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THE EFFECTS OF ASCORBIC ACID, ROSEMARY EXTRACT AND α-TOCOPHEROL / ASCORBIC ACID ON SOME QUALITY CHARACTERISTICS OF FROZEN CHICKEN PATTIES

Meltem Serdaroğlu, Gülen Yıldız-Turp
Food Engineering Department, Ege University, Bornova, Izmir, Turkey

ABSTRACT

The effects of using ascorbic acid (AA), rosemary extract (RE) and α-tocopherol/ ascorbic acid (T+AA) were evaluated on some quality characteristics of chicken patties stored at -20°C for 6 months. On 0th day and 2nd, 4th and 6th months of storage period, TBA, non-heme iron and colour parameters were measured and sensory evaluation was performed on chicken patties. At the end of the storage period patties with T+AA had the lowest TBA values. Non-heme iron content indicated no difference during storage and among treatments. On month 4 and 6 no differences were found on flavour scores between treatment groups.

Key words: Rosemary, chicken patty, ascorbic acid, α-tocopherol, oxidation

INTRODUCTION

Lipid oxidation is one of the major problems encountered in meat processing, cooking and refrigerated storage. It affects the quality of the product due to loss of desirable colour, odour and flavour and a reduced shelf life [1]. Since heat and oxygen have been the factors which promote lipid oxidation, it is thought that the process of cooking may increase the oxidized fat content of food [21]. Warmed-over flavour which is the term used for typical off flavour developed in cooked meat products is a major factor limiting the sensory quality [12]. Increased consumption of precooked foods has raised the concern of the food processing and food service

industries about off-flavour development. However consumers have expressed an interest in reduced use of chemical additives with many segments of the food industry responding by use of natural ingredients. Using of natural antioxidants offers the potential advantages of a reduction and/or replacement of synthetic antioxidants, lowered assumed toxicity due to their natural origin as components of foods; enhanced masking of off-flavours arising from oxidation and greater consumer acceptability as natural ingredients in foods [2]. Vitamin E and C are the most common used natural antioxidants. Rosemary, sage, fenugreek, mulberry, citrus juice concentrates, cherry and oilseed products, Maillard reaction products and carnosine are the other samples of the natural antioxidants [24].

Ascorbic acid is known to act as an antioxidant or as a synergist to antioxidants in models and foods containing autoxidizable lipids [27]. However ascorbic acid may also act as a pro-oxidant in fats and especially in aqueous fat systems. Metal ions appear to be involved in the prooxidative activity of ascorbic acid [10, 27]. Extracts of rosemary are considered as effective alternative to chemical antioxidants. Rosemary extracts contain many compounds with antioxidant properties. Four of these; rosmaridiphenol, rosmariquinone, rosmanol and carnosol were identified as phenolic type compounds, which probably function as free radical scavengers similar to BHA and BHT [11].

α-tocopherol behaves as a chain breaking antioxidant [8]. Localization of α-tocopherol in the membranes allows it to function very efficiently compared to other antioxidants [18]. The synergistic effect of ascorbate and tocopherol was recorded by different investigators [3, 6]. The primary objective of our study was to assess the effectiveness of ascorbic acid, rosemary extract, α-tocopherol /ascorbic acid as an antioxidant during frozen storage of chicken patties.

MATERIALS AND METHODS

Deboned chicken thighs, breasts, trimmings and skin were obtained from a local meat processing plant. Skin was boiled at 95°C ± 2 for 10 min. After all visible fat was removed, the white and dark meat and cooked skin were ground through 1 cm plate. The patties were formulated with 40% breast meat, 30% thigh meat, 15% skin and 14% trimmings. Mixture was divided into 4 equal batches. Three different additives were used (i) 300 ppm rosemary extract (Dragoco 9/037174), (ii) 500 ppm. L (+) ascorbic acid (Merck 5.00074.0100), (iii) 200 ppm. (+)-α-tocopherol (Sigma, Type V from vegetable oil T-3634)/ 500 ppm. L (+) ascorbic acid (Merck 5.00074.0100). Additives were mixed with 1% NaCl to obtain homogenous distribution in batter. NaCl salt (1%) was added in order to obtain a control batch.

