Protein extraction aids salt swelling of pork meat

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Introduction: The salt-induced swelling of meat is an important aspect of meat processing. One of the three main hypotheses (Puolanne & Halonen, 2010) for the mechanism of this are involves entropically-driven osmotic forces around the thick and thin filaments, balanced by the elasticity of the actin-myosin cross-bridges. This mechanism was proposed (Offer & Knight, 1988) from experimental work on myofibrillar swelling in very large relative volumes of salt solution (Offer & Trinick, 1983). These experiments exclude the possibility of studying the effects of soluble proteins and metabolites on swelling behaviour. We describe a preliminary study of the effects of soluble and solubilised proteins on swelling of pork meat pieces.

Materials & Methods: Rectangular blocks, approx. 5 cm long (parallel to the fibre direction) and 1.5 cm in width and depth, were cut from porcine longissimus muscle obtained 60 hours post-mortem. Eight blocks were initially weighed and four blocks placed in each of two baths containing 500 ml of 3% NaCl, pre-chilled at 4°C. The blocks were lightly blotted and weighed after each 24-hour period of storage at 4°C, for a total of 7 days. After each weighing, the saline in one bath was replaced by fresh 3% NaCl, whereas the saline in the other bath was not changed. The protein content in each bath at the end of the experiment was determined by UV absorption at 280nm (Aitken & Learmonth).

Results: Muscle blocks soaked in 3% NaCl with no change of solution showed a weight gain of approximately 12% after one day, 20% after 3 days, and little change thereafter. The pH showed little change (5.45 after 1 day, 5.52 after 3 days) In contrast, where the 3% NaCl bathing solution was changed daily, the blocks, gained approximately 30% after 3 days and over 40% in total, with no sign of a plateau being reached by day 7. The pH just prior to changing the solution was 5.47 after 1 day, and 5.50 after 3 days. In the bath with no change of saline, the final protein content was 12.56 mg/ml. The total amount of sarcoplasmic proteins in the meat blocks in this bath could only yield 9.04mg/ml. As expected, the amount of protein extracted by the last change of saline (between day 6 and 7) in the bath where the saline was changed daily was much lower (1.24 mg/ml).

Conclusions: The rate and extent of swelling is substantially higher when saline containing molecules leached out from the meat is replaced by fresh saline daily. Although the buffering capacity of the meat may be extracted when the saline was changed daily, no appreciable change in pH was noted between the two treatments. Continual removal of soluble protein, and probably a small amount of myofibrillar protein from the periphery of the meat blocks together with small molecular-weight metabolites, promotes a greater swelling between the remaining myofibrillar structures. This is not adequately explained by the entropically-driven osmotic force hypothesis, or the alternative mechanisms of electrostatic interactions or capillary forces proposed for salt swelling of meat, and suggests a further mechanism may be involved.

Literature cited:

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