EFFECTS OF DIETARY INCORPORATION OF IZMIR OREGANO ON MICROBIOLOGICAL PROPERTIES OF BROILER MEATS

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Abstract – Spices are excellent sources of phenolic compounds with antimicrobial activity. Plants from *Lamiaceae* family have been demonstrated to have strong antimicrobial properties. In this study, effect of dietary incorporation of Izmir oregano into chicken feeds on their microbiological properties of brisket and thigh meats obtained from the chickens after slaughter. *Salmonella,* a pathogen commonly found in animal products, was not detected in any of the samples. In general, oregano supplementation did not provide remarkable improvements in microbiological quality of broilers while storage was an effective factor. Microbiological numbers of broiler meats increased during the refrigerated storage (+4 ºC for 6 days). However, effect of storage at -18 ºC for 180 days on the microbiological quality of the chickes was varied.

Key Words – Brisket, Broiler, Chicken diet, Izmir oregano, Microbiological properties, Thigh

I. INTRODUCTION

Meat chickens, also known as broilers take an important part in human diet depending on its high nutritional value and attractive flavor. In the view of consumer perception, chicken is considered as leaner, with less fat than beef and less likely to cause heart disease, overweight or obesity [1]. Therefore, producers have made their efforts to enhance the meat quality of commercial broiler type chickens. On the other hand, commercialization of broiler meat after slaughter is very difficult because of its short shelf-life [2]. Microbial spoilage and lipid oxidation are the major limiting factors of meat and meat products quality during its shelf-life leading some sensorial problems and health risks [3]. It has been well demonstrated that incorporation of some active compounds in animal diets improves the quality of meat shelf-life. Spices from *Lamiaceae* family have been used for ancient times for flavoring of foods. They have been also known as strong antimicrobials and antioxidants [4-6]. The aim of this study was to improve the microbiological quality and shelf-life of broiler chicken meats by incorporating Izmir oregano (*Origanum onites* L.) in chicken diets with different concentrations.

II. MATERIALS AND METHODS

Chickens and Diets

Ross 308 genotype commercial broilers (*Gallus domesticus*) were separated into 3 homogeneous treatment groups (n: 12 birds); (1) control group broilers fed with no spice; (2) 3.5 % of Izmir oregano (*Origanum onites* L.); and (3) 7.0 % of Izmir oregano. Fresh and fine ground spices were mixed thoroughly with the commercial broiler feed in the ratio of 3.5% or 7% (w/w), and the entire broilers were fed with these diets for 40 days. The broilers were cage-raised in a temperature-controlled room. The temperature of the room was held at 32±3 °C for first 7 days, 29±2 °C during the following week, and 25±3 °C thereafter. Continuous lighting was provided in the room during the feeding. The experimental basal diets in 4 terms had dry matter. Following the broilers were slaughtered under commercial conditions, breast and thigh of the carcasses were excised and then packed with sterile stomacher bags (Nasco Whirl-Pak, Atkinson, WI) and stored at 4 °C for 6 days or -18 °C for 180 days.

Microbiological Analysis

Ten g of meat sample was aseptically transferred into Stomacher bag and homogenized with 90 mL of physiological saline using a Stomacher. Serial dilutions were prepared using the homogenized samples. Pour plate method was employed for counting the microbial colonies. Incubation conditions were specified in Table 1. Results were expressed as log cfu/g.

Table 1 Incubation conditions in microbiological analysis.

Bacteria counted	Agar	Incubation conditions
TMAB	PCA	30 °C / 48 h
TPAB	PCA	10 °C / 7 d
YM	PDA[1]	22 ºC / 4-5 d
TC	VRB	30 °C / 24h
LAB	MRS	30 °C / 3-4 d
Staphylococcus aureus	BPA[2]	37 °C / 24–48 h
Salmonella	BPLS[3]	37 °C / 24 h

TMAB: Total mesophilic aerobic bacteria; TPAB: Total psycrophilic aerobic bacteria; YM: Total yeast-mould; LAB: Lactic acid bacteria; PCA: Plate Count Agar; VRB: Violet Red Bile Agar; MRS: De Man Rogosa and Sharp Agar; BPA: Baird Parker Agar; BPLS: Brillant Green Fenol Red Agar; [1]pH was adjusted to 3.5 using 10% lactic acid; [2]Egg yolk tellurite was added; [3]Preenrichment was performed in Selenite Cystine Broth using 25 g sample.

