EFFECT OF RADIO FREQUENCY HEATING ON OXIDATION PROCESSES IN MAP PACKAGED FRIED MEATBALLS

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I. INTRODUCTION

Radio frequency heating finds a number of applications in the meat processing industry, most notably for rapid defrosting of meat. No data were found in the literature on its use to extend the shelf life of modified atmosphere packaging (MAP) packaged heat-treated meat products. Therefore, we set out to determine whether the shelf life of fried meatballs in MAP packaging can be extended judging by the degree of oxidation of the lipid and protein fraction of the product.

II. MATERIALS AND METHODS

In the experiment, fried meatballs, regularly produced by the company "Pikant Trade" Ltd., Varna, were used. Radio frequency heating of the packaged fried meatballs was carried out on a STALAM apparatus, model "RF 1 x 7 kW", series 2627/1 (Stalam S.p.A., Nove VI, Italy). Oxidative changes were monitored in five experimental samples: (1) dwell time in the radiofrequency heating zone 10 min (belt speed 7.2 m/h) and set voltage 2000 V; (2) - 10 min (7.2 m/h) and 4000 V; (3) 30 min (2.4 m/h) and 2000 V; (4) - 30 min (2.4 m/h) and 4000 V; and (5) - 20 min (3.6 m/h) and 3000 V. A Control sample (6) - not radio frequency heated was also studied. The lipid oxidation was determined by thiobarbituric acid reactive substances (TBARS) method [1]. The degree of protein oxidation (P-Ox) was determined by the method of Mercier et al. [2]. The effect of both factors (regime of radio frequency heating and time of refrigerated storage) was evaluated applying two-way ANOVA with replications at $p \leq 0.05$ ($n = 6$) [3].

III. RESULTS AND DISCUSSION

It was found that both factors – regime of radio frequency heating and time of refrigerated storage influenced on TBARS and P-Ox at $p \leq 0.05$. The secondary products of lipid oxidation, in particular malondialdehyde (MDA) increased during 90 days of refrigerated storage of all samples ($p \leq 0.05$). On the 60th days their levels are up to 2 mg MDA/kg (limit discussed as maximum permissible for meat products). At this stage of storage, sample No. 4 has the lowest ($p \leq 0.05$) TBARS levels - up to 1.5 mg MDA/kg (Figure 1 A). Similar results were found for protein carbonyls (Figure 1B). On the 60th day P-Ox's levels are very low - up to 0.30 nmol DNPH/g protein and sample No. 4 shows the lowest P-Ox levels - up to 0.25 nmol DNPH/g protein ($p \leq 0.05$).

During the last 30 days (from 60th to 90th d) of storage, a significant ($p \leq 0.05$) acceleration of both lipid and especially protein oxidation was found (Figure 1).

The changes found in this way may be due to impaired gas permeability of the packages and entry of oxygen (especially evident after the 60th day of storage at 4 - 6°C), as well as to a faster transformation of primary oxidation products into secondary ones as a result of radio frequency heating.

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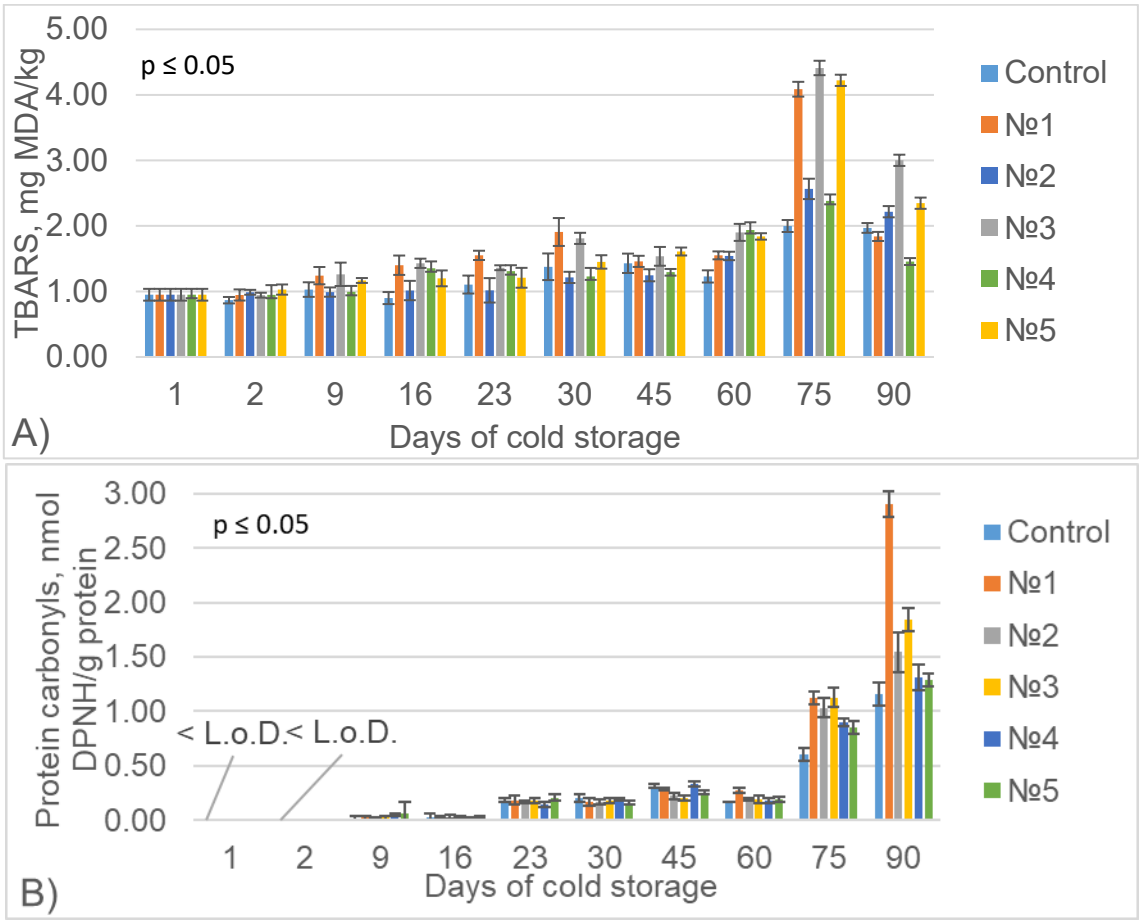

Figure 1. Changes in degree of: A) Lipid oxidation (TBARS); B) Protein oxidation (P-Ox)
*L.o.D – limit of detection

IV. CONCLUSION

Based on the results obtained, it was concluded that the shelf life of MAP-packaged fried meatballs could be extended from 30 up to 60 days if subjected to 30 min (belt speed 2.4 m/h) of radio frequency heating at 4000 V.

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