RADIOTRACER STUDY OF PHOSPHATE EXCHANGE BETWEEN WHEY AND CASEIN MICELLES IN COW'S MILK

Z.I. Kolar*, H.J.M. van Dijk and T.G. Verburg***

Department of Radiochemistry, IRI, Delft University of Technology, Mekelweg 15, 2629 JB, DELFT, The Netherlands

**B. Wuytierslaan 156, 3818 LM, Amersfoort, The Netherlands*

Cow's milk contains about 30 g l^{-1} proteins to be divided in caseins (80%) and whey proteins. Most of the caseins occur as submicron particles, casein micelles. Micelles contain 6% inorganic matter i.e. ions such as calcium, phosphate, magnesium and citrate. These are referred to as micellar calcium phosphate (MCP) which is an essential element of the structure of casein micelles. However, there is much controversy on the structure of casein micelles, the role of the MCP and its chemical form. Recently a new model for intramicellar relation of casein and MCP has been proposed. It assumes a MCP consisting of ion clusters comprising (inorganic) phosphate groups and Ca-ions (some of then may be replaced by Mg-ions).

Skimmed-milk can be considered as a two-phase system of casein micelles in state of dynamic equilibrium with whey, an aqueous solution of salts and proteins. In such a system no net transport of matter between components of the system is taking place; the composition of the system is constant in time. However, there is a permanent bi-directional transport of equal amounts of matter - exchange - between various components of the system. The rate of exchange is closely related to chemical and physical processes governing this transport; a high exchange rate, for example indicates a weakly bound exchanging species.

Radiotracer method has proven to be a valuable tool for studying interfacial exchange in equilibrium systems. It has been applied to study exchange of calcium ions between the whey calcium salts and MCP. The present paper deals with a similar study pertaining to phosphate ions.

^{32}P-labelled Na_2HPO_4 was used as the radiotracer for inorganic phosphates of milk. After addition of the radiotracer to skimmed-milk, samples were taken regularly for 700 hours. In the samples casein micelles were separated from whey by ultracentrifugation and finally the radiotracer quantity i.e. ^{32}P-concentration in the whey samples was measured using a Liquid Scintillation Counter.

Compartmental analysis and modelling were used to evaluate the thus obtained time curves for radiotracer quantity in whey. This analysis revealed the presence of three phosphate compartments i.e. exchangeable phosphate entities; one being the whey phosphate. The other two are associated with the exchangeable phosphates of MCP. The mean residence times of phosphate in the latter two compartment differ considerably pointing at two distinctly different embeddings of phosphate groups in the structure of the micellar calcium phosphate of the cow's milk casein. The obtained results are in fair agreement with the mentioned model of MCP.