INCORPORATION OF NATURAL ANTIOXIDANTS IN AN INORGANIC COMPOUND AS ACTIVE PACKAGING FOR MEAT

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I. INTRODUCTION

Meat has a complex chemical composition that is susceptible to oxidation, that involves the development of off odors and decreases the acceptability of meat products by deterioration of their color, texture and nutritive value [1, 2]. Preserving food to extend its shelf life, whilst ensuring its safety and quality, is a central preoccupation of the food industry and government agencies. For the meat industry, retailers and consumers spoilage of raw meat represents a loss, which could be as high as 40% of production. To satisfy the demand for extending fresh meat shelf life and reduction of spoilage, anoxic preservative packaging techniques are widely used, but there is still a place for meat packaged with enhanced O_2 [3]. On the other hand, the use of antioxidants is one of the major strategies for preventing lipid oxidation and may be effective in controlling and reducing the oxidation in meat products [4]. In this regard, the incorporation of natural antioxidants in an inorganic compound in order to obtain an active, recyclable and inexpensive package to increase the shelf life of fresh perishable foods, such as meat, can be a good strategy and has been investigated in this work.

II. MATERIALS AND METHODS

II.1. Active films

Polyethylene based films, in which a 1.5% of three different kinds of terpene natural antioxidants (eugenol, thymol or carvacrol) have been incorporated, antioxidants previously absorbed by an inorganic compound with retention capacity (included in the film at a percentage of 3%). The number of replicates for each tested film were 5.

II.2. Meat packaging

Samples of fresh meat (veal loins) kindly supplied by Portalconsa S.L. (O Porriño, Spain) were packaged with the modified films under study. The trays were sealed at 146 ˚C under a protective atmosphere (80% CO_2 and 20% O_2) and were stored at refrigeration temperatures (0-4 ºC) during 18 days. Control samples were packaged without active film.

II.3. Meat shelf life analysis

The following physico-chemical analysis were performed after 18 days of storage:

- pH and color parameters were measured as described by Lorenzo et al. [2].
- Lipid oxidation. The lipid stability was evaluated according to Lorenzo et al. [2], expressing the thiobarbituric acid reactive substances (TBARS) values as mg MDA/kg sample.
- Textural profile analysis was carried out as described by Lorenzo et al. [5].

Likewise, microbiological studies were carried out in representative meat samples, determining the presence of different groups of microorganisms (expressed as log cfu/g) such as lactic bacteria, enterobacteria, pseudomonas, mold and yeasts [2].

III. RESULTS AND DISCUSSION

The pH values did not show significant differences among groups and they were below 6 in all cases, within that is considered acceptable for meat. Regarding color parameters, the reduction of the red index (a *) to a value close to 9.0 in the control would affect negatively the acceptance of the fresh meat by consumers,

whereas no significant differences were found among the three films tested (values above 13). On the other hand, TBARS values showed significant differences among groups, presenting the lower TBARS values in samples packed with natural antioxidant compared to control batch. This finding is in agreement with data previously reported by Lorenzo et al. [2] who observed lower TBARS values in samples packed with natural antioxidant (oregano and tea extracts). Finally, statistical analysis did not display significant differences on microbial spoilage among the groups studied. This outcome is in disagreement with data reported by Lorenzo et al. [2] who noticed that microbial populations were reduced up to 3.60 log cfu/g on day 14 of storage with the most pronounced effect being achieved by green tea film.

Table 1. Physico-chemical and microbiological data after 18 days of storage

Parameter	Treatment				SEM	P values	Sig.
	Control	Eugenol	Thymol	Carvacrol			
pH	5.74	5.85	5.98	5.66	0.058	0.216	ns
L*	48.02	43.62	43.65	47.96	0.921	0.126	ns
a*	9.02^{a}	13.28^{b}	15.46^{b}	15.34^{b}	0.813	0.011	*
b*	16.70^{b}	13.93^{a}	16.36^{b}	16.88^{b}	0.383	0.006	**
Force (N)	52.07^{b}	46.46^{ab}	36.25^{a}	41.60^{ab}	2.033	0.000	*
TBARs (mg MDA/kg sample)	2.82^{b}	0.06^{a}	0.16^{a}	0.30^{a}	0.299	0.031	***
Mould/Yeasts (log cfu/g)	5.73	5.65	5.56	5.56	0.071	0.840	ns
Pseudomonas (log cfu/g)	3.91	4.36	5.20	4.46	0.209	0.194	ns
Lactic bacteria (log cfu/g)	7.94	8.25	8.05	8.22	0.097	0.694	ns
Enterobacteria (log cfu/g)	3.39	4.95	4.57	4.73	0.273	0.229	ns

Values in the same row differ significantly (Duncan test, P <0.05); Sig: Significance; ns: not significant; *P<0.05; **P<0.01; ***P<0.001; SEM: standard error of mean.

IV. CONCLUSION

The modified films under study presented the ability to reduce the meat oxidation but did not exert antimicrobial capacity.

ACKNOWLEDGEMENTS

Authors are grateful to FEDER-INNTERCONECTA (LIBERCARN project) (grant number ITC-20161009) for the financial support. Special thanks to Coopbox Hispania S.L., Portalconsa, S.L., Destilerias Muñoz Gálvez S.A. and Centro Tecnológico del Calzado y del Plástico for the samples supplied for this research.

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