Statistical Analysis

Analyses were performed in duplicate with 3 parallels. Test design was composed of five groups of chickens fed with 5 different rations, 2 meat types (thigh and brisket), 2 storage temperatures (+4 ºC and -18 ºC), 3 storage intervals (0, 3 and 6 days at +4 ºC and 0, 90 and 180 days at -18 ºC). Data were analyzed with Windows based S.A.S. 8.0 statistical analysis software (SAS Institute, Cary, North Carolina, USA) and significant differences between means were verified by Tukey's multiple range test.

III. RESULTS AND DISCUSSION

Table 2 presents the microbiological properties of brisket meats obtained from chickens fed with the feeds containing different amounts of oregano. When considering the effects of oregano supplementation to the diets, it did not make remarkable improvement in the general microbiological quality of the meats. Significant ($P<0.05$) increases were observed during storage of brisket meats at +4 ºC while effect of frozen storage was variable.

TPAB, LAB and YM counts were significantly ($P<0.05$) effected from the concentration of oregano in the diet. All the samples were contaminated with *S. aureus*. *Salmonella* was not detected in any brisket meat samples stored at -18 °C (Table 2).

Table 2 Microbiological properties of brisket meats stored at +4 °C or -18 °C.

Microbial group	Temp. (°C)	Storage (Day)	Microbial counts (log cfu/g)		
			Control	3.5% Oregano	7% Oregano
TMAB	4	0	4.69^{Aa}	4.33^{Aa}	4.79^{Ab}
		3	5.52^{Aa}	5.40^{Aa}	5.45^{Ab}
		6	7.26^{Aa}	7.01^{Aa}	7.96^{Aa}
	-18	0	4.69^{Aa}	4.33^{Aa}	4.79^{Aa}
		90	3.92^{Ab}	3.90^{Aa}	3.80^{Aa}
		180	3.77^{Ab}	3.70^{Aa}	3.76^{Aa}
TPAB	4	0	2.86^{Ba}	3.00^{Ba}	2.79^{Ba}
		3	4.63^{Aa}	4.03^{Aa}	4.50^{Aa}
		6	5.05^{Aa}	5.83^{Aa}	5.61^{Aa}
	-18	0	2.86^{Ba}	3.00^{Ba}	2.79^{Ba}
		90	2.87^{Aa}	2.89^{Aba}	2.70^{Aa}
		180	2.51^{Ab}	2.49^{Ab}	2.42^{Ab}
YM	4	0	2.50^{BCb}	2.20^{Cb}	1.84^{BACb}
		3	4.87^{Ab}	4.71^{Aba}	3.41^{Aba}
		6	6.12^{Aa}	5.25^{Aa}	5.90^{Aa}
	-18	0	2.50^{BCa}	2.20^{Ca}	1.84^{BACa}
		90	2.44^{Ab}	2.25^{Ab}	2.42^{Ab}
		180	2.25^{Ab}	2.13^{Ab}	2.34^{Ab}
TC	4	0	1.18^{Ab}	1.43^{Ab}	1.43^{Ab}
		3	2.29^{Aba}	2.52^{Ab}	2.07^{Aba}
		6	3.29^{Aa}	3.73^{Aa}	3.66^{Aa}
	-18	0	1.18^{Aa}	1.43^{Aa}	1.43^{Aa}
		90	1.42^{Ab}	1.26^{Ab}	1.43^{Ab}
		180	1.26^{Ab}	1.17^{Ab}	1.18^{Ab}
S. aureus	4	0	1.64^{Ac}	1.37^{Ab}	1.63^{Aa}
		3	2.82^{BAb}	2.04^{Bba}	2.79^{Baa}
		6	3.96^{Aa}	3.13^{Aa}	3.28^{Aa}
	-18	0	1.64^{Aa}	1.37^{Aa}	1.63^{Aa}
		90	1.47^{Ab}	1.37^{Ab}	1.42^{Ab}
		180	1.39^{Ab}	1.28^{Ab}	1.30^{Ab}
LAB	4	0	2.59^{Baa}	2.88^{Ba}	2.18^{Ba}
		3	3.35^{Baa}	3.68^{Ba}	3.72^{Ba}
		6	5.02^{Baa}	5.02^{Ba}	5.04^{Ba}
	-18	0	2.59^{Baa}	2.88^{Ba}	2.18^{Ba}
		90	3.85^{Aa}	3.93^{Aa}	3.81^{Ab}
		180	3.70^{Aa}	3.69^{Aa}	3.60^{Ab}
Salmonella	4	0	+	-	-
		3	-	-	-
		6	-	-	-
	-18	0	+	-	-
		90	-	-	-
		180	-	-	-

