutrient compositions of the basal diet are presented in Table 1.

Table 1. Nutriment and chemical composition of commercial fattening diet (85 to 112d)

Metabolic energy(kcal/kg)	3200	**Phosphorus available (%)**	0.50	**Selenium mg/kg**	0.32	**Vit B2 mg/kg**	6.40
Fats (%)	8.79	**Sodium (%)**	0.16	**Cobalt mg/kg**	0.2	**Vit B5 mg/kg**	12.8
CP (%)	18.3	**Chlore (%)**	0.21	**Iode mg/kg**	2	**Vit B6 mg/kg**	4.8
Dig.lysine (%)	0.96	**Choline mg/kg**	595	**Vit A UI/kg**	10799	**Vit B12 mg/kg**	0.02
Dig.methionine (%)	0.42	**Zinc mg/kg**	80	**Vit D3 UI/kg**	3200	**Vit PP mg/kg**	48
Dig M+C (%)	0.68	**Cuivre mg/kg**	20	**Vit E mg/kg**	50	**Vit B9 mg/kg**	0.96
Dig.threonine (%)	0.57	**Fer mg/kg**	64	**Vit K3 mg/kg**	1.6	**Vit H mg/kg**	0.24
Calcium (%)	1	**Manganese mg/kg**	88	**Vit B1 mg/kg**	2		

* The different levels of vitamin E and rosemary are added to the basic diet.

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The remaining 5 groups were given the same basal diet, further supplemented with either dried rosemary leaves or alpha-tocopherol acetate. Rosemary plant was added to the diets at 5g/kg (Group Ros1) or 10g/kg (Ros2). The diets of groups VitE2 and VitE3 were supplemented with 150 and 300 mg/kg of alpha-tocopherol acetate. The rosemary plant used in this study consisted of the leaves of Rosmarinus officinalis collected from the mountain of Zaghouan in north east of Tunisia between late May and the end of June. It was dried and ground to pass through a 2mm screen. During the feeding period of 112d, feed and water were provided ad libitum. The animals are fed by a commercial starter concentrate until 28 day of age and a grower commercial diet until 84 day of age. During the finishing period (5 weeks), the turkeys were received the experimental treatments, at 85 day of age. A total of birds were slaughtered with a constant postprandial delay to slaughter (10h), to avoid the confounding between the effects of the experimental treatments and those of fasting duration. All birds were slaughtered on a commercial processing line, after 4h recovery-time. The pectoralis *major* muscle samples were collected for pH (20min and 24 h), color values L*, a* and b*(24h). The meat samples was conserved at 4° C during three days postmortem to measure drip loss, cook loss, water holding capacity and shear force.

2.2 pH

The initial pH (pH_{20min}) was measured on turkey carcasses at the pectoral muscle 20-30 minutes after slaughter. The pH_{24h} was measured at 24 hours, at 4 ± 2 ° C, taken on the right pectoral muscle with a penetrating electrode connected to a portable pH-meter type microcomputer HI 99163 (HANNA instruments). The pH values at 20 min were measured on carcasses (right breast). The pH at 24h was measured in the laboratory on fifteen samples randomly selected.

2.3 Meat color

The color was measured after 24 hours postmortem on a section of the pectoral muscle at 4 ± 2°C. The meat samples were measured for chromaticity using a Minolta Chromameter CR-410 (Minolta). The colorimeter was standardized using a white tile with illuminance D65. The CIELAB color space has been used in the color measurement. Chromaticity coordinates, luminance (L*), the index to red (a *) and yellow index (b *) were measured three repetitions on muscle surface and averaged for statistical analysis. The instrument was calibrated with a white tile before analysis. Measurements were done perpendicularly to the meat surface at three different locations per breast, and the mean value from each meat was measured (Pietrzak et al., 1997).

2.4 Shear force

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Slices of pectoralis *major* were cut rectangular parallelepipeds, around 1*1 cm-thick and 2–3 cm-long, were cut parallel to the muscle fibres. The maximum shear force was measured on meat aged 3 days post-mortem. Raw meat texture was measured in the longitudinal configuration using a TA-XT plus (Texture analyser, Stable Microsystem, UK) with HDP/BSK, BLADE SET GUILLOTINE (Honikel, 1998).

2.5 Drip losses

Losses to flow were evaluated on samples of 100g turkey raw fillets placed in trays on a paper towel. The trays are kept for 3 days at 4 ° C. The weight difference indicates elapsed amount of water during storage (Honikel, 1998). The difference was measured at 3 days.

