ANTIOXIDANT ACTIVE PACKAGING FOR BEEF USING OREGANO EXTRACTS

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Introduction

The three most important factors that limit the shelf life of fresh meat are colour, microbial growth and lipid oxidation. Lipid oxidation is perhaps a critical point for red meat; nevertheless, lipid oxidation is not the main limitation for storage for meat packed under aerobic conditions because it occurs at a slower rate than discolouration and microbial growth (Jakobsen and Bertelsen, 2000).

To retard or minimise oxidative deterioration, effective antioxidants could be added in such products. Synthetic antioxidants have long been used, but their use has recently come into dispute due to a suspected carcinogenic potential (Chen *et al.*, 1992 and Imaida *et al.*, 1983) and the general rejection of synthetic food additives by consumers. There is, therefore, a growing interest in the identification of new, natural antioxidants that would serve as alternatives to the synthetic compounds.

Oregano, a characteristic spice of Mediterranean cuisine obtained by drying leaves and flowers of *Origanum vulgare* subsp. *hirtum* plants, is well known for its antioxidative activity (Economou *et al.*, 1991).

The combined use of antioxidants and modified atmosphere packaging for meat represents a realistic and attractive strategy to increase the shelf life of fresh meat (Giese, 1996). The interest in the application of naturally occuring antioxidants has increased over recent years. Besides this, the development of active packaging is currently attracting the attention of food technologists. We are now focusing on applying the antioxidant potential of oregano to the design of a new active packaging system.

The aim of this work was to investigate the effect of treatment with oregano extract and antioxidant active packaging on the display life of beef steaks packaged in modified atmospheres.

Materials and Methods

Whole loins were obtained from the abattoir 48h post-slaughter. Thick steaks 1.5 cm were prepared: (1-3) without any addition, (4) sprayed on the surface with an oregano extract. Batches 1 and 4 were packaged in a modified atmosphere of 70% O_2, 20% CO_2, 10% N_2; batches 2 and 3 were packaged in the same atmosphere with active films containing 1 and 2% oregano extract, respectively. The samples were stored in the dark at 1±1 °C. Samples were taken at selected times (5, 10, 19, 22, 25, 28 and 32 days) for subsequent analysis.

Meat colour was measured at the surface of beef steaks using a reflectance spectrophotometer (Minolta CM-2002; Osaka, Japan). The metmyoglobin (MetMb) percentage of the total myoglobin perceptible at the steak surface was estimated spectrophotometrically, according to Stewart *et al.*, (1965), by measuring steak surface reflectance at 525 and 572 nm (Minolta CM-2002; Osaka, Japan). Lipid oxidation was assessed in duplicate by the 2-thiobarbituric acid (TBA) method of Pfalzgraf *et al.*, (1995). Meat samples were evaluated by a six-member expert panel. All three attributes were scored using a 5-point scale. For 'Red colour', 1 denoted extremely high and 5 denoted extremely low. Scores for 'Discolouration' referred to percentage of discoloured surface, according to Djenane *et al.*, (2001): 1=none, 2=0–10%, 3=11–20%, 4=21–60%, and 5=61–100%. Scores for 'Fresh Meat Odour' were: 1=excellent, not different from fresh meat; 2=good, but slightly poorer than fresh meat; 3=acceptable, but obviously poorer than fresh meat; 4=hardly acceptable as fresh meat; and 5=non acceptable.

Results and Discussion

Values of CIE a^* (redness) are depicted in Figure 1. Treatment with antioxidant led to significant differences ($P<0.05$) with the control from day 8 of storage onwards. At the end of the storage period, untreated sample had very low a^* values, below 5, while samples sprayed with oregano extract and oregano film showed a^* values above 12, representative of a bright red colour.

Figure 2 shows the results of metmyoglobin, expressed as percentage of metmyoglobin of total surface myoglobin. Results demonstrated that the antioxidant extract sprayed effectively delayed metmyoglobin formation. Packs with oregano film were significantly ($P<0.05$) less effective than the sprayed sample.

Figure 3 shows the results of TBA reactive substances (TBARS) throughout the storage of treated and untreated steaks. All of the treated samples showed a highly significant ($P<0.05$) inhibitory effect on the formation of TBARS, with only small differences between surface treatment with the oregano extract and packaging with the active films. Differences were significant ($P<0.05$) from day 9 of storage onwards.

Results of sensory analysis of meat samples, including evaluation of red colour, discolouration and fresh meat odour, are summarised in Table 1.

