OPTI'TOM : Industrial validation of a predictive model of the nutritional quality of tomato-based products during processes

Mélodie Gil, Claire Dufour, Xuan Mi Meyer, Cédric Brandam, Magali Wagner, Stephane Georgé

Title : Industrial validation of a predictive model of the nutritional quality of tomato-based products during processes

Authors : Mélodie Gil[1,2], Claire Dufour[1,2], Xuan Meyer[3,4], Cédric Brandam[3,4], Magali Wagner[5], **Stéphane Georgé[5]**

1 : INRA, UMR408 Sécurité et Qualité des Produits d'Origine Végétale, F-84914, Avignon, France.

2 : Université d'Avignon, UMR408 Sécurité et Qualité des Produits d'Origine Végétale, F-84914, Avignon, France.

melodie.gil@avignon.inra.fr ; claire.dufour@avignon.inra.fr

3 : Université de Toulouse ; INPT, UPS ; Laboratoire de Génie Chimique ; 4, Allée Emile Monso, F-31030 Toulouse, France

4 : CNRS ; Laboratoire de Génie Chimique ; F-31030 Toulouse, France

XuanMi.Meyer@ensiacet.fr ; cedric.brandam@ensiacet.fr

5 : CTCPA, Site Agroparc ZA Aéroport BP21203 84911 AVIGNON Cedex 9

mwagner@ctcpa.org ; sgeorge@ctcpa.org

Introduction

Food companies want to improve the quality of their products guaranteeing complex organoleptic properties and high nutritional value. The development of such foods and the reassessment of existing products and processes require controlling the interaction between structure and chemical reactivity of the food in relation with applied treatments. The study and at last the control of these reactions are an important challenge of progress for food industry.

The aim of this project is to build and provide, for companies in the sector of tomato-based products, a tool to optimize existing processes and predict the final nutritional quality and avoid many uncertain and expensive preindustrial trials.

Material and methods

The project is divided into four tasks.

Task 1: Experimental design

In a previous project, using kinetic laws, we partially modeled the tomato sauce process using kinetic laws obtained in model systems (Chanforan C. – PhD thesis 2010, Université d'Avignon). This task aimed to define the most relevant trials to be performed to validate this reaction model with data from pilot plant trials. These data are of two types:

- Technical routes (temperature, oxygen content, duration of treatment...)
- Micronutrient composition : (E)-lycopene, (E)-β-carotene, chlorogenic acid, rutin, naringenin, naringenin chalcone, ascorbic acid and α–tocopherol

Task 2: Pilot plan trials

Following the recommendations of task 1, trials imitating industrial processes have permitted to collect essential data such as temperatures, flow rates on pilot equipment, and nutrient evolution.

The two types of products targeted are tomato paste (directly processed from tomato) and tomato sauce (processed from tomato paste)

The processes used for tomato paste are Hot and Cold breaks (HB and CB).

- The different steps of hot break process are: receiving fresh product (whole raw tomatoes), washing, crushing, enzyme inactivation (continuous process), sieving, concentration, pasteurization in retort.

- The different steps of cold break process are: receiving fresh product, washing, crushing, sieving, preheating, concentration, pasteurization in retort.

The process used for tomato sauce is : mixing of tomato paste from industrial manufacturing with water, vegetable oil, salt, sugar and starch, pasteurization in retort.

Task 3: Consolidating the model by implementing experimental data

The experimental data collected in task 2 will face the model already developed. This phase should allow or not the validation of hypotheses made in the reaction scheme.

At this step, a tool able to optimize existing processes and predict the final nutritional quality should be available.

Task 4: Industrial validation

The industrial validation will be performed by sampling tomato products directly on the process line of our industrial partners.

The data collection will consist in:

- Sampling at different points of the production line followed by micronutrient analysis.
- Surveys of process data.

The initial composition in micronutrients of the raw material will be used in the kinetic model to estimate the final product composition. This estimated final content will be compared with the analytical one.

Main results

All the process parameters and micronutrient kinetics have already been collected.

For the tomato sauce:

- Ascorbic acid is the main affected compound. Under the conditions applied, it decreases by 90% after half an hour, and totally disappears after one hour at any temperature tested.
- α-Tocopherol remains quite constant
- For phenolic compounds, there is two phases. First, extractability increases for all of them, then chlorogenic acid remains constant while naringenin and rutin slightly decrease.
- Carotenoids decrease with time and temperature. This degradation is more important for (E)-lycopene than for (E)-β-carotene.

For the tomato paste: All micronutrients decrease all along the processes (HB and CB). Most of degradations seem to happen during the concentration step. But interpretation of these results is to be completed/reviewed.

The confrontation of all the data with the existing model is in progress and the predictive model will soon be available.