2.6 Cooking losses

The cooking losses are determined according to Wood et al. (1981) and Honikel (1998). They are measured on scallops which have approximately the same weight and the same geometric shape. 100g samples were boiled during 15 minutes in a water bath at 80 ° C. The difference in weight indicates the amount of water lost during cooking.

2.7 Sensory attributes

2.7.1 Sample preparation

The sensory test was carried out in the Sensory Analysis Laboratory of the laboratory analysis of food quality in the Institute of Agronomy of Tunisia. The day before the event tasting meat samples were thawed in a refrigerator at 4°C. Breast meat samples were cooked with no added salt and cut into 1cm3 pieces. The slices should be of uniform size and thickness. These were placed in aluminum trays covered with aluminum foil identified and put in a conventional oven pre-heated at 80°C. A thermocouple was inserted in the center of each piece of meat to register the core temperature. The core temperature was not allowed to exceed 80°C, the breast was removed from the oven at 75 to 776.5 °C to allow for post-heating rise. The breast slices were warmed at 80 °C before the evaluation, covered with aluminium foil and presented to the panelists.

2.7.2 Descriptive analysis

Twelve trained panelists, who had at least 1 yr of experience in the sensory analysis of poultry meat, consisting mainly of graduate students, were served diced turkey breast with water and an unsalted snack in between to remove the remaining flavor. The panel evaluated each sample in triplicate. Judges were requested to evaluate the cooked breast meat (offered in a randomized order) with a 3-digit code. Each attribute was scored on a scale of 10 cm for each

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characteristic: taste, color, tenderness, flavor, juiciness, and odor. The attributes were ranged from the lowest intensity of each trait to the highest. They measured overall acceptability in breast meat samples using the 9-point (1: Dislike extremely, 2: Dislike very much, 3: Dislike moderately, 4: Dislike slightly, 5: Neither like nor dislike, 6: Like slightly, 7: Like moderately, 8: Like very much, 9: Like extremely) hedonic scale (Peryam and Pilgrim, 1957).

2.8 Statistical analysis

The data were analyzed by ANOVA using the GLM procedure of SAS (9.1, 2001), where the main effects were either 2 levels of rosemary (5 or 10 g/kg) and 3 levels of α-tocopherol acetate (50 mg/kg (control), 150 mg/kg and 300 mg/kg. As the following model:

$$Y_{ijk}= \mu + T_i + L_j + T_i \, x \, L_j + e_{ijk}$$

Where Y_{ijk} are the observations; μ is the population average; T_i is the effect of the i^{th} treatment group; L_j is the effect of the j^{th} level; T_i x L_j is the interaction of treatment x level and e_{ijk} is the random error. Moreover, the effect of the interaction treatments Diet x Storage were determined for sensory attributes. When the effect was significant, the differences between dietary treatment means were separated by Duncan's multiple range tests. Mean values and SEM are reported. All statements of significance were based on P<0.05.

3. RESULTS

Physical aspects of turkey meat

The effects of supplementation with ground rosemary and vitamin E (α-tocopheryl acetate) on technologic and organoleptic parameters of meat quality are shown in Table 2. In this study, the initial pH measured at 15min on pectoralis *major* muscle and the ultimate pH (pH_{24h}) were affected significantly by diet treatments (P <0.05). A significant differences were determined in meat pH values of treatment groups (P <0.05). Samples from ROS1 and ROS2 groups had the highest pH values compared with other groups. The initial pH values were 6.22 and 6.24 and the ultimate pH values were 5.87 and 5.84, respectively for ROS1 (5g/kg) and ROS2 (10g/kg) groups. Samples from the control diet (VitE1) group displayed a lower initial pH value of 6.06 and reached the ultimate pH value of 5.70. The addition of 150mg/kg (VitE2) and 300mg/kg (VitE3) of α-tocopheryl acetate did not improve the pH values compared to the control diet.

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Table 2. Effect of dietary rosemary and α-tocopheryl acetate on post-mortem pH values

