THE EFFECT OF THYME ESSENTIAL OIL ON SOME QUALITY CHARACTERISTICS OF CHICKEN MEATS

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Abstract - Lipid oxidation and microbial deteriorations in meat and meat products may lead to important problems during the processing and storage stages. In food industry, some synthetic antioxidants are used to resolve these problems. Considering the tendency of consumers toward the natural additives, the use of spices and their extracts in foods as antioxidants and antimicrobials would be a plausible choice against the synthetic antioxidants. In this research, chicken thigh and breast meats treated with essential oil extracted from Izmir thyme at the level of 250, 500 and 1000 ppm while the control samples received no oil. Then the samples were stored at 4°C for 0, 3, 7 and 10 days and subjected to some physicochemical and sensory analyses. In the results, TBA analysis revealed that the application of essential oil at the level of 1000 ppm increased the oxidation stability of the chicken meats. Again, no adverse effect of the essential oil treatment was determined at the level of 250 and 500 ppm in terms of the sensory properties. Consequently, the results of this study showed that the essential oil treatment may help to maintain the quality of the chicken samples.

Keywords: Thyme, Chicken meat, Antioxidant

I. INTRODUCTION

Lipid oxidation and microbial deteriorations in meat and meat products may lead to important problems during the processing and storage. In the food industry, synthetic antioxidants have been generally used to resolve these problems [1, 2]. However, consumers have been demanding the foods containing no synthetic preservatives due to the fact that the consumer consciousness increased about the food-health interactions. Considering the tendency of consumers toward natural additives, like spices and/or their extracts in foods as natural antioxidants and antimicrobials have been welcomed as a good alternative to replace the synthetic preservatives [3]. Some spices and their extracts have widely been recognized as antioxidant and antimicrobial agents [4]. As a result, considerable research has been carried out on the assessment of the antioxidant activity of many herbs, spices and their extracts when added in a variety of foods and food model systems [5]. Two primary phenols carvacrol and thymol are responsible from the antioxidant properties of thyme spices that constitute about majority of the essential oil and their precursors, g-terpinene and r-cymene, the two monoterpene hydrocarbons [6]. Carvacrol, thymol and their precursors would react with lipid and hydroxyl radicals converting them into stable products [7]. Additionally, some other spice compounds were reported to inhibit lipid peroxidation by quenching oxygen free radicals and by enhancing the activity of endogenous antioxidant enzymes; superoxide dismutase, catalase, glutathione peroxidase and glutathione transferase in the animal tissues [8]. Some studies conducted previously have shown that the dietary supplementation of essential oil of oregano could improve the oxidative stability of broiler meats during the refrigerated storage [5, 9, 10]. In the present research, chicken thigh and breast were treated with essential oil extracted from Izmir thyme (at the level of 250, 500 and 100ppm) and stored at 4 ºC at different days (0, 3, 7 and 10 d) to evaluate its effect on physicochemical and sensory traits.

II. MATERIALS AND METHODS

In this research, Izmir thyme (*Origanum onites*) was ground with a laboratory grinder, and their essential oil was obtained with hydrodistillation in a Clavenger type apparatus. Fresh chicken breast and thigh meats were provided by FAT Poultry Inc. Kayseri, Turkey within one day after the slaughter. Their skins were removed, and 250 g chicken samples were placed into sterile stomacher bags for each treatment, and the bags were vacuum sealed. Then the essential oil was injected with a sterile injector at the

level of 250, 500 and 1000 ppm, while the control samples receiving no oil, and then the pores on stomacher bags were resealed with a tape immediately. Then the samples were stored at 4°C for 0, 3, 7 and 10 days.

Determination of pH and proximate composition

Moisture and fat content of the samples were determined according to the methods of AOAC International [11]. The results were expressed as percentage of wet weight. pH values were measured by a calibrated pH meter (Hanna 8314, Romania) [12].

Thiobarbituric acid assay

Lipid oxidation was assessed by the 2-thiobarbituric acid (TBA) method of Ulu [13].

Sensory analysis

The sensory quality of thigh and breast meat samples were evaluated at each sampling time (excluding the 10 day samples that were deteriorated) by a ten member trained panel.

Statistical Analysis

Differences among the essential oil treatments were analyzed statistically using the analysis of variance technique, and Duncan's Multiple Range Test was used for the comparison of treatment means [14].

III. RESULTS AND DISCUSSION

The effect of essential oil treatments on pH, fat and moisture contents of thigh and breast meats is shown in Table 1. The essential oil and storage time had significant ($p<0.05$) effects on pH and moisture values of the thigh and breast samples of chicken. The fat content of thigh meat did not change with the treatments while the storage time and essential oil concentrations had a significant effect ($p<0.05$) on fat content of the breast samples.

