

STABILITY OF LAMB BURGER CONTAINING NATURAL ANTIOXIDANT EXTRACT: OXIDATIVE AND COLOUR PARAMETERS DURING TWO MONTHS OF FROZEN STORAGE

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Abstract – The aim of this study was to assess the influence of the addition of natural (*Origanum vulgare* extract) and synthetic (sodium erythorbate) antioxidants into lamb burgers in relation to oxidative and color parameters during two months of storage at $-18\pm 1^{\circ}\text{C}$. The herb extract was obtained from a mixture of chemical solvents and, like synthetic antioxidant, was evaluated regarding its antioxidant activity by the colorimetric methods of FRAP (Ferric ion Reducing Antioxidant Power). Lamb burgers were prepared without antioxidants (blank), with sodium erythorbate (control) and with natural extract calculated to have equivalent antioxidant power as 500 ppm sodium erythorbate, according to the antioxidant capacity evaluated by FRAP method. Statistical analysis did not show significant ($P>0.05$) differences for TBARS and carbonyls contents along the storage time in lamb burgers manufactured with oregano extract. On the other hand, a^* values and Hue displayed significant ($P<0.05$) differences during storage time. From the obtained results, it can be concluded that the oregano extract can be considered a quite viable solution as natural antioxidant increasing to the shelf life of lamb burgers compared with sodium erythorbate, due to the positive effects on color parameters and oxidative stability along storage time at $-18\pm 1^{\circ}\text{C}$.

Key Words – FRAP, lipid and protein oxidation, *Origanum vulgare*, ovine.

I. INTRODUCTION

In recent years there is a great concern by most consumers about the food safety and toxicity that can be promoted by the use of synthetic compounds. The current trend for the consumption of natural foods is associated with

numerous epidemiological studies that have reported adverse effects of synthetic additives to the health, which contributes significantly to the search for new natural alternatives [1]. In this sense, herbs have been studied in relation to their antioxidant potential for possible use in replacing chemical additives [2].

The use of antioxidant derived from plant sources are of great importance in preventing the onset of oxidative reactions, showing a high ability to capture free radicals which promote changes in nucleic acids, proteins, lipids and small cellular molecules. According to these functions, they can assist in the quality maintenance of foods with high levels of oils and fats, preventing impairment of texture, flavor, nutritional value and shelf life [3, 4, 5].

Thus, the objective of this study was to evaluate color parameters and oxidative stability of lamb burgers manufactured with natural antioxidant extract (oregano) and stored for two months at $-18\pm 1^{\circ}\text{C}$, aiming the possible replacement of synthetic compound (sodium erythorbate) currently applied by the meat industry.

II. MATERIALS AND METHODS

A. Preparation of natural antioxidants

According to Michiels *et al.* [6] the extract of oregano (*Origanum vulgare*) was obtained using a 20 mL of chemical solvent mixture [acetone/water/glacial acetic acid, 70:28:2%

(v/v)]. One gram of dry plant material was subjected to grinding, agitation, centrifugation, filtration, concentration in a rotary evaporator, lyophilization process and resuspension in ultrapure water [$\frac{1}{4}$ (v/v)].

B. Ferric reducing/antioxidant power (FRAP) assay

The samples, as well as the sodium erythorbate, were evaluated for antioxidant capacity by colorimetric method of FRAP as described by Benzie *et al.* [7], with modifications.

C. Processing of the burgers

The formulation of burgers consisted of meat (84%) and fat (14%), salt (2%) and the antioxidant (synthetic or natural). The meat and fat were thawed at 4 °C for 12 hours and minced separately using disc of the 4 mm. Three batches were processed, being one without antioxidants (blank), other with sodium erythorbate (control) and one with oregano extract. From the average value obtained in relation to antioxidant capacity of the natural extract and sodium erythorbate (500 ppm), was determined the volume of natural extract to be added in the lamb burger.

The burgers were formed using a manual molder (112 mm diameter x 2 cm height) and individually separated with polyethylene films, weighing 95-100 grams. Burgers were frozen in ultra freezer and packed in air-permeable polypropylene bags, being immediately stored at -18 °C. A total of 18 burgers were analyzed (3 batches x 3 different times of manufacture x 2 samples of each batch) in sampling point.