	Rosemary		Vitamin E (α-tocopheryl acetate)			
	ROS1[1]	ROS2[1]	VitE1 (control)[1]	VitE2[1]	VitE3[1]	P
pH_{15min}	6.22±0.13a	6.24±0.21a	6.06±0.23b	6.05±0.14b	6.07±0.18b	0.01
pH_{24h}	5.87±0.1a	5.84±0.09a	5.70±0.07c	5.72±0.07bc	5.79±0.11b	0.01
L_{24h}	53.43±3.45dc	53.14±1.8d	54.31±2.97bc	54.75±2.01ab	55.62±2.02a	<0.0001
a^*_{24h}	15±1.73	14.83±1.4	15.18±1.22	14.9±1.05	15.32±1.05	0.3
b^*_{24h}	6.71±1.52b	6.83±1.6ab	7.44±1.68a	7.09±1.31ab	6.98±1.22ab	0.2
Drip loss[2]%	2.5±0.43	2.66±0.64	2.65±0.38	2.6±0.45	2.41±0.66	0.64
Cooking loss[2]%	9.21±1.47	9.79±1.68	9.36±1.7	9.03±1.91	8.85±1.2	0.58
Water-holding capacity(%)[2]	11.71±1.53	12.45±2.01	12.02±1.95	11.64±2.02	11.26±1.53	0.5
3d-Shear Force (N)[2]	21.85±11.71abc	18.06±10.02c	25.95±11.8a	20.16±6.92bc	22.88±9.56ab	0.005

a, b, c, d:Means within a column with different letters are significantly different ($P < 0.05$)
[1]n=15 for each group
[2]the attributes were measured at 3 day post-mortem
L = lightness (luminance); a* = redness; b* = yellowness

Although a* and b* variables of meat color were not affected by dietary treatments (Table 2). The luminance attribute (L) was significantly affected by the addition of natural (Rosemary) and synthetic (vitamin E) antioxidants in the diet ($P<0.0001$). The addition of the highest dose of α-tocopheryl acetate 300mg/kg (VitE3) made meat lighter. However, the higher dose of rosemary group ROS2 (10g/kg) made the meat dark, compared to the control diet.

Furthermore, the supplementation with rosemary and α-tocopheryl acetate did not affect neither drip loss nor cooking loss nor water-holding capacity (WHC).

In the present study, tenderness of meat was evaluated using with BLADE SET GUILLOTINE shear force test on raw meat (Table 2). The maximum shear force was significantly affected by the rosemary and alpha-tocopherol acetate supplementation in turkey diet. The samples from

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ROS2 had a lower maximum shear force value than the other groups. Moreover, the maximum shear force of meat from control group was 70% higher than VitE2 meat.

Sensory evaluation

The effect of the dietary treatments on the sensory qualities of turkey meat is presented in Table 3. There were significant differences (P<0.05) for the sensory quality of the meat between the control and treatment groups. The highest scores in sensory qualities among all groups were found in the groups containing 5 g/kg or 10g/kg of ground rosemary. Also, the supplementation with 150 mg/kg α-tocopherol acetate (VitE2) improve taste, tenderness, color and juiciness score values compared to control treatement.

Table 3. Effects of rosemary and α-tocopherol acetate on the sensory qualities of breast turkey aged 3 days

		Sensory qualities of meat samples					
Groups		**Taste**	**Odor**	**Tenderness**	**Color**	**flavor**	**Juiciness**
Rosemary	**ROS1**	5.86b	6.12ab	7.07a	5.02a	5.52	6.18a
	ROS2	6.17a	6.77a	7.24a	5.36a	5.51	6.17a
Vitamin E	**VitE1 (control)**	4.46c	5.37b	5.48c	4.48b	4.92	4.61b
	VitE2	5.04ab	4.3c	6.28b	5.65ab	4.47	5.68ab
	VitE3	4.98bc	5.74ab	6.10b	5.05ab	5.2	5.85ab
P-values		**0.0005**	**0.0002**	**<0.0001**	**0.02**	**0.1**	**0.02**

a, b, c:Means within a column with different letters are significantly different (P < 0.05)

In this study, diet treatments and storage period of turkey breast were affected significantly the specific abnormal flavor and overall acceptability. The ground rosemary found in diet had the lowest scores of abnormal flavor (rancidity) and the greatest overall acceptability during storage (Table 4).

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Table 4. Effects of rosemary and alpha-tocopherol acetate on the sensory attribute of meat during storage

		Abnormal flavor intensity (Rancidity)			Overall acceptability*		
	Groups	**10days**	**2months**	**4months**	**10days**	**2months**	**4months**
Vitamin E	**VitE1 (control)**	0.8±0.15a	1.48±0.14a	3.02±0.6a	6.3±0.69b	5.2±0.48c	4.4±0.87c
	VitE2	0.3±0.13b	1.49±0.12a	1.88±0.59b	6.7±0.48ab	6±0.47ab	6±0.5b
	VitE3	0.34±0.16b	1.52±0.16a	1.67±0.63b	6.7±0.67ab	5.9±0.56ab	5.8±0.42b
Rosemary	**ROS1**	0.3±0.17b	0.64±0.12b	1.26±0.28c	7.10±0.73a	6.5±0.52a	6.7±0.48a
	ROS2	0.3±0.16b	0.73±0.18b	1.29±0.25c	7±0.52a	6.6±0.51a	6.5±0.52a
P-values	**Diet (D)**		**<0.0001**			**<0.0001**	
	Storage duration (S)		**<0.0001**			**<0.0001**	
	D*S		**<0.0001**			**<0.0001**	

a,b et c:Means within a column with different letters are significantly different (P < 0.05)
*9: Like extremely, 8: Like very much, 7: Like moderately, 6: Like slightly, 5: Neither like nor dislike 4: Dislike slightly, 3: Dislike moderately, 2: Dislike very much, 1: Dislike extremely.

