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Lipid oxidation in cooked pork meat sausages as affected by natural antioxidant combinations (#73)

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Introduction

Lipid oxidation in meat products causes major quality deterioration during storage (Valencia et al., 2008; Erdmann et al., 2017). Nitrite, phosphates and ascorbates are the mostly used antioxidants, but an interest has been growing towards natural antioxidants due to the risks associated with the above antioxidants (Yu et al., 2015). Spices, herbs, berries and fruit are rich in natural antioxidants (Carlsen et al., 2010) and during recent years different natural antioxidants, but not so often mixtures of them, have been studied to find suitable replacers for synthetic antioxidants in meat products (Karre et al., 2013; Kumar et al., 2015).

The purpose of the present study was to study the antioxidative effect of mixtures of vegetables, berries and fruits in cooked sausages and the development of the oxidative status of sausages during storage of 40d.

Methods

21 different edible plant materials and mixtures of them were screened for antioxidant capacity. Antioxidant activity of the plant extracts (1:1 ethanol:water mixture) was measured as a radical scavenging capacity with the ABTS [2,20-azinobis-(3-ethylbenzothiazoline-6-sulfonic acid)] radical scavenging assay (Re et al., 1999), with modifications of Pihlanto et al. (2008). Based on the results, two mixtures of vegetables were prepared to achieve ingredients with high antioxidant capacity and good sensory properties.

The mixtures were white beetroot, plum mash, onion, rosehip and lovage (VegA) and apple mash, purple carrot and white onion (VegB). Dry matter (dm) content and pH of the mixtures were for VegA 25% and 3.33 and for VegB 20% and 3.81, respectively.

Three different sausage batches with ten sausages each were prepared; control (Cont) and two with the antioxidative plant ingredients (VegA and VegB). Raw pork pH was measured in order to ensure equal meat pH in each sausage batch, resulting in pork pH for Cont, VegA and VegB 5.87, 5.94 and 5.75, respectively. Based on the dm contents of the plant ingredients the amount of added water in the formulation (Table 1) was adjusted to produce approximately equal moisture contents in the sausages.

The sausage batters were mixed with bowl chopper Seydelmann K 20 Ras (temperature of batter 15-18°C) and stuffed by Minerva VINS22 stuffer to approx. 500g weight and ø58mm. The sausages were smoked lightly and cooked to 70°C core temperature with oven Kerres CS 350 EL FLR.

The sausages were analyzed for cooking loss. Samples for dry matter, fat and protein content were stored overnight at 2°C and thereafter frozen until analysed. On 2, 20 and 40d of storage the pH and lipid oxidation levels of the sausages were measured as thiobarbituric acid reactive substances (TBARS) utilizing a specific UPLC method from pooled sample of three sausages in each treatment at each time point.

Results

Antioxidant activity between the materials varied greatly with Trolox equivalent capacity (TEAC) values from 0.01 to 0.27 mg dm/ml. Savory, rosehip and lovage were categorized the most efficient antioxidants with TEAC values 0.27, 0.16 and 0.12 mg dm/ml, respectively. The TEAC values for the VegA and VegB mixtures were 0.04 and 0.03 mg dm/ml, respectively.

The cooking loss of the sausages two days after cooking was on average for Cont 4.5%, VegA 4.6% and VegB 3.7%. They were at a general acceptable level.

The protein and fat contents of the sausages were similar in each treatment (Fig. 2). The moisture content was highest in Cont and lowest in VegB sausages. The pH of the sausages was highest in the Cont and lowest in the VegA group (Fig. 2). The oxidative stability of all sausages was good throughout the storage of 40 d, although the VegA and VegB showed TBARS at slightly higher level.

Conclusion

The antioxidative capacity of the plant ingredients was low compared to the ones of individual vegetables. However, the materials for the plant ingredients were chosen to support the color and taste properties of the sausages. According to Puolanne et al. (2001) meat pH affects the sausage water holding capacity. Sour vegetable mixtures VegA and VegB in the present study lowered the sausage pH, but did not increase the cooking loss, eventually due to the good water-holding of the formulation.

The lipid oxidation status of the sausages was stable during the 40d of storage and the plant ingredients did not show any significant effect on the TBARS levels. The results indicate that the concentrations of nitrite, sodium citrate and ascorbic acid used in the sausages were sufficient to prevent lipid oxidation. However, the plant ingredients provide a source of fibers and phytochemicals lacking in the meat and thus, can be used to increase the nutritional quality of the sausages.

Literature

Carlsen et al., 2010. Nutrition Journal 9, 3–13; Erdmann et al., 2017. LWT-Food Sci Technol 79, 496–502; Karre et al., 2013. Meat Sci 94, 220–227; Kumar et al., 2015. Compr Rev Food Sci Food Saf 14, 797–812; Pihlanto et al., 2008.

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Food Chemistry 109, 104-112; Puolanne et al., 2001. Meat Sci 58, 1–7; Re et al., 1999. Free Radic Biol Med 26, 1231-1237; Valencia et al., 2008. Meat Sci 80,1046–1054; Yu et al., 2015. J Food Sci Technol 52, 1032–1039

Table 1. Formulation of the experimental sausages

Ingredient	Control %	VegA,VegB %
Pork neck	45.3	45.3
Pork back fat	15	15
Pea protein	1.15	1.15
Water	12.55	10.55
Ice	20	15
Vegetable mixture A/B		7
Nitrite salt 0,6 %	1.25	1.25
NaCl	0.55	0.55
Sodium citrate	0.5	0.5
Ascorbic acid	0.05	0.05
Dextrose	0.3	0.3
Potato starch (organic)	3.35	3.35
All	**100**	**100**

Meat and fat from a Finnish meat enterprise

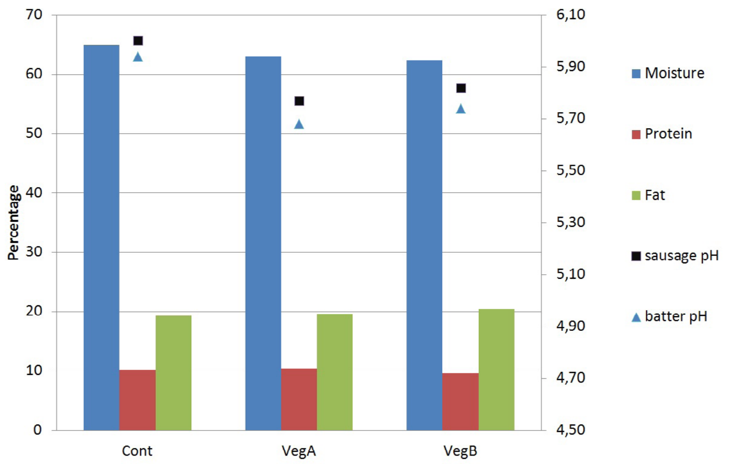

Figure 1. Proximate composition and pH of the three treatment groups sausages.

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