ABSTRACT

Bread is an ancient widely consumed food resulting from a dynamic breadmaking process. One of the most successful innovations in breadmaking has been the partially baked bread obtained by the bake off technology which provides crispy bread at any time of the day. Crispness is the most consumers' demanded attribute in fresh crispy bread. Unfortunately, crispness is rapidly lost after baking and then bread is rejected by consumers. The objective of this research was the modulation of the physico-chemical and functional properties of bread by applying surface treatments in order to understand crust features and to develop value-added bread products. Studies have been conducted to identify the impact of steaming during baking on the crust mechanical properties and to assess the weight of crust mechanical properties on the overall quality parameters using different commercial breads. Further on studies were focused on modulate crust properties by understanding its microstructure and modify it by enzymatic treatments with amyloglucosidase or functional coating to modify the crust permeability or to obtain probiotic breads, respectively.

Results showed that the amount of steaming used during baking (100, 200 and 400 ml) modified the physico-chemical and mechanical properties as well as structure of bread crust. Quality parameters allowed the differentiation of bread type,

specifically crust mechanical properties together with specific volume, crumb hardness and structure. Nevertheless, texture of the bread crust was significantly dependent on the tests conditions (speed and punch cross-section). Results showed that low speed (0.5 mm/s) gave information about the cellular structure of the crust related to crispness texture. Moreover, that cellular structure was modified by amyloglucosidase sprayed on the bread surface prior to the bake off technology, leading to a decrease in the moisture content and water activity of the crust, which is required for extending the crispness shelf life. The application of edible coating with microencapsulated *L. acidophilus* onto the bread surface (dispersed or multilayer) guaranteed microorganisms survival after baking and storage time, although they reduced failure force and water activity of the crust. Microstructure analysis showed the presence of scattered microcapsules onto the bread crust. Therefore, *L. acidophilus* included in microcapsules can be incorporated to bread surface through edible coatings, leading a prospect future for obtaining a functional bread.