

Inhibitory Effects of Sodium Chloride on the Formation of Mutagens/Carcinogens and Expression of Genotoxicity during Cooking of Meat

Shuichi Masuda, Yuko Shimamura

University of Shizuoka, School of Food and Nutritional Sciences

Summary

This study was aimed at examining the effect of sodium chloride on the formation of toxic substances mutagens/carcinogens, such as heterocyclic amines (HCAs), glycidol fatty acid esters (GEs) and 3-monochloropropanediol fatty acid esters (3-MCPDEs) in cooked meat.

Sodium chloride was added to each meat (beef, pork and chicken) to be a final concentration of 2, 5 and 10% before forming meat patties. Each meat patty containing sodium chloride was heated for 6 minutes (each side for 3 minutes) by gas cooking. The lightness (L^*), redness (a^*), yellowness (b^*) and whiteness (W^*) of each cooked meat was measured by the color difference meter. Formed mutagens in cooked meat samples were extracted using a blue cotton-adsorption method. Mutagenicity of extracted samples was evaluated using the Ames test (TA 98, +S9 mix). The concentration of HCAs, such as Norharman, MeIQx, IQ, PhIP, Trp-P-2, MeIQ, MeA α C, Harman, in the cooked-meat extracts was determined using LC-MS / MS. After similarly cooked meat samples were lyophilized, lipids were extracted from samples by Soxhlet extraction with diethyl ether. The diethyl ether solution was evaporated to obtain lipids. Lipid samples were purified using a solid phase column. The concentration of 6 types of GEs and 6 types of 3-MCPDEs in the lipid samples were measured by LC-MS/MS.

The L^* and W^* of each cooked meat was decreased by the addition of sodium chloride. The addition of sodium chloride to meats reduced the mutagenicity of cooked samples. The concentrations of each HCA in cooked meats were decreased by the addition of sodium chloride. This is because the denaturation of protein and the water retention capacity in meat increased with the addition of sodium chloride. The concentration of GEs was decreased in cooked-meats with the addition of sodium chloride. However, the concentrations of 3-MCPDEs in cooked meats were increased. It is suggested that the formation of GEs and 3-MCPDEs was affected by the amount of lipids and water in the meat. GEs and 3-MCPDEs were generated from the same product intermediates from lipids. Therefore, it was suggested that the addition of sodium chloride tended to produce 3-MCPDEs rather than GEs. These results showed that the addition of salt to meat may inhibit the formation of mutagens in cooked meats.