TBA values of the samples can be seen in Table 2. In general, TBA values of the thigh samples which had higher lipid content were higher than those of the breast samples. Similarly, Nam et al. [4] observed that oxidative changes in thigh were more extensive than that of the breast muscle, due to the higher lipid content. Again, the statistical analyses revealed that storage time and essential oil concentration had a significant ($P<0.05$) effect on TBA values. As can be seen from the Table 2, TBA values increased in both breast and thigh samples during the storage ($P>0.05$), and the highest TBA values were determined in the control group except for the seventh day of breast samples. These results were in agreement with the literature where the antioxidant effects of some spices studied [15, 16]. Some researchers showed that different natural antioxidants were effective on the retardation of lipid oxidation in chicken meats [5, 17, 18].

The data obtained for the sensorial values of thigh and breast samples treated with essential oil and stored at 4°C are shown in Table 3. The statistical analyses revealed that the essential oils concentrations had a significant ($P<0.05$) effect on sensorial attributions of the breast meat while no significant differences ($P>0.05$) were observed on the thigh samples. However, storage time was effective ($p<0.05$) on sensory properties of both thigh and breast meat samples.

In general, thigh samples had higher sensorial scores when compared to the breast samples. Although 500 ppm essential oil addition was the most favorable in the thigh samples, it was the most desirable with 250 ppm in the breast samples. Briefly, the addition of essential oils did not have negative effect on the sensorial properties of both thigh and breast meat samples.

IV. CONCLUSION

The results of this study showed that thyme essential oil treatment increased the oxidation stability of meats. The essential oil treatment had a significant effect on pH, fat and moisture contents of breast and thigh meats (except for fat content). Additionally, these factors were effective on some color parameters of the samples. In terms of the sensory properties, no adverse effect of essential oil treatment was determined at the level of 250 and 500 ppm in the chicken meats, and beneficial effects were determined especially with 1000 ppm essential oil. Thigh meat was more susceptible to oxidation compared with breast meats in all treatments. In conclusion, it might be suggested that the essential oil treatment may help to maintain the quality of the chicken samples during the storage.

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Table 1. The effects of essential oils on pH, fat and moisture parameters of thigh and breast meats

Sample	Parameter	Storage time (day)	Concentration of essential oil (ppm)			
			0	250	500	1000
Thigh	pH	0	6.42^{Ca}±0.01	6.42^{Ca}±0.01	6.42^{Ca}±0.01	6.42^{Da}±0.01
		3	6.64^{Ba}±0.01	6.50^{Bb}±0.01	6.44^{Cc}±0.01	6.48^{Cb}±0.00
		7	6.90^{Aa}±0.01	6.66^{Ac}±0.01	6.49^{Bd}±0.02	6.71^{Bb}±0.01
		10	6.12^{Dd}±0.01	6.65^{Ac}±0.01	6.96^{Aa}±0.01	6.76^{Ab}±0.01
	Fat %	0	9.62^{Aa}±0.25	9.62^{Aa}±0.25	9.62^{Aa}±0.25	9.62^{Aa}±0.25
		3	9.30^{Ab}±0.27	9.97^{Aa}±0.19	9.83^{Aab}±025	9.84^{Aa}±0.19
		7	9.89^{Aa}±0.32	9.39^{Aa}±0.28	9.62^{Aa}±0.43	9.62^{Aa}±0.31
		10	9.97^{Aa}±0.20	9.74^{Aa}±0.41	9.68^{Aa}±0.10	9.38^{Aa}±0.28
	Moisture %	0	72.07^{Aa}±0.10	72.07^{Ca}±0.10	72.07^{Aa}±0.10	72.07^{Ca}±0.10
		3	72.63^{Aa}±0.07	70.63^{Dc}±0.26	71.54^{Abc}±0.73	72.51^{Bab}±0.28
		7	72.35^{Ac}±0.60	73.78^{Ba}±0.16	72.44^{Abc}±0.14	73.24^{Aab}±0.14
		10	70.69^{Bc}±0.17	74.98^{Aa}±0.14	71.08^{Ac}±1.00	72.96^{Ab}±0.13
Breast	pH	0	5.85^{Ca}±0.01	5.85^{Ca}±0.01	5.85^{Da}±0.01	5.85^{Da}±0.01
		3	5.86^{Cc}±0.01	5.85^{Cc}±0.01	5.96^{Cb}±0.01	5.97^{Ca}±0.01
		7	6.16^{Bb}±0.02	6.20^{Bab}±0.00	6.23^{Aa}±0.03	6.06^{Bc}±0.01
		10	6.33^{Aa}±0.01	6.25^{Ab}±0.01	6.13^{Bc}±0.00	6.27^{Ab}±0.01
	Fat %	0	0.89^{Ba}±0.00	0.89^{Ba}±0.00	0.89^{Aa}±0.00	0.89^{Aa}±0.00
		3	0.93^{ABab}±0.03	1.04^{Aa}±0.02	0.89^{Ab}±0.10	0.92^{Aab}±0.03
		7	0.91^{ABa}±0.01	0.99^{Aa}±0.04	0.86^{Aa}±0.10	0.93^{Aa}±0.03
		10	0.94^{Aa}±0.02	0.92^{Ba}±0.01	0.93^{Aa}±0.01	0.92^{Aa}±0.02
	Moisture %	0	75.82^{Aa}±0.03	75.82^{Aa}±0.03	75.82^{Aa}±0.03	75.82^{Aa}±0.03
		3	75.67^{ABb}±0.04	75.74^{Ab}±0.00	76.22^{Aa}±0.38	74.92^{Bc}±0.02
		7	75.68^{ABa}±0.11	74.75^{Bb}±0.15	75.76^{Aa}±0.15	74.92^{Bb}±0.15
		10	74.67^{Cb}±0.02	74.59^{Bb}±0.13	74.57^{Bb}±0.17	75.51^{Aa}±0.38

