Effects of transition metals on the early stage of Maillard reaction during food processing

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Summary

Typical nonenzymatic reaction occurring among food components is caused by amino and carbonyl compounds, called Maillard reaction. Dicarbonyl compounds, such as 3-deoxyglucosone (3-DG) and glyoxal are generated in the early stage of Maillard reaction and they react rapidly with proteins to form advanced glycation end products (AGEs). The generation of these compounds in the early stage of the reaction was investigated. Fructose was incubated in the absence or presence of lysozyme for 14 days at 50 ℃ in 0.2 M sodium phosphate buffer at pH 7.4. Dicarbonyls generated from each reaction system were incubated with 2, 3-diaminonaphthalene, and the benzo[g]quinoxaline derivatives of dicarbonyls were analyzed by reverse-phase HPLC. It revealed that 3-DG was predominant in this reaction system, whereas lower amount of other dicarbonyls (3-deoxyxylosone, glyoxal, glucosone, tetrosone, methylglyoxal, 3-deoxytetrosone, and 4-deoxytetrosone) were also generated. These results suggest the important role of 3-DG in the formation of AGEs.

In order to evaluate the effect of transition metal ions contained in the buffer, diethylenetriamine pentaacetic acid (DETAPAC) was used to chelate metals. Depletion of metals resulted in the considerable reduction of glucosone, tetrosone, 3-DX, and glyoxal, suggesting these dicarbonyls arise from the oxidative pathway. Whereas the amounts of 3-DG were not reduced, suggesting 3-DG is generated from the non-oxidative pathways. Analysis using this method should reveal the generation mechanisms of dicarbonyl compounds and their contribution to the formation of AGEs.