# EDIBLE BIOACTIVE PACKAGING APPLIED TO REDUCED-SALT BACK BACON RASHERS: EFFECT ON SHELF LIFE

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**Abstract – Reduced-salt back bacon rashers were prepared with two different formulations (C, with 1.25% salt; K with 1.25% salt and 1.25% potassium chloride), and under two different edible packaging films (F, HPMC film; R, bioactive HPMC film with rosemary extract). The rashers were packaged under modified atmosphere (75% $N_2$, 25% $CO_2$) and stored at 6 °C for two thirds of the storage time and at 8 °C for one third. Their shelf life was analysed at day 8, 18 and 25 in terms of colour, pH, water activity, lipid oxidation (TBARS) and microbial stability. The use of rosemary extract decreased lipid oxidation at the end of storage but did not affect the microbial stability.**

**Key Words – rosemary extract, HPMC, reduced sodium**

## I. INTRODUCTION

Bioactive packaging refers to the inclusion of additives into the packaging material that changes the shelf-life or improves the safety of the product [1]. The use of essential oils and plant extracts in this type of packaging has attracted a great deal of interest. Rosemary (*Rosmarinus officinalis* L.), contains a considerable amount of bioactive and antimicrobial compounds and has been successfully used in meat formulations [2]. Due to public health recommendations on salt reduction, the meat industry has been trying to reduce formulation sodium levels. However, salt reduction entails several challenges as it not only provides flavour and texture but also acts as a preserving agent contributing to the shelf life [3]. The aim of this study is to analyse the effect of a bioactive packaging with rosemary extract on reduced-salt back bacon rashers in terms of stability and shelf life during storage.

## II. MATERIALS AND METHODS

Two formulations of back bacon rashers were produced by injecting the corresponding brine (Inject-O-MAT type PSM-21, Dorit Maschinen, Handels AG, Switzerland) into pork loins. Control brine (C) was prepared with 1.25% sodium chloride and 150 ppm of sodium nitrite, the second brine (K) had the same levels of sodium chloride (1.25%) and sodium nitrite (150 ppm) with 1.25%potassium chloride (KCl). The injected loins were weighed, vacuum packed and left to mature at 0-4 ºC for 48 h. Two types of edible coating films were prepared, one with hydroxypropyl methylcellulose (HPMC) (Methocel, Dow Chemicals) and water (F) and a bioactive film with HPMC, water and 0.5 % of rosemary extract (R). The bacon was sliced and the slices were covered by the edible film and packaged under modified atmosphere (75% $N_2$, 25% $CO_2$). In total, four batches were prepared: CF, control bacon with edible film; CR, control bacon with rosemary bioactive film; KF, bacon with KCl and edible film; and KR, bacon with KCl and rosemary bioactive film. Shelf life analysis followed the recommendations from the Food Safety Authority of Ireland [4] regarding storage time and temperature: two thirds of the storage time at 6 °C and one third at 8 °C, representatives of the $75^{th}$ percentile of chill chain temperatures in Ireland. The following analysis took place at day 8, 18 and 25: Gas composition was measured with a headspace gas analyser, bacon colour was analysed using a Hunterlab Ultrascan XE spectrophotometer (CIE L*a*b system); TBARS as [5]; pH using an Orion 420A pH-meter; water activity with the Aqualab Lite meter (Decagon Devices Inc., Pullman, WA); ISO 4833-2:2013, 15214:1998, 13722:1996, 13720:2010 were followed for the analysis of total viable counts (TVC), lactic acid bacteria (LAB), *Brochothrix Thermospacta* and *Pseudomonas spp*, respectively.

## III. RESULTS AND DISCUSSION

Gas composition did not significantly vary during the storage time for any of the formulations; presence of oxygen in the measured trays was always below 0.6%. Instrumental colour was significantly affected ($p<0.05$) by formulation but no significant differences were found between storage times. Control rashers (CF and CR) were lighter, redder and

yellower than the samples with KCl (KF and KR). The use of rosemary extract in the film did not affect the colour of control samples but it made KR slightly more yellow when compared to KF, b* mean value of 5.76 vs. 5.12 ($p<0.05$), due to its brownish colour. Lipid oxidation was very low during storage (< 0.08 mg MDA/kg sample), only increasing at day 25 for samples with edible film (CF: 0.22±0.06 mg MDA/kg sample, KF: 0.15± 0.05 mgMDA/kg sample). The use of rosemary extract exerted an antioxidant effect for both formulations, being significantly lower than CF and KF. The antioxidant effect of rosemary extract when used in coatings has been reported previously [1, 2, 6]. The use of potassium chloride increased the pH ($p<0.05$) when compared to the samples without it (CF and CR). The pH significantly increased from day 8 for CF and KF, while the pH of samples with rosemary extract did not change until day 18. No significant differences were found in the water activity of any formulation during storage.