^{AB}: Means with different capital letters in the same column, compare the storage times, show significant differences at $P<0.05$. ^{ab} Means with lowercase on the same row, compare the essential oil concentration, show significant differences at P<0.05.

Table 2. The effects of essential oil on breast and thigh meat samples TBA assay (mg MA/kg)

Sample	Storage time (day)	Concentration of essential oil (ppm)			
		0	250	500	1000
Thigh	0	0.16^{Da}±0.00	0.16^{Da}±0.00	0.16^{Da}±0.00	0.16^{Da}±0.00
	3	0.30^{Ca}±0.03	0.27^{Cab}±0.00	0.26^{Cb}±0.00	0.22^{Cc}±0.01
	7	0.59^{Ba}±0.02	0.50^{Bb}±0.01	0.39^{Bc}±0.01	0.37^{Bc}±0.00
	10	0.71^{Aa}±0.04	0.65^{Ab}±0.00	0.54^{Ac}±0.03	0.48^{Ad}±0.02
Breast	0	0.09^{Da}±0.01	0.09^{Ca}±0.01	0.09^{Da}±0.01	0.09^{Ca}±0.01
	3	0.14^{Ca}±0.00	0.12^{Cb}±0.01	0.12^{Cb}±0.01	0.11^{Cb}±0.01
	7	0.31^{Ba}±0.02	0.33^{Ba}±0.01	0.32^{Ba}±0.01	0.23^{Bb}±0.01
	10	0.48^{Aa}±0.00	0.43^{Ab}±0.00	0.42^{Ab}±0.02	0.39^{Ac}±0.00

^{AB} Means with different capital letters in the same column compare the storage times and show significant differences at $P<0.05$. ^{ab} Means with lowercase on the same row compare the essential oil concentration and show significant differences at $P<0.05$.

Table 3. The effects of essential oils treatments on sensorial attributions of thigh and breast meats

Sample	Storage Time (day)	Concentration of essential oil (ppm)			
		0	250	500	1000
Thigh	0	58.00^{Aa}±0.28*	58.00^{Aa}±0.28	58.00^{Aa}±0.28	58.00^{Aa}±0.28
	3	51.00^{Ba}±2.14	51.00^{ABa}±1.19	53.00^{Aa}±0.21	53.00^{ABa}±2.30
	7	47.00^{Cab}±0.13	45.00^{Bb}±1.92	52.00^{Aa}±1.92	48.00^{Ba}±0.93
Breast	0	46.00^{ABa}±0.13	46.00^{Aa}±0.13	46.00^{Aa}±0.13	46.00^{Aa}±0.13
	3	47.00^{Aa}±2.13	44.00^{Aab}±2.44	37.00^{Bab}±1.63	34.00^{Bb}±1.90
	7	40.00^{Ba}±0.50	40.00^{Aa}±0.58	31.00^{Bb}±1.65	40.00^{ABa}±1.75