D. Color measurement

The samples were subjected to objective color evaluation using a portable colorimeter (Model XE MiniScan, Mark HunterLab) with CIELab system assessment, using the illuminant D65, observation angle of 10° and open cell with 30 mm. Six readings at different points of the burger surface were taken after exposition to atmosphere.

E. Lipid and protein oxidation

To evaluated lipid and protein oxidation the samples were submitted to analysis of total thiobarbituric acid-reactive substances [TBARS] [8] and carbonyls content [9].

F. Statistical analysis

The results were analyzed using analysis of variance (ANOVA) using the IBM SPSS Statistics 19.0 (IBM Corporation, Somers, NY, USA). A Duncan's test was performed to compare the mean values at a significance level of $P < 0.05$.

III. RESULTS AND DISCUSSION

The results of antioxidant capacity obtained by FRAP methodology for oregano extract and sodium erythorbate were 472.32 and 7044.53 μmol of Trolox/g of dry sample, respectively.

From these results, were performed calculations of equivalence to antioxidant capacity of oregano extract in relation to the 500 ppm sodium erythorbate, obtaining average value of 7463.08 ppm, and consequently 24.01 mL/kg.

Regarding lipid oxidation, statistical analysis show significant ($P < 0.05$) differences along the storage time (Fig. 1), except for the lamb burgers manufactured with oregano extract, which did not differ significantly ($P > 0.05$) during 60 days of storage, showing final mean values of 0.76 mg MDA/kg of sample.

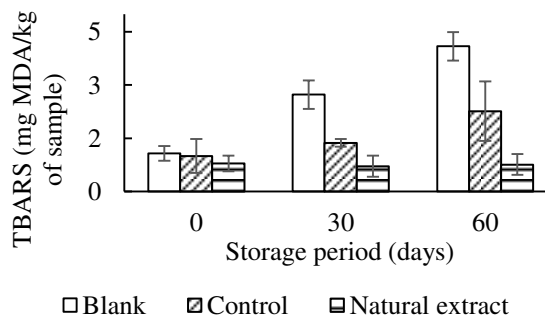


Fig. 1. Effect of addition of antioxidant on the evolution of TBARS values during the storage time of lamb burgers at -18°C

During the storage period, a significant ($P < 0.05$) variation on TBARS values was observed among

treatments at 30 and 60 days, since lamb burgers manufactured with oregano extract presented the lowest values (0.76 vs. 4.09 vs. 2.26 mg MDA/kg of sample for oregano, blank and control batches, respectively after 60 days of storage). These findings are in agreement with those reported by Akarpat *et al.* [10], who noticed that the addition of natural extracts into beef patties stored at freezing delayed the development of oxidative processes in lipids compared with control samples. In line with this, Ozogul *et al.* [11], demonstrated that the addition of oregano, green tea and laurel extracts reduced significantly ($P<0.05$) the TBARS values in fish burgers stored during 9 months at -18°C .

A similar behavior to TBARS values was observed for carbonyls content during the storage time (Fig. 2), since lamb burgers manufactured with oregano extract showed the lowest contents (1.43 vs. 2.48 vs. 2.01 mmol/mg of protein for oregano, blank and control batches, respectively after 60 days of storage).

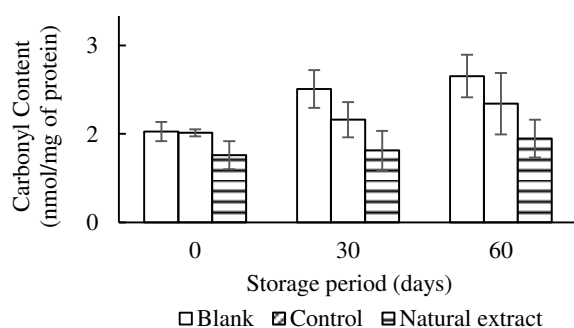


Fig. 2. Effect of addition of antioxidant on the evolution of carbonyl contents during the storage time of lamb burgers at -18°C

The TBARS values and carbonyl contents of the lamb burgers manufactured with oregano extract did not change significantly ($P>0.05$) during the storage time probably because the quantity of extract added presented high content of bioactive compounds [12], capable of act as chelating agents, thus inhibiting the catalytic activity of iron ions [13].