TMAB: Total mesophilic aerobic bacteria; TPAB: Total psycrophilic aerobic bacteria; YM: Total yeast-mould; LAB: Lactic acid bacteria; TC: Total coliform. The same uppercase letters within the same column for each sample show that the results are not significantly different ($P>0.05$). The same lowercase letters within the same line for each sample show that the results are not significantly different ($P>0.05$).

Table 3 Microbiological properties of thigh meats stored at +4 °C or -18 °C.

Microbial group	Temp. (°C)	Storage (Day)	Microbial counts (log cfu/g) Control	3.5% Oregano	7% Oregano
TMAB	4	0	4.85^{Bb}	4.59^{Ba}	4.64^{Bb}
		3	5.25^{Aba}	5.63^{Aa}	5.85^{Aba}
		6	7.55^{A}	7.25^{Aa}	7.47^{Aa}
	-18	0	4.85^{B}	4.59^{Ba}	4.64^{Ba}
		90	4.23^{Aba}	$4,13^{Aba}$	4.29^{Aa}
		180	3.89^{Ab}	3.90^{Ab}	3.72^{Ab}
TPAB	4	0	2.18^{Bb}	1.90^{Bb}	2.08^{Bb}
		3	3.84^{Aba}	3.34^{Aba}	3.54^{Aba}
		6	5.82^{Aa}	5.72^{Aa}	5.75^{Aa}
	-18	0	2.18^{Ba}	1.90^{Bba}	2.08^{Ba}
		90	3.13^{Aa}	3.12^{Aa}	3.05^{Aa}
		180	2.38^{Aa}	2.36^{Ab}	2.23^{Ab}
YM	4	0	2.47^{Bc}	1.48^{Bb}	2.04^{Bb}
		3	4.20^{Ab}	2.83^{Aba}	3.14^{Aba}
		6	5.47^{Ba}	4.24^{Ba}	4.24^{Ba}
	-18	0	2.47^{Ba}	1.48^{Ba}	2.04^{Ba}
		90	2.59^{Ab}	2.41^{Bb}	2.47^{BAb}
		180	2.21^{Ac}	2.25^{Ab}	2.16^{Ab}
TC	4	0	1.10^{Ab}	1.07^{Aa}	1.22^{Aa}
		3	2.91^{Aba}	2.68^{Aa}	2.41^{Aa}
		6	3.71^{Aa}	3.20^{Aa}	3.41^{Aa}
	-18	0	1.10^{Aa}	1.07^{Aa}	1.22^{Aa}
		90	1.56^{Ab}	1.71^{Ab}	1.62^{Ab}
		180	1.43^{Ab}	1.38^{Ab}	1.47^{Ab}
S. aureus	4	0	1.49^{Ab}	1.48^{Ab}	1.07^{Ac}
		3	2.42^{Aba}	2.28^{Ab}	2.32^{Ab}
		6	3.13^{Aa}	3.01^{Aa}	3.19^{Aa}
	-18	0	1.49^{Aa}	1.48^{Aa}	1.07^{Aa}
		90	1.47^{Ab}	1.48^{Ab}	1.49^{Ab}
		180	1.31^{Ab}	1.29^{Ab}	1.39^{Ab}
LAB	4	0	2.77^{Aa}	2.79^{Aa}	2.83^{Aa}
		3	3.34^{Ba}	3.82^{Ba}	3.13^{Ba}
		6	4.86^{Ba}	4.60^{Ba}	4.31^{Ba}
	-18	0	2.77^{Aa}	2.79^{Aa}	2.83^{Aa}
		90	3.86^{Aa}	3.90^{Aa}	4.00^{Aa}
		180	3.73^{Aa}	3.45^{Aa}	3.64^{Aa}
Salmonella	4	0	+	-	-
		3	-	-	-
		6	-	-	-
	-18	0	+	-	-
		90	-	-	-
		180	-	-	-

TMAB: Total mesophilic aerobic bacteria; TPAB: Total psycrophilic aerobic bacteria; YM: Total yeast-mould; LAB: Lactic acid bacteria; TC: Total coliform. The same uppercase letters within the same column for each sample show that the results are not significantly different (P>0.05). The same lowercase letters within the same line for each sample show that the results are not significantly different (P>0.05).