Every 5 kg batches of appropriate amounts of each formulation was mixed by hand and processed into chicken patties by using metal shaper. Moisture [20], fat [7], protein [26] and ash analysis [13] were done on raw patty mixtures to evalutate the proximate composition. Moisture contents of patties were ranged from 66.9 to 68.2%, fat contents ranged from 14.2 to 15.3%, protein contents ranged from 19.0 to 19.4% and ash contents ranged from 1.2 to 1.3%. Patties were cooked in an electric oven to an internal temperature of 78°C and frozen at -20°C for 6 months in polypropylene boxes with lids. On 0^{th} day and 2^{nd}, 4^{th} and 6^{th} months of frozen storage, samples were thawed at 4°C for one night and heated in the grill for 10 min at each side with medium heat before the analyses. Oxidative rancidity of chicken patties was determined by Thiobarbuturic acid test (TBA) the level of oxidative rancidity was determined according to Tarladgis et al. [25], the results were expressed as mg malonaldehyde /kg (ma/kg). Non-heme iron plays a major role in accelerating lipid oxidation in cooked meat, non- heme iron content of samples was measured according to Schricker et al. [23]. CIE color parameters; L* (lightness), a* (redness) and b* (yellowness) of cooked patties were measured by Datacolor 3881 Texflash Spectrophotometer. Patties were divided into two parts in horizontally and colour measurements were done on the internal surface.

Sensory evaluation for oxidize flavor was carried out by 8 trained panelists. Patties were heated in the grill for 10 min at each side with medium heat before serving to the panel. For evaluation of oxidize flavor, scoring test was applied [16]. All samples were evaluated using a 5 point scale with 1= very strong oxidized flavour and 5 = no detectable oxidized flavour. All analyses were performed in duplicate with the entire experiment replicated twice. The trial was performed twice and the data was evaluated by one-way analysis of variance (ANOVA). Significance of differences was defined as ($p<0.05$) with Duncan test.

RESULTS AND DISCUSSION

The effects of additives on the oxidative stability of chicken patties stored at -20°C for 6 months were given in Table 1. On the 0^{th} day, the TBA numbers of control (C) and ascorbic acid (AA) added groups were found significantly higher than the group of containing rosemary extract (RE). High TBA values on C and AA

treatments on 0th day, probably was the result of precooking and heating which cause warmed over flavour in patties and the prooxidative effect of ascorbic. TBA value of chicken breast and leg meat has been reported to increase five fold during cooking process [15]. On the 0th day the lowest TBA number of 0.792 was found on RE treated samples. This may indicate that, during precooking and heating process, rosemary extract effectively eliminated autooxidation in chicken patties. Antioxidant properties of rosemary have been demonstrated by other researchers [4, 5, 6, 19]. TBA value of all treatment groups slightly increased during the frozen storage but the increment in TBA values was found significant only for control samples. Lai et al. [17] reported that frozen storage increased malonaldehyde concentration in chicken patties. In our research using α-tocopherol+ascorbic acid and rosemary extract as an antioxidant were found effective to prevent lipid oxidation during the storage period at -20°C for six months. At the end of storage period, T+AA and RE treated samples had TBA values 2.04 and 3.56 mg ma/kg respectively. AA samples had similar TBA values with the control samples at the end of the storage period. These findings confirmed the results of King et al. [14], who found ascorbic acid ineffective in preventing lipid oxidation on poultry at the end of the storage at -20°C for 6 weeks. At 6th month of storage there was a slightly decrease in TBA values of samples with T+AA. Apparent loss of malonaldehyde or other TBA-reactive substances after several months of frozen storage could be due to the interactions of malonaldehyde and amino groups [9].

Table 1. TBA values of pattie stored at -20°C for 6 months

Samples	Storage Period (Month)			
	0	2	4	6
AA	5.26±1.7 ^{a}	7.03±3.5 ^{a}	7.55±1.1 ^{a}	7.30±2.7 ^{a}
RE	0.79±0.2 ^{b}	2.63±0.6 ^{b}	2.71±1.1 ^{b}	3.57±0.8 ^{bc}
T+AA	1.79±0.3 ^{ab}	2.00±0.3 ^{b}	2.33±0.6 ^{b}	2.04±1.4 ^{c}
C	4.75±1.7 ^{aY}	8.53±0.5 ^{aX}	8.72±2.7 ^{aX}	9.40±1.2 ^{aX}

$^{a-c}$ Values being different letters mean significant differences between treatment groups ($p<0.05$).
$^{X-Y}$Values being different capital letters mean significant differences between storage periods ($p<0.05$).