^{AB} Means with different capital letters in the same column compare the storage times and show significant differences at $P<0.05$. ^{ab} Means with lowercase on the same row compare the essential oil concentration and show significant differences at $P<0.05$. *: The results were given total effects of the cooked samples surface color, texture, crispness, juiciness, taste and flavor, off flavor or odor parameters and surface color of the raw samples. The samples were evaluated in raw and cooked. The deteriorated samples which were stored for 7 or 10 days were not evaluated for sensorial properties. Samples were rated on a nine-point hedonic scale (1 = dislike extremely, 9 = like very much)

REFERENCES

1. Yin, M., & Cheng, W. (2003). Antioxidant and antimicrobial effects of four garlic-derived organosulfur compounds in ground beef. Meat Science 63: 23-28.
2. Fernandez-Lopez, J., Zhi, N., Aleson-Carbonell, L., Perez-Alvarez, J.A., & Kuri, V. (2005). Antioxidant and antibacterial activities of natural extracts: Application in beef meatballs. Meat Science 69: 371-380.
3. Rey, A.I., Hopia, A., Kivikari, R., & Kahkonen, M. (2005). Use of natural food/plant extracts: cloudberry (*Rubus chamaemorus*), beetroot (*Beta vulgaris "Vulgaris*") or willow herb (*Epilobium angustifolium*) to reduce lipid oxidation of cooked pork patties. LWT - Food Science and Technology 38: 363-370.
4. Nam, K-T., Lee, H-A., Min, B-S., & Kang, C-W. (1997). Influence of dietary supplementation with linseed and vitamin E on fatty acids, α-tocopherol and lipid peroxidation in muscles of broiler chicks. Animal Feed Science Technology 66: 149-158.
5. Botsoglou, N.A., Christaki, E., Fletouris, D.J., Florou-Paneri, P., & Spais, A.B. (2002). The effect of dietary oregano essential oil on lipid oxidation in raw and cooked chicken during refrigerated storage. Meat Science 62: 259–265.
6. Yanishlieva, N.V., Marinova, E.M., Gordon, M.H., & Raneva, V.G. (1999). Antioxidant activity and mechanism of action of thymol and carvacrol in two lipid systems. Food Chemistry 64: 59–66.
7. Yanishlieva-Maslarova, N.V. (2001). Inhibiting oxidation. In: Pokorny, J., Yanishlieva, N., Gordon, M., Eds. Antioxidants in Food-Practical Applications. Woodhead Publishing Limited, CRC Pres, Cambridge, England, 22–70.
8. Srinivasan, K. **(**2005) Spices as influencers of body metabolism: an overview of three decades of research. Food Reviews International 38: 77–86.
9. Botsoglou, N.A., Grigoropoulou, S.H., Botsoglou, E., Govaris, A., & Papageorgiou, G. (2003). The effect of dietary oregano essential oil and α-tocopheryl acetate on lipid oxidation in raw and cooked turkey during refrigerated storage. Meat Science 65: 1193–1200.
10. Simitzis, P.E., Deligeorgis, S.G., Bizelis, J.A., Dardamani, A., Theodosiou, I., & Fegeros, K. (2008). Effect of dietary oregano oil supplementation on lamb meat characteristics. Meat Science 79: 217–223.
11. AOAC International. In Official Methods of Analysis of AOAC International. 16th edn. Gaithersburg, MD, USA, 1999; AOAC International.
12. Sallam, Kh. I., Ishioroshi, M., & Samejima, K. (2004). Antioxidant and antimicrobial effects of garlic in chicken sausage. Lebensm.-Wiss. u. Technol. 37: 849-855.
13. Ulu, H. (2004) Evaluation of three 2-thiobarbuturic acid methods for the measurement of lipid oxidation in various meats and meat products. Meat Science 67: 683–687.
14. SAS: SAS/STAT User's guide (6.03); SAS Institute, Inc.: Cary, New York, 1988.
15. Sagdic, O. (2003). Sensitivity of four pathogenic bacteria to Turkish thyme and oregano hydrosols. LWT- Food Science and Technology,; 36: 467-473.
16. Sagdic, O., Karahan, A.G., Ozcan, M., & Ozkan, G. (2003). Effect of some spice extracts on bacterial inhibition. Food Science and Technology International 9: 353-356.
17. Tang, S.Z., Kerry J.P., Sheehan D., Buckley D.J., & Morrissey, P.A. (2001). Antioxidative effect of dietary tea catechins on lipid oxidation of long-term frozen stored chicken meat. Meat Science 57: 331–336.
18. Giannenas, I.A., Florou-Paneri, P., Botsoglou, N.A., Christaki, E., & Spais, A.B. (2005). Effect of supplementing feed with oregano and/or -tocopheryl acetate on growth of broiler chickens and oxidative stability of meat. Journal of Animal and Feed Sciences,; 14: 521–535.