

Effect of three-component antioxidant blend on oxidative stability and nitrite reduction of cooked sausages

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Objectives: The composition of meat products makes them one of the most nutritional valuable and in the same time the most susceptible to oxidative deterioration food. There is a number of synthetic additives used to preserve their quality but consumers' demand for "clean label" products pushes the area of research. The use of sodium nitrite in cooked meat products is almost essential. Firstly, to form the characteristic pinkred color and to inhibit the growth of pathogens. On the other hand, the residual nitrites threat to harm the consumers health and their reduction is important. Rose-oil industry generate tons of by-products whose utilization has positive ecological aspects. Contained in those by-products compound exhibiting antioxidant properties and their natural origin makes them an alternative preserving additives. The aim is to evaluated the effect of the incorporation of the three-component antioxidant blend on the antioxidant activity and oxidative stability of functional cooked sausages with nitrite reduction.

Materials and Methods: A mathematical optimization according four target functions was performed to determine the optimal concentration of the blends' three components. The blend consists of: 0.100 g freeze-dried extract from dry distilled rose (*Rosa dama-scena* Mill.) petals/kg, 0.091 g dihydroquercetin isolate from *Larix sibirica* Ledeb/kg and 0.100 g sodium L-ascorbate/kg. The experimental cooked sausages were produced from chilled deboned beef shoulder and pork bacon, at 48 h *post mortem*. Samples were formulated as follows: control - C 100% nitrite and no three-component antioxidant blend, AN100, AN75, AN50, AN25 and AN0 with three-component antioxidant blend and respective percentage of nitrite. The changes in residual nitrites, antioxidant activity as well as the hydrolysis and oxidation in lipid and protein fractions were evaluated at 1, 7 and 14 days of the cold storage (0 - 4 °C).

Results and Discussion: The content of the residual nitrites in the final cooked sausages decreased proportionally to their reduction. Almost half reduction of residual nitrites was found in AN75 (6.51 ± 0.08 , mg NaNO₂/kg) compared to the control - C (11.79 ± 0.19 , mg NaNO₂/kg). The antioxidant activity expressed by the radical-scavenging activity (DPPH, $\mu\text{mol Trolox Eq}/100 \text{ g}$) and iron-reducing activity (FRAP, $\mu\text{mol Trolox Eq}/100 \text{ g}$) increased in all experimental samples compared to the control. DPPH values assessed in AN75 (224.64 ± 2.92) are more than five times higher than the control ones (41.00 ± 0.69). Similar are the FRAP values where the increase is almost 3.4 times for the respective samples. With the incorporation of three-component antioxidant blend lipolysis and lipid oxidation are inhibited. The cooked sausages with reduced up to 50 % nitrites (AN100 - 0.74 ± 0.04 ; AN - 0.70 ± 0.05 and AN50 - 0.81 ± 0.03) are characterized by a lower acid value (AV, mg KOH/g fat) compared to the control (C - 1.54 ± 0.04). The changes in peroxide values (POV, $\mu\text{eqO}_2/\text{kg fat}$) during storage show extension of the induction period in the cooked sausages with reduced up to 50 % nitrites. The evaluated decrease in DPPH and FRAP values during storage confirms the extended induction period observed in POV. At the seventh day the thiobarbituric (TBA) values (mg MDA/kg) of AN100 (0.47 ± 0.07), AN75 (0.51 ± 0.01) and AN50 (0.42 ± 0.01) are two times lower in comparison to the control (1.03 ± 0.06). At the 14th of the storage period the TBA value of control - C decreased compared to the 7th day suggesting that the end products of the lipid oxidation are inducing protein oxidation. The hydrolytic changes in protein fraction expressed by the α -aminoacidic nitrogen during storage are minimal and no significant between the examined samples. The formation of protein carbonyls is inhibited in the samples produced with three-component antioxidant blend. At the 7th day the protein carbonyls expressed as nmol DNPH/mg protein in AN100 (0.146 ± 0.001) and AN75 (0.188 ± 0.015) are 1.5 and 1.2 times lower than those of the control - C (0.230 ± 0.007). Similar are the results obtained at the 14th day of the cold storage (0 - 4 °C). The assessed to some extent higher accumulation of protein carbonyls in AN75 in theory is to the fact that sodium nitrite exhibit weak antioxidant activity which decreases with its reduction.

Conclusion: The results allow us to conclude that the incorporation of the three-component antioxidant blend containing 0.100 g freeze-dried extract of dried distilled rose petals/kg; 0.091 g dihydroquercetin/kg and 0.100 g sodium L-ascorbate/kg has the potential for production of functional cooked sausages with up to 50 % reduced nitrite inclusion.

Key words: Functional meat products, Lipid oxidation, Residual nitrites, Rose extract