Table 1 shows the effect of addition of antioxidant on the evolution of color parameters during the storage time of lamb burgers. A decreasing trend

was observed as regards to a^* and b^* values, together with an increasing trend in hue values, which are attributed to the gradual oxidation of the iron atom within the heme group in red oxymyoglobin) to brownish metmyoglobin [14].

The results confirm that lamb burgers suffered discoloration, mainly defined by loss of redness, and are in agreement with those reported by Georgantelis *et al.* [14] in beef burgers subjected to frozen storage.

Table 1 Effect of addition of antioxidant on the evolution of color parameters during the storage time of lamb burgers at -18°C (mean \pm standard deviation)

Treatment	Days of storage			Sign.	
	0	30	60		
L^*	BL	46.41 \pm 3.79	48.04 \pm 1.36	47.53 \pm 4.79	n.s.
	CO	46.70 \pm 3.39	48.05 \pm 2.72	47.32 \pm 5.01	n.s.
	NE	47.25 \pm 3.22	48.70 \pm 2.07	47.63 \pm 3.75	n.s.
	Sign.	n.s.	n.s.	n.s.	
a^*	BL	9.16 \pm 0.56 ^b	5.06 \pm 0.41 ^{a1}	3.87 \pm 0.98 ^a	***
	CO	8.29 \pm 0.95 ^b	6.34 \pm 0.35 ^{a2}	5.38 \pm 0.71 ^a	**
	NE	7.96 \pm 0.29 ^b	5.34 \pm 0.50 ^{a1}	4.70 \pm 0.51 ^a	***
	Sign.	n.s.	*	n.s.	
b^*	BL	16.51 \pm 0.84	15.78 \pm 0.30 ²	15.39 \pm 0.44	n.s.
	CO	14.98 \pm 0.66	14.36 \pm 0.64 ¹	14.57 \pm 0.75	n.s.
	NE	15.19 \pm 1.18	14.83 \pm 0.54 ^{1,2}	14.58 \pm 0.43	n.s.
	Sign.	n.s.	*	n.s.	
Hue	BL	60.96 \pm 0.71 ^a	72.19 \pm 1.69 ^{b2}	75.83 \pm 3.80 ^b	***
	CO	61.05 \pm 2.58 ^a	66.15 \pm 0.45 ^{b1}	69.65 \pm 3.35 ^b	*
	NE	62.24 \pm 2.18 ^a	70.16 \pm 1.90 ^{b2}	72.12 \pm 1.79 ^b	***
	Sign.	n.s.	**	n.s.	

BL = Blank; CO = Control; NE = Natural Extract; ^{a,b,c}: Mean values in the same line (corresponding to the same treatment) not followed by a common letter differ significantly ($P<0.05$); ^{1,2}: Mean values in the same column (corresponding to the same days of storage time) not followed by a common number differ significantly ($P<0.05$); Sign. = Significance: n.s.: not significant; * ($P<0.05$); ** ($P<0.01$); *** ($P<0.001$)

At the end of storage period, lamb burgers from blank treatment presented the lowest a^* values, and this outcome could be related with the higher lipid and protein oxidation during the storage causing a decrease in redness. However, at the end of storage period, a^* values did not show significant ($P<0.05$) differences among batches.

These findings are in agreement with those reported by Georgantelis *et al.* [14] who found that the addition of natural extract into beef burgers contributed to retention of red color for a longer time ($P<0.05$) in relation to treatment without antioxidant, due the inhibition of the oxidation.

IV. CONCLUSION

In conclusion, the results suggest that the oregano extract represent an important antioxidant source against lipid and protein oxidation of lamb burgers and it to meat industry due to the positive effects with respect to the parameters evaluated, can replace synthetic compounds to the elaboration of natural consumer-friendly foods with longer shelf life.

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