



Food structure and moisture transfer : A modeling approach

Valérie Guillard, Claire Bourlieu-Lacanal, Nathalie Gontard

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Food Structure and Moisture Transfer

A Modeling Approach

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Abstract

The physical state and structural characteristics of food materials influence their mass transfer properties, especially during most processing units, such as drying, hydration, storage, and so forth. All sorts of structural characteristics coexist according to the type of food material. In porous cereal-based products, the effective water diffusivity is highly affected by the volume fraction and the distribution of both the solid and gas phases, while in homogeneously dense food materials, such as fat-based coatings or other edible coatings, the effective water diffusivity depends mainly on factors that affect the “tightness” of the molecular structure (i.e., free volume, cohesive energy density, crystallinity, etc.).

In this book, the impact of the structure of food, including edible coatings, on mass transfer properties is reviewed and illustrated in the challenging case of moisture transfer, for which studies are widely available. The first part is devoted to the theoretical background necessary to understand and achieve a complete characterization and modeling of moisture transfer in food. Then, in the second part, a multi-scale analysis of the structure/moisture-transfer relationship is proposed, focusing first on the molecular structure (e.g., free volume, crystallinity), then on the nanoscale structure, and finally on the microscale (e.g., porous food) and macroscale (e.g., bilayer) structures. The continuity of knowledge between these different scales will be analyzed and illustrated in the case of fat-based edible coatings. For each scale of structural observation, a focus on the mathematical modeling of the relationship between structural properties and moisture transfer properties will be performed. In regard to moisture transfer properties, equilibrium (water sorption isotherm) and dynamic (diffusivity) water transfer properties will be considered.