4. DISCUSSION

Physical aspects of turkey meat

Our results demonstrated the beneficial effects of dietary supplementation of ground rosemary and vitamin E (α-tocopheryl acetate). The dietary rosemary increased the pH in breast of turkey. Chen et al. (2008) reported that the dietary garlic increased the pH in pork. Dietary oregano essential oil increased the pH of female lamb meat (Simitzis et al., 2008). Jang et al. (2008a) reported that the pH of breast meat from broilers fed medicinal herb extract mix was higher than that of control.

Contrary to the present study, Yesilbag et al. (2011) showed that there are significant differences in breast meat pH values (P<0.0001) between the rosemary, rosemary volatile oil and vitamin E groups. They reported that the addition of α-tocopherol acetate at the 50 mg/kg level caused a

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higher pH value on breast compared to the groups supplemented with rosemary plant (R1, R2 and R3). Therefore, they reported that the addition of rosemary to the diets caused a decrease in pH, which delayed the microbial degeneration period. Similarly, Park and Yoo (1999) reported that the dietary inclusion of Chinese medicine by-products at levels of 4 and 8% decreased the pH of thigh muscle in broiler chicks. Shirzadegan and Falahpour (2014) showed that pH of the thigh meat from the broiler fed the garlic dietary was higher than control, treated by vitamin E. Contrary, Rossi et al. (2013) reported that plant extract had no significant effect on pork meat quality, such as pH. However, the groups were received 150 to 300mg/kg of α-tocopheryl acetate during finishing period had initial and ultimate pH values similar to control group (50mg/kg). This result may be due to the short period of supplementation. Olivo et al. (2001) suggested that the occurrence of PSE chicken could be suppressed with reduction of pH decline at postmortem by dietary antioxidant.

In the present study, the luminance L, only, was affect by the dietary rosemary and vitamin E ($P<0.0001$). Moreover, the luminance L* value is highly correlated with muscle pH and water-holding capacity (Barbut 1993, 1997). That is why the rosemary groups had the lowest L values and the highest ultimate pH values. Yesilbag et al. (2011) showed that the dietary rosemary, rosemary oil and vitamin E did not affect meat colour (L*, a*, b*). Fernandez-Lopez et al. (2003) have determined that the dietary addition of rosemary and Hyssopus officinalis significantly increased redness and yellowness compared to controls. Dietary garlic decreased L*, a* and b* values in pork (Chen et al., 2008) but dietary oregano extract showed greater a* and b* values in chicken meat than in the meat of control chickens (Young et al., 2003).

At the end of the study, Shear force values can be used to determine if meat products vary in texture by measuring the variability in total cutting force. Miller (1994) pointed out that shear force values were highly correlated with overall tenderness of animal muscle. The shear force value has a highly variable characteristic depending on many intrinsic and extrinsic factors of the meat and on their interactions (Destefanis et al., 2008). The maximum shear force was significantly affected by the rosemary and α-tocopherol acetate supplementation in turkey diet ($P< 0.05$). It can be said that the addition of ground rosemary and vitamin E to the diet made turkey meat softer. Naveena and Mendiratta (2004) reported a decrease in shear force values by addition of ginger extract in buffalo meat with extensive degradation of muscle fibers and connective tissue. Harris et al. (2001) reported that high levels of vitamin E in meat increased the rate of tenderization. Furthermore, Kim et al. (2009) showed that the significant decrease in shear force values of the dietary treatments at different levels could be due to the tenderizing effects of garlic when supplemented to broilers. The lower values ($P<0.05$) for shear force detected in all the antioxidant groups when compared to the control group (Table 2) might have been due to the protection exerted by both vitamin E and ground rosemary against the oxidation

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of endogenous proteases that might reduced the functionality of μ-calpain and m-calpain as a consequence of the oxidation undergone by the postmortem muscle during the aging process (Moran et al., 2012; Huff-Lonergan and Lonergan, 2005; Xiong, 2000). As well, these cytoskeletal and other myofibrillar proteins are known μ-calpain substrates, an enzyme highly susceptible to oxidation due to histidine and SH-containing cysteine residues at its active site (similar to m-calpain).

