Utilization of soybean post-production waste as an antioxidant additive in pork meat formulation

Hana Derbew, Marzena Zając, Joanna Tkaczewska, Ewelina Jamróz

University of Agriculture in Kraków, Kraków, Poland

Introduction: Lipid oxidation is a major cause of meat and meat products deterioration during processing and storage, resulting in undesired changes in color, flavor, texture, and nutritional profile. Antioxidants have been extensively utilized to protect meat and meat products from oxidation. For many years, both BHA and BHT have been broadly applied to retard lipid oxidation and prolong the shelf-life of meat and meat products. However, concerns regarding the long-term safety of synthetic antioxidants, as well as a negative consumer impression of them, have led to an increase in the usage of natural antioxidants in meat and meat products (Oliveira et al., 2014) Soy husks are wastes received in high amounts at soybean flour production. They contain about 35% of protein and can be used as a raw material for hydrolysate production. The results of preliminary studies, on soy protein hydrolysate obtained from soy husk, revealed its high potential to work as an antioxidant. It could be used in the production of meat emulsions, which are susceptible to oxidation (Cheng et al., 2010). The objective of the present study was to investigate the e- ects of soy protein hydrolysate in meat products manufacturing.

Materials and methods: Soy husk (as a production waste) was donated by a soy flour producer. Soy protein hydrolysate (SPH) was prepared through hydrolyzing soy husk with Alcalase at a temperature of 65 °C in pH 7 for 3 hours. Pork meat and salt (NaCl) used for production of meat formulation were obtained from a local retailer (Krakow, Poland). Two variants of meat products were prepared: C-with 1.5% (w/w) NaCl and 30% of water (with no soy husk hydrolysate) and S – with 1.5% (w/w) NaCl and 30% of water and 1% soy husk hydrolysate. Meat was homogenized with other ingredients for 3 minutes (Robot Coupe, France) and then meat batters were placed in 50 ml plastic tubes using a hand filler. pH was measured in raw formulations. The samples were cooked in a water bath (90 oC for 30 min). Three independent production batches were prepared. Each sample was weighed before and after cooking to measure cooking loss. Fat and water content in the liquid released during cooking were determined by drying the exudate in an oven (100 °C/16h) (Choi et al., 2007). TBARS values (Pikul et al., 1989) were measured in the samples on the next day and after storage at 4 °C for 8, 14, and 21 days.

Results: The result shows that pork formulation supplemented with 1% soy husk hydrolysate had higher pH (6.19 vs 6.05) and lower weight loss than the control (19.51 % vs 20.98%). The analysis of cooking loss showed, that samples with soy protein hydrolysate maintained more water and less fat compared to the control samples. The fluid released during cooking consisted of 6.33% fat and 93.67% of water in the control, while 6.67% of fat and 93.33% of water in the sample with hydrolysate. This indicates that SPH binds water slightly better than fat. However, the presence of 1% soy protein hydrolysate did not inhibit lipid oxidation in pork meat formulation when compared to control. In fact, it was even enhanced in the samples containing SPH. The concentration of TBARS values in SPH treated formulation increased from 1.55 to3.96 mg malonaldehyde/kg and from 1.46 to 3.30 mg malonaldehyde in the control sample during 21 days of storage. These unexpected results contradicted the findings of other authors (Lee et al., 2015). According to our preliminary study soy husk hydrolysate contains a lot of free amino acids. (37, 66 g/100 g of hydrolysate). Most amino acids have been reported to act as antioxidants. However, depending on the concentration and pH, the antioxidative effect varies and can even reverse into a pro-oxidative effect. Linoleic acid oxidation was shown to be inhibited by cysteine, histidine and alanine at pH 9.5, while at pH 7.5 cysteine was strongly pro-oxidative and both histidine and alanine were antioxidative at low, and pro-oxidative at higher concentrations. To sum up, the antioxidative effect of amino acids seems to be very complex and dependent on a number of factors such as presence and concentration of trace metals, pH, temperature and the concentration of the amino acid itself (Eriksson et al, 1982). Therefore, it is possible that amino acid concentration at pH typical for meat determines rather prooxidative activity.

Conclusions: Protein hydrolysate produced from soy husk, despite its positive effect on decreasing cooking losses, cannot be used in meat product formulations as an antioxidant agent. Careful analysis of its chemical structure and interactions with meat constituents is necessary, to detect the exact cause of the prooxidative effect observed in this study.

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