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Dual Mode Diffusion and Sorption of NaCl in a Carbohydrate Foodstuff, Potato

Hiroko Hashiba [1], and Hiromi Gocho [2]

[1] Department of Registered Dietitian, Faculty of Health and Nutrition, Tokyo Seiei College,
[2] Department of Human Life Science, Faculty of Human Environmental Sciences, Jissen Women's University

Summary

This study aims to obtain insight into the mechanism of NaCl diffusion in soggy potato. It has been generally presumed that NaCl in foodstuffs diffuses with a constant Fick's diffusion coefficient, D, through liquid water channel imbibed in them. However, the present study reports that D's for the potato, measured at 30-98℃ exhibit maximum showing variations with total concentration, C_t, of NaCl in potato. The same kind of dependences of C_t have been found by us for Japanese radish, solidified egg white and pork meats. These variations were consistently interpreted in terms of a dual mode diffusion and sorption theory, comprising two thermodynamic diffusion coefficients, D_T(p) and D_T(L), for p and L regions in the water swollen potato substrate. These two D_T's showed remarkable rises in the same temperature range, 50-70℃, which were ascribed to the "glass transition" in the substrate. Experimentally obtained sorption isotherms, which were slightly convex upward in the low C_t range, were satisfactorily reproduced with the dual parameters and the fractions of water swollen substrate in the whole potato. Throughout the observations on the NaCl diffusion in the four foodstuffs, we concluded that the diffusion mechanism of NaCl in the four foodstuffs is unifiedly represented by the dual mode diffusion and sorption theory.