Effect of soluble dietary fiber on microstructural changes, in vitro and in vivo starch digestibility in laminated dough and wheat bread

BOUCHON P. (1), TORRES J. (1), DUEIK V. (2), CONTARDO I. (3)
1 Pontificia Universidad Catica de Chile, Santiago, Chile
2 Commercial e Industrial SOLUTEC Ltda., Santiago, Chile
3 Universidad de los Andes, Santiago, Chile

The prevalence of diet-related chronic diseases such as type 2 diabetes encourages the design of starchy foods to control starch digestibility. The objective of this research was to understand the effect of soluble dietary fiber (SDF) addition in the structure of baked gluten-starch matrices and wheat bread, and analyze its effect during *in vitro* and *in vivo* starch digestibility, using a microstructural approach.
Inulin and polydextrose were firstly examined by adding them at different concentration (7.5 and 13%) in laminated gluten-starch model doughs, which were baked at 170°C.
Both SDFs showed a significant reduction in starch gelatinization, probably linked to a decrease in water activity in the dough (r=0.85). *In vitro* starch digestibility was reduced accordingly. The rapid available glucose (RAG) fraction decreased compared to the control, from 34.85 to 8.56 and to 15.13 g/100g, whereas the unavailable glucose (UG) fraction increased from 47.59 in the control sample to 87.76 and 76.27 g/100g, in matrices with 13% inulin or polydextrose, respectively. These results could be also linked to a reduced bioaccessibility due to starch granules coating, as revealed by FE-SEM and, also, to the lower porosity and higher compactness as quantified using X-ray microCT image analysis.
Accordingly, inulin was selected to be added to wheat bread formulation and was combined with modified cellulose fiber. The dough was processed following a standard industrial protocol for bread production. All samples showed a well-developed and continuous protein network with a good performance during breadmaking, as shown by FE-SEM micro-images. SDF-formulated bread showed a reduction in total porosity and pore diameter along with a slight increase in structure thickness, compared to regular bread, leading to a more homogeneous structure. *In vitro* assays revealed a decrease in RAG from 31.02 to 11.52 g/100g, and an increase in UG from 62.81 to 80.49 g/100g, in SDF-formulated bread compared to the control. These results were consistent with *in vivo* clinical trials (12 male volunteers), which showed a lower postprandial glycemic response in SDF-formulated bread and could be classified as slowly digestible since both the glycemic index (56.43) and the glycemic load (15.11) were in the intermediate range.