Non-heme iron plays a major role in accelerating lipid oxidation in cooked meat [13]. During the storage non-heme iron concentration indicated no differences among formulations ($p>0.05$). Rhee et al. [22] also reported significant increment in non-heme iron content of chicken dark and white meat during frozen storage.

Colour evaluation results of chicken patties are shown in Table 2. The results indicated no differences among treatment groups at each period of storage, except b* values. On 0th day b* values of RE group and on 4th month b* values of control samples were higher than the other treatment groups. Higher b* value in C patties (on month 4) might be attributed to the oxidative changes. Oxidative changes in meat products may affect colour [15].

Table 2. Colour parameters of patties stored at -20°C for 6 months

	L, a*, b**	Storage Period (Months)			
		0	2	4	6
AA	*L**	73.0±1.1	73.9±2.5	71.5±4.7	71.6±1.9
	*a**	2.5±0.1	2.2±0.6	1.8±0.7	2.1±0.8
	*b**	13.4^{a}±1.7	12.2±1.8	13.2^{a}±1.3	12.9±2.7
RE	*L**	71.6±2.3	71.8±0.8	72.6±4.9	72.6±0.7
	*a**	1.8±0.2	1.5±0.4	1.4±0.3	1.8±0.1
	*b**	14.7^{b}±0.4	14.5±1.3	13.0^{a}±0.9	12.9±1.9
T+AA	*L**	73.7±0.2	72.3±0.2	71.0±1.6	71.9±1.4
	*a**	2.5±0.9	2.1±1.1	1.9±0.3	2.3±1.0
	*b**	11.8^{a}±2.4	12.4±3.8	12.1^{a}±1.7	12.8±2.4
C	*L**	75.0±0.6	74.9±0.1	72.1±3.2	74.5±2.6
	*a**	1.7±3.3	1.9±0.3	2.2±0.4	2.0±0.4
	*b**	13.1^{a}±0.9	12.6±1.3	14.9^{b}±0.3	13.6±0.4

$^{a-b}$ Values being different letters ^{b} mean significant differences between treatment groups ($p<0.05$).

Table 3. Sensory flavour scores of patties stored at -20°C for 6 months

Samples	Storage Period (Months)			
	0	2	4	6
AA	4.6 ± 0.2^{x}	2.7 ± 0.4^{x}	2.1 ± 0.6^{y}	1.5 ± 0.7^{y}
RE	4.1 ± 0.1^{x}	2.5 ± 0.2^{xy}	2.1 ± 1.6^{y}	2.1 ± 1.4^{y}
T+AA	4.3 ± 0.5^{x}	2.7 ± 0.4^{xy}	2.4 ± 0.4^{y}	2.3 ± 0.1^{y}
C	3.7 ± 0.1^{x}	1.9 ± 0.1^{xy}	1.8 ± 0.6^{y}	1.9 ± 0.1^{y}

$^{x-y}$ Values being letters $^{x-y}$ mean significant differences between storage periods ($p<0.05$).

The sensory flavour scores were given in Table 3. There were no significant effects between the flavour scores of patties at each evaluation period. The differences between 0th month flavour scores of AA treated samples and T+AA samples with those of 2nd, 4th and 6th month were found significant. It could be concluded that at early stages of storage there was a great change in flavour of AA and T+AA patties but after that this differences didn't increase continuously. Between month 4th and month 6th no decrement was observed in flavour scores of all treatment groups. Huisman et al. [12] reported that addition of rosemary in a sensory acceptable amount of 0.05% depresses the development of WOF of precooked pork meat balls during storage by 20%. In the present study the panel did not detect the effectiveness of RE and T+AA on lipid oxidation.

CONCLUSIONS

Results indicated that, using of α-tocopherol /ascorbic acid and rosemary extract in chicken patties during storage at -20°C for 6 months slowed down the oxidation effectively. At the end of the storage period, samples added α-tocopherol /ascorbic acid had lowest TBA values. Ascorbic had no effect on lipid oxidation. Non-heme iron concentration indicated no differences during storage and among formulations. Colour parameters did not change significantly during storage except b* values on 0th and 4th months. Using antioxidative additives did not affect flavour scores at the end of the storage period.

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Meltem Serdaroğlu, Gülen Yıldız-Turp
Food Engineering Department, Ege University
35100 Bornova, Izmir, Turkey
Fax (+90232) 342 75 92
e-mail: mserdaroglu@food.ege.edu.tr

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