Bringing knowledge in the technofunctionality of fruit and vegetables powders using a multiscale approach

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The current inability of most consumers to achieve the recommended daily intake of fruits and vegetables triggers food research toward the generation of improved fruit- and vegetable-based products and ingredients. Many types of fruit and vegetables are processed to increase their shelf-life (including drying and powdering), year-round availability, or to increase their value, which integrates structure-enabling and preservation techniques. It is now generally accepted that particle surface composition has a strong impact on the powder functional properties, such as reconstitution and flowability, as it constitutes the part of the powder particle that directly interacts with the environment. Consequently, monitoring only the bulk properties of a food powder during the production process is not enough to ensure good quality products.

In the powder form, the stability and the functionality of fruits and vegetables powders are maintained provided that the storage conditions are adequate. However, fruits and vegetables powders contain a high quantity of low molar mass sugars with low glass transition temperature (Tg). The direct consequence is that fruits and vegetables powders are highly hygroscopic and sticky at high temperatures but also at ambient temperature if the water content is not well mastered. This feature causes the powder adhesion through their surfaces leading to powder caking during storage, loss of solubility, which affects the quality of the final product.

The present project aims at understanding the process–structure–function relations to tailor the functional properties of fruits and vegetables powders. To this end, a multiscale approach is employed to investigate powder functional properties (flowability and reconstitutability) and particle surface properties (topography and roughness, adhesion and nanomechanics) by using atomic force microscopy (AFM). Even if process parameters define powder surface structure and functional properties, they can be impacted by environmental conditions (temperature, relative humidity) and the present project intends to reproduce them when performing AFM measurements with the aim to decipher mechanisms leading to powder surface modifications.

The overall objective of the present project is therefore to bring knowledge in the technofunctionality of food powders using a multiscale approach and enable the preservation of fruits and vegetables powders stability and quality.