Researchers had shown that a strong positive relationship between shear force and WHC existed in meat (Joo et al., 1999; Alvarado and Sams, 2000). In this study, no significant differences were found in drip loss, cooking loss and WHC among the turkey meat samples for diets with different levels of ground rosemary and vitamin E ($P > 0.05$). Rossi et al. (2013) were indicate that long term supplementation with plant extract has no detrimental effect on the physical parameters of pork quality. Neither cooking loss, nor shear force was affected by the dietary treatment, agreeing with Lahucky et al. (2010). No difference in cooking loss was reported in pigs fed green tea powder (Sarker et al., 2010). By contrast, Kołodziej-Skalska et al. (2011) reported lower drip and cooking losses from the LD muscle of pigs fed plant extract compared with the control group. Shirzadegan and Falahpour (2014) were showed that water-holding capacity (WHC) was affected by administration of HEM in broiler diets ($P<0.05$).

Sensory evaluation

Samples from turkey breast, aged 3 days postmortem, were cooked and evaluated. The color, taste, odor, tenderness and juiciness of meat samples were significantly different between groups ($P<0.05$), flavor intensity value was not significantly different ($P<0.05$). In this study, panelists gave the highest marks to the experimental groups containing the highest level (10 g/kg) of rosemary plant. The samples from rosemary groups seem to be the tastier, softer, juicy and keen smell. Furthermore, the addition of 150mg/kg α-tocopherol acetate improved the sensory meat characteristics. Simsek et al. (2007) have also demonstrated that the addition of antibiotics and thyme oil can cause a significant difference in the taste, tenderness and overall acceptability of the meat between groups. There were relatively small differences in flavor intensity, which were significantly greater between the birds fed on diets with rosemary and garlic supplements (Cross et al., 2011). Moreover, the addition of essential oil positively affected the sensory characteristics on the 15th d of storage. The meat samples from chickens that consumed 400ppm thyme oil were found to be tastier and softer. However, Yesilbag et al. (2011) reported that rosemary and rosemary oil caused a negative effect on the sensory analysis (taste, odor and overall acceptability) possible due to the keen smell and specific taste. Basmacioglu et al. (2004) examined the combined or individual addition of rosemary, thyme oil and α-tocopherol acetate to diets; they reported no effects of these treatments on the meat sensory analysis at different levels

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(for taste, odor, tenderness and overall acceptability). All of these studies have demonstrated that the addition of aromatic herbs to poultry diets can change the results of the sensory analysis. These differences depend on the kind of aromatic herb used, their characteristic structure, and dosage used (Yesilbag et al., 2011).

The storage of turkey breast during long term, diet treatments and storage x diet treatments interaction affected significantly ($P<0.0001$) the abnormal flavor and overall acceptability. The rosemary and vitamin E supplementation diet decrease the rancidity score 0.84 to 1.76 vs 0.5 to 1.14, respectively during the storage, compared to the control group. The overall acceptability score also decrease during the storage. The lower level of vitamin E and ground rosemary had the great score of overall acceptability.

Lipid oxidation causes the development of rancidity and 'warmed-over flavors' and membrane phospholipids are the sites where oxidative changes are initiated in meat (Barroeta et al., 2012). It is well known that to decrease these oxidative processes, vitamin E is a highly-efficient antioxidant in cell membranes, acting as a chain-breaker. Experiments have shown that vitamin E reduced lipid oxidation in chicken meat (Sheehy et al., 1993) and pork (Monahan et al., 1992) during storage. In frozen turkey meat, Bartov et al. (1983) and Bartov and Kanner (1996) have shown that dietary vitamin E decreased TBARS values.

Rossi et al. (2013) showed that the Raw LD of pig fed with plant extract had lower lipid oxidation levels than controls. Also, a reduction of fat odor and rancid flavor intensity in cooked LD muscle stored at 4 °C for 24 h was observed in the treated group.

5. CONCLUSION

The results of the current study suggest that rosemary plant had beneficial effects on meat quality. Additionally, it was determined that the vitamin E do not have strong activity if included for short period (finishing period). Results showed that the incorporation of rosemary used in the present study in turkey diet delayed abnormal flavour, such as rancidity, in the cooked turkey breast after storage up to 4 months. The meat had to be softer, tastier and had a keen smell.

In conclusion, assessment of dietary rosemary supplement on sensory properties in meat represents an interesting area for further study, as subtle taste and flavour modifications can be discerned. It may be considered as a natural improver for turkey meat quality

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