Heat treatment of food is a key operation resulting in the development of a large range of flavors and tastes through the Maillard and caramelization reactions. The drawback is that some of the Maillard reactions and caramelization products (MRPs) are currently suspected to have deleterious health effects. It has been reported that the consumption of high thermally treated foods rich in MRPs could increase the total *in vivo* advanced glycation end products (AGEs) accumulation. Recently, the accumulation of AGEs *in vivo* has been implicated as a major pathogenic process in diabetic complications and other disorders, such as atherosclerosis, Alzheimer's disease, and cancers. Some of the better-known potentially harmful MRPs are furosine (FUR), Nε-(carboxymethyl) lysine (CML), hydroxymethyl furfural (HMF), volatile furans (V-Fs) and α-dicarbonyl compounds (α-DCs). Since traditional cereal-based products are a major source of exogenously formed MRPs in the diet, the formation, quantification, and elimination of those components should be a major target of both industry and research. Over the last years, there has been a rise in consumer interest in wheat-free foods, due in part to increases in the recognition of celiac disease. However, gluten is a structure-building protein essential for formulating leavened baked goods. Obtaining high-quality gluten-free bread is thus a technological challenge. Several approaches have been used to understand and improve gluten-free bread systems. Replacing wheat flour by gluten alternate components and additives can modify both the nutritional and organoleptic properties of the final product, but can also affect the formation of potentially harmful compounds.

There has been little information to date on the concentration of MRPs in gluten-free bread systems. Moreover, in-depth studies into the formation pathways of α-DCs are necessary to provide new information about the dynamics of these toxicants in gluten-free food and potential mitigation strategies. Knowledge of these reactive compounds in gluten-free bread systems, as well as their correlation with the formation of other potentially harmful MRPs, has been limited, despite evidence of the important role they play in the genesis of AGEs.

Given these factors, **the aim of this proposed project is** to assess the effects of the various approaches used to improve gluten-free bread systems by evaluating the effects of different food ingredients (types of flour, oil, and sugar), additives, and technologies on MRPs formation. Additionally, their relationship with reactive α-DCs will be also studied to obtain further insights into their formation dynamics and, ultimately, an estimation of the exposure to these heat-induced contaminants from gluten-free bread.

This project is expected to provide answers to the following questions:

(H1) Does the composition of gluten-free dough affect the formation of potentially harmful MRPs in the baked bread?

(H2) Does the number of double bonds in a fatty acid chain affect oxidative stability and MRP formation?

(H3) Could oils obtained from roasted seeds be sources of canolol and volatile compounds, and thus significantly affect glycation processes and flavor of gluten-free breads?

(H4) Could the thermal degradation products of sweeteners contribute to MRP formation?

(H5) Could different gluten-free flours act as sources of natural dietary antiglycation agents, on account of their ability to trap α-DCs and reduce MRP levels?

(H6) Could compounds formed following enzymatic treatment contribute to the accumulation of MRPs in final gluten-free products?

(H7) Could extrusion cooking of flour improve the aroma—while also leading to an increase in the level of toxic compounds in gluten-free breads?

(H8) Do α-DCs play an important role in the formation of heat-induced contaminants in GF foods?

Finding answers to our research hypotheses will help select gluten-free dough recipes and will assist in investigating the effects of composition, as well as the various approaches used to improve gluten-free bread systems in terms of their MRPs content. The comprehensive character of these studies will contribute to a better understanding of mechanisms of formation of MRPs, which amounts in the diet may depend on its composition. Studies concerning nutritional prevention of autoimmune and neurodegenerative diseases are currently priority research and this project will significantly contribute to development of food chemistry.