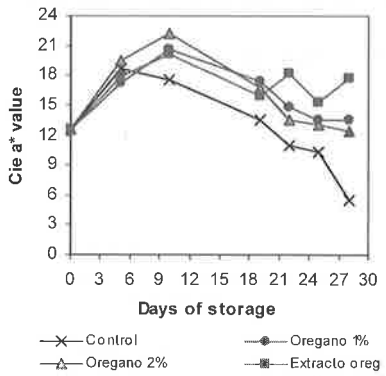

Figure 1: Values of CIE a^* (redness).

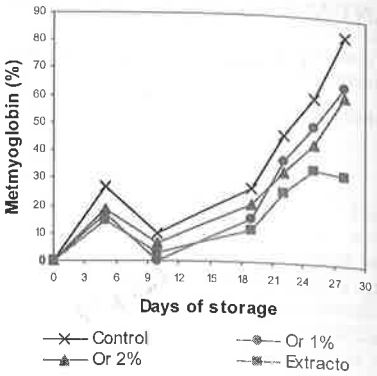

Figure 2: Metmyoglobin, (expressed as percentage of metmyoglobin of total surface myoglobin).

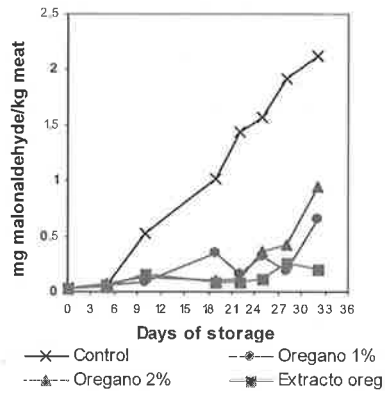

Figure 3: TBA reactive substances (TBARS).

Parameter	Sample	Days of storage 0	5	10	19	22	25	28
Red colour	Control	1	1	1	2	2	4	4
	Oregano 1%	1	1	1	1	2	2	3
	Oregano 2%	1	1	1	2	2	2	3
	Extract	1	1	1	1	1	1	2
Discolouration	Control	1	1	1	2	1	4	5
	Oregano 1%	1	1	1	1	1	2	2
	Oregano 2%	1	1	1	2	2	3	3
	Extract	1	1	1	1	2	1	2
Off odour	Control	1	1	2	2	2	3	4
	Oregano 1%	1	1	1	1	2	2	3
	Oregano 2%	1	1	1	2	1	2	3
	Extract	1	1	1	1	1	1	2

Table 1: Sensory Analysis of meat samples.

Conclusions

Both the addition of the oregano extract and packaging with an oregano active film resulted in enhanced oxidative stability of beef steaks packaged in modified atmosphere at 1ºC, although to different extent. Oxymioglobin and lipids were protected against oxidation during storage, resulting in a better colour and odour stability than the control, extending the self life for at least 3 days.

References

Jakobsen M. and Bertelsen G., (2000). Colour stability and lipid oxidation of fresh beef. Development of a response surface model for predicting the effects of temperature, storage time, and modified atmosphere composition. *Meat Science* 54, 49-57.

Chen C.H., Pearson A.M. and Gray J.I., (1992). Effects of synthetic antioxidants (BHA, BHT and PG) on the mutagenicity of IQ-like compounds. *Food Chemistry,* 45, 177-183.

Imaida K., Fukishima S., Shirai T., Ohtami M., Nakamishi K. and Ito N., (1983). Promoting activities of butylated hydroxyanisole and butylated hydroxytoluene on 2-stage urinary bladder carcinogenesis and inhibition of gamma-glutamyl trans-peptide-positive for development in the liver of rats. *Carcinogenesis,* 4, 895-899.

Economou, Oreopoulou, V., and Thomopoulos, C.D., (1991). Antioxidant properties of some plant extracts of the Labiatae family. *Journal of the American Oil Chemical Society,* 68, 109-113.

Giese, J., (1996). Antioxidants: tools for preventing lipid oxidation. *Food Technology,* 50 11, 73-80.

Stewart, M.R., Zipser, M.W. and Watts, B.M., (1965). The use of reflectance spectrophotometry for the assay of raw meat pigments. *Journal of Food Science,* 30, 464-469

Pfalzgraf, A., Frigg, M. and Steinhart, H., (1995). Alpha Tocopherol contents and lipid oxidation in pork muscle and adipose tissue during storage. Journal of Agricultural and *Food Chemistry,* 43, 1339-1342.

Djenane, D., Sanchez-Escalante, A., Beltrán, J.A. and Roncalés, P., (2001). Extension of the Retail Display Life of Fresh Beef Packaged in Modified Atmosphere by Varying Lighting Conditions. *Journal of Food Science,* 66, 181-186