Effect of sodium chloride on myoglobin and lipid oxidation in pork

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Objectives: Sodium chloride added to meat adjusts its taste, reduces the meat product's water activity, and improves its storage stability. On the other hand, sodium chloride is known to promote the oxidation of meat lipids and contribute to the generation of warmed-over flavour (WOF). The mechanism is thought to be that sodium chloride liberates the ferric atom from myoglobin, a chromoprotein in meat. The ferric atom released by sodium chloride is oxidized to generate hydroxyl radical, and this hydroxyl radical deteriorates the polyunsaturated fatty acid of meat to cause WOF. However, our results suggest that sodium chloride pro- motes lipid oxidation in pork in a concentration-dependent manner but has no apparent effect on the amount of free iron. Therefore, we examined the effects of sodium chloride addition on myoglobin and lipid oxidation to further clarify the cause of lipid oxidation in meat products due to added salt in this study.

M**aterials and Methods:** We purchased flesh pork thigh meats from a nearby meat wholesaler. The pork thighs were ground using a chopper and used in subsequent experiments. Refined salt (sodium chloride 99.0% or more) was added to the ground meat at 0 to 10%, mixed well and degassed, and then the meat batter was stuffed into a clear plastic bag that was not permeable to oxygen. In addition, an experimental group was set up in which 1.25% sodium chloride and 100 ppm sodium nitrite were added as a reference sample. The reference group was made into meat batter, similarly to the experimental groups. The meat batters were stored in a refrigerator at 5 ° C for up to 3 days. The reflection spectroscopy measured the change in the methylation ratio during refrigeration (Izumimoto & Ozawa, 1993).

Furthermore, we measured the meat batter's non-heme iron content and thiobarbituric acid reactive substances (TBARS) value after 3-day's refrigeration. Non-heme iron content was determined by the phenanthroline-iron method. TBARS values were deter- mined by steam distillation (Kawahara et al., 2003). In an experiment to examine the effect of sodium chloride on the redox state of myoglobin preparation (from horse skeletal muscle, Sigma), myoglobin preparation (0.15% final concentration) reduced with sodium hydrosulfite in advance was dissolved in a 0 to 10% sodium chloride solution (adjusted to pH 7.2 with phosphate buffer). The samples were then allowed to incubate at 5˚C. We then measured the absorption spectrum over time, and the metmyoglobin ratio of myoglobin was calculated according to Trout's method (1990).

R**esults and Discussion:** The TBARS values of the refrigerated meat paste gave higher values depending on the amount of salt added, confirming that sodium chloride added to meat promotes lipid oxidation in a concentrationdependent manner. Non-heme iron content increased in a salt concentration-dependent manner up to 2.5%. However, it did not increase in a salt concentration-dependent manner in the test plots where salt concentration was further increased. Chloride ions derived from sodium chloride in an aqueous solution are known to enhance iron solubilization. The results of this study suggest that the amount of iron solubilized from myoglobin by the action of chloride ions is not necessarily concentration-dependent. On the other hand, the metmyoglobin ratio in pork increased in a salinity-dependent manner. As the sodium chloride concentration increased, we also observed reduced myoglobin to change to metmyoglobin in a shorter time. These results suggest that salt added to meat products directly affects the iron coordinated to myoglobin in meat and promotes its oxidation.

Based on these results, we conclude that the direct oxidation of iron atoms coordinated to myoglobin by salt is the primary mechanism by which lipid oxidation is promoted by salt addition.

Key words: Sodium chloride, Myoglobin, Metmyoglobin, Lipid oxidation, Iron