Identification of solubilization kinetics of food powders using a sequential reconstitution device

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Food powders represent a large proportion of the total processed food in the world. There are several reasons for this, such as extended shelf-life, facilitated transport and usage conveniences, relatively high stability and the possibility of a high production rate. Preserving excellent functional properties strongly depend on powder processing parameters and storage conditions. For example, increase in water content during storage causes the powder adhesion through their surfaces leading to powder caking, loss of flowability, loss of solubility, which affect the quality of the final product. Thus, much attention has to be paid to the understanding of particulate food systems and how intrinsic and extrinsic factors can influence them. This involves control of surface and internal structures of the powder particles.
Studies carried out on reconstituted powders have highlighted the interdependence between the reconstitution time and the particle physicochemical properties, and particularly the particle surface composition. In the present work, a diafiltration method was employed to perform a sequential reconstitution and, to fractionate soluble components according to their presence at the surface/core of the particle. To this end, fractions were collected through a hydrophilic filter at defined times, and then analyzed (i.e., mineral, protein, lipid, sugar contents). The powders employed here present a singular reconstitution behavior according to their wetting time and their total reconstitution time. For example, a high protein dairy powder (80% casein / 20% whey proteins) presenting a long wetting step and a long reconstitution time was studied. It was evidenced that whey proteins were strongly enriched at the particle surface, whereas casein micelles were located at the core of the particles. This protocol also allows the identification of the rehydration kinetics for each rehydrated protein layer of the particle, revealing that two distinct forms of swelling occurred: (1) first a rapid swelling and elution of whey proteins present at the particle surface, and (2) then a swelling of casein micelles located below the whey proteins, associated with a slow elution of casein micelles from the particles being rehydrated.