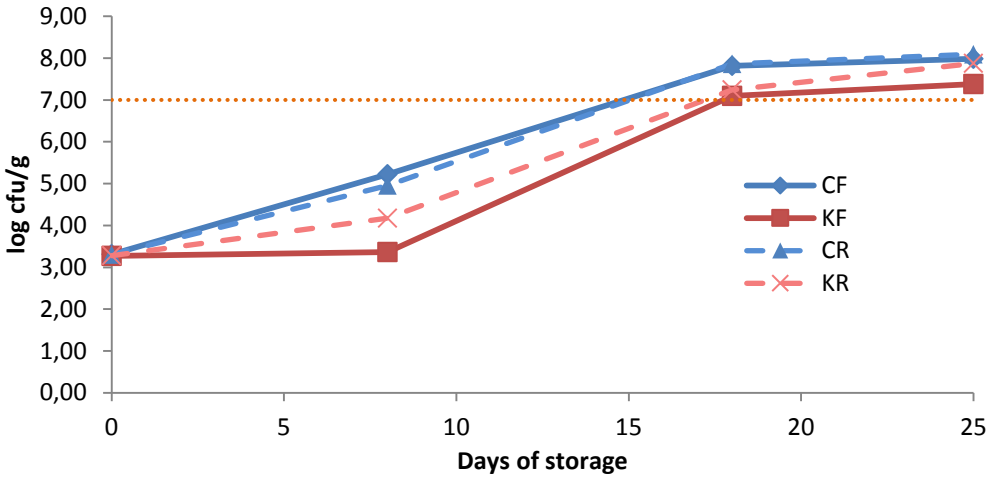


Figure 1. Total Viable Counts during storage for back bacon rashers

Rosemary extract did not exert any antimicrobial effect, as TVC were similar or even higher in CR and KR than in their counterparts without the extract (Fig. 1). LAB were the predominant bacteria. The counts for *Pseudomonas* and *Brochothrix* were below the detection limit during the whole storage time for all formulations. The use of KCl increased the microbial stability of the rashers.

## IV. CONCLUSION

The use of Rosemary extract in a bioactive edible film had an antioxidant effect but did not exert any antimicrobial effect on reduced-salt back bacon rashers under the studied conditions.

## ACKNOWLEDGEMENTS

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## REFERENCES

1. Coma, V.(2008).Bioactive packaging technologies for extended shelf life of meat-based products.Meat Science,78:90-103
2. Sirocchi, V., Devlieghere, F., Peelman, N., Sagratini, G., Maggi, F., Vittori, S., & Ragaert, P.(2017).Effect of *Rosmarinus officinalis* L. essential oil combined with different packaging conditions to extend the shelf life of refrigerated beef meat. Food Chemistry, 221: 1069-1076.
3. Desmond, E. (2006). Reducing salt: A challenge for the meat industry. Meat Science, 74(1), 188-196
4. Food Safety Authority of Ireland (FSAI) (2014). Guidance Note No. 18: Validation of Product Shelf-life (Revision 2)
5. Delgado-Pando, G., Cofrades, S., Ruiz-Capillas, C., Solas, M.T., Triki, M., & Jiménez- Colmenero, F. (2011). Low-fat frankfurters formulated with a healthier lipid combination as functional ingredient: Microstructure, lipid oxidation, nitrite content, microbiological changes and biogenic amine formation. Meat Science, 89 ,65–71
6. Zhang, H., Wu, J., & Guo, X. (2016). Effects of antimicrobial and antioxidant activities of spice extracts on raw chicken meat quality. Food Science and Human Wellness, 5(1), 39-48.