Table 3 shows the microbiological properties of thigh meats obtained from broilers fed with different concentrations of oregano. Oregano supplementation did not make remarkable changes in microbial counts of the samples. Numbers of microbial groups analyzed in the thigh meats were significantly (P<0.05) higher after the storage period at +4 °C than the before. Both storage period and oregano concentration in the broiler diet were significantly (P<0.05) effective on TMAB, TPAB, YM, TC, LAB and *S. aureus* counts of the samples. As was the same in brisket meats, all thigh meat samples were free of *Salmonella* contamination.

It has been well demonstrated that meat quality can be positively manipulated by incorporation of some herbs, spices or natural active constituents into animal diet before slaughter. One of the positive effects of dietary supplementation of herbs and spices is retardation of lipid oxidation in meats during refrigerated and frozen storage [7-10]. However, Sensorial properties of animal meats are not influenced from dietary aromatic compounds [11, 12].

IV. CONCLUSION

Salmonella was not observed in any of meat samples during the storage. Microbiological counts tended to increase in refrigerated meat samples. However, frozen storage generally enabled bacteroiostatic effect to meats. In this research, incorporation of oregano into chicken diet in different ratios (3.5% or 7%) did not make a considerable improvement in the general microbiological quality of the broiler meats.

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REFERENCES

1. Husted, R. (2005). Consumers say they are eating beef less often and cite health concerns. http://www.beefusa.org/uDocs/marketresearch.pdf, Accessed in April 2013.
2. Velasco, V. & Williams, P. (2011). Improving meat quality through natural antioxidants. Chilean Journal of Agricultural Research 71(2): 313-322.
3. Fernandez-Lopez, J., Zhi, N., Aleson-Carbonell, L., Perez-Alvarez, J. A. V. & Kuri, V. (2005). Antioxidant and antibacterial activities of natural

extracts: application in beef meatballs. Meat Science 69: 371-380.
4. Sagdic, O., Ozkan, G., Aksoy, A. & Yetim, H. (2009). Bioactivities of essential oil and extract of *Thymus argaeus* Turkish endemic wild thyme. Journal of the Science of Food and Agriculture 89: 791-795.
5. Ozkan G., Sagdic, O. & Ozcan, M. (2003). Inhibition of pathogenic bacteria by essential oils in different concentrations. Food Science and Technology International 9: 85-88.
6. Sagun, E., Durmaz, H., Tarakci, Z. & Sagdic, O. (2006). Antibacterial activities of the extracts of some herbs used in Turkish herby cheese against *Listeria monocytogenes* serovars. International Journal of Food Properties 9: 255-260.
7. Lopez-Bote, C. J., Gray, J. I., Gomaa,, E. A. & Flegal., C. J. (1998). Effect of dietary administration of oil extracts from rosemary and sage on lipid oxidation in broiler meat. British Poultry Science 39: 235-240.
8. Botsoglou, N. A., Christaki, E., Fletouris, D. J., Florou-Paneri, P. & Spaisa., 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.
9. Botsoglou, N. A., Fletouris, D. J., Florou-Paneri, P., Christaki, E. & Spais. A. B. (2003). Inhibition of lipid oxidation in long-term frozen stored chicken meat by dietary oregano essential oil and α-tocopheryl acetate supplementation. Food Research International 36: 207-213.
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. Chaves, A. V., Stanford, K., Gibson, L. L., McAllister, T. A. & Benchaar, C. (2008). Effects of carvacrol and cinnamaldehyde on intake, rumen fermentation, growth performance, and carcass characteristics of growing lambs. Animal Feed Science and Technology 145: 396-408.
12. Janz, J. A. M., Morel, P. C. H., Wilkinson, B. H. P. & Purchas, R. W. (2007). Preliminary investigation of the effects of low-level dietary inclusion of fragrant essential oils and oleoresins on pig performance and pork quality. Meat Science 75: 350-355.