**Polyelectrolyte character of citrus peel fibers and its relevance on rheological properties**

Guéba Agoda-Tandjawaa,\*, Stéphane Debonb, Joël Wallecan b, Isabelle Délérisb, Jacques Mazoyera

*a Centre of Expertise Texture, Cargill Starches Sweeteners & Texturizers, Carentan, 50500, France*

*b Ingredient, Material & Nutrition, Cargill R&D Centre Europe, Havenstraat 84, Vilvoorde, 1800, Belgium*

Understanding surface characteristics/rheology relationships of cellulose-rich fibers such as citrus peel fibers is one of the main concerns of academic and industrial scientists. This can allow guaranteeing the texturizing performances of commercial citrus fibers to customers and consumers, exploiting fully their texturizing potential, improving existing processing operations and/or identifying novel routes for rational formulations. As a consequence, numerous studies have been carried out on the polyelectrolyte character of these composite biomaterials by considering them as a single system, while they contain various non-cellulosic biopolymers which can contribute to the electrokinetic behavior of the fibers under the right dissociation conditions. This can affect the bulk fiber properties such as swelling and water holding capacity1, and will also influence the post-reconstitution properties of the suspensions. Another aspect to keep in mind is the microstructure of the hydrated fiber system. To be industrially relevant, cellulose-rich fibers are often dried, which can lead to irreversible losses in functionality2. Studies have demonstrated that these losses are coming from re-aggregation phenomena during drying leading to a reduction in the pore volume or pore structure of the fibers.3 Various researchers demonstrated that virtually all the pores smaller than 1 μm are closed4,5 upon drying. However, during rehydration water penetrates into the cell wall matrix and reconstitutes the porous network.6 The rate of this process and the degree of reversibility will drive the extent of recovery of the never-dried properties. The environmental conditions as well as the amount of surface charges have to be considered as well as they will both influence the balance of forces within the pores (i.e. electrostatic, osmotic).7 Reconstitution of such complex composite biomaterials is therefore a dynamic phenomenon that has to be studied at various length scales.

In this study, a multiscale approach was taken to better understand the polyelectrolyte character of citrus peel fibers and its relevance on rheological properties after reconstitution in aqueous media. Specifically, the rheological behaviors of the fibers as a function of the environmental conditions were studied. The amount of charges as function of pH on the surface of the material was evaluated. Both potentiometry and cationic polyelectrolyte adsorption were used in order to determine their origin. The impact of ionic strength was also considered. In order to quantify the amount of charges more accurately, a critical review of the methods for determining the surface charges by cationic adsorption was performed.8

**References**

1. Barzyk, D., Page, D. H. & A. Ragauskas. (1997). Acidic group topochemistry and fiber-to-fiber specific bond strength, **Journal of Pulp and Paper Science**, 23, 56–61.

# Agoda-Tandjawa, G., Mazoyer, J., Wallecan, J. & V. Langendorff. (2020).Effects of sucrose addition on the rheological properties of citrus peel fiber suspensions before and after drying, *Food Hydrocolloids, 101,* 105473.

1. Déléris, I. & J. Wallecan. (2017). Relationship between processing history and functionality recovery after rehydration of dried cellulose-based suspensions: A critical review, ***Advances in Colloid and Interface Science***, 246, 1-12.
2. Fahlen, J. & L. Salmen. (2005). Pore and matrix distribution in the fiber wall revealed by atomic force microscopy and image analysis, ***Biomacromolecules***, 6, 433–438.
3. Aarne, N., Kontturi, E. & J. Laine . (2012). Influence of adsorbed polyelectrolytes on pore size distribution of a water-swollen biomaterial, ***Soft Matter***, 8, 4740–4749.
4. Hidayat, B. J., Thygesen, L. G. & K. S. Johansen. (2013). pH within pores in plant fiber cell walls assessed by fluorescence ratio imaging, ***Cellulose,*** 20, 1041–1055.
5. Andreasson, B., Forstrom, J. & L. Wagberg. (2005). Determination of fibre pore structure: influence of salt, pH and conventional wet strength resins, ***Cellulose***, 12, 253–265.
6. Wallecan, J. & S. J. J. Debon. (2018). Strong cationic polyelectrolyte adsorption on a water swollen cellulosic biomaterial and its relevance on microstructure and rheological properties, ***Cellulose***,25, 4437–4451.