EFFECT OF PROCESSING ON FUNCTIONAL PROPERTIES OF MANDARIN JUICE FOR THE DEVELOPMENT OF FUNCTIONAL FOODS.

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Study of Structure-Properties-Process relations in real functional FOODs (FoodSPProcess)

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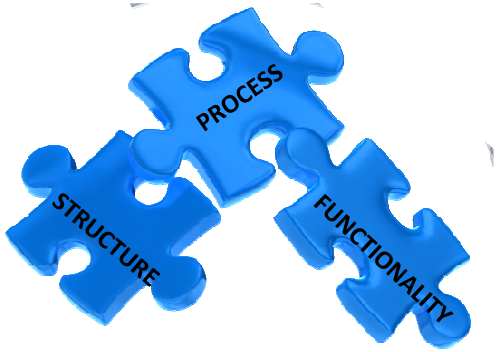
Project duration: 24 months from 1st March 2014
Total Budget: 187.414,80 €

AIM

The **overall goal of this work** is to go in-depth on the study of any type of **interactions** that can be established between trehalose, antioxidant activity compounds, probiotic microorganisms and cellular structure of fruits.

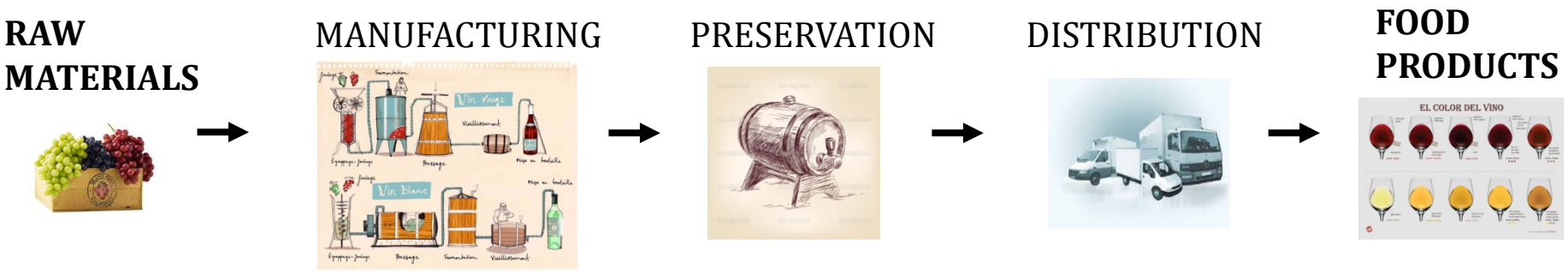
The determination of the effect of homogenization pressures and drying temperatures in these interactions will be assessed, in order to **improve the technology** to develope the process and functionality of natural functional foods with antioxidant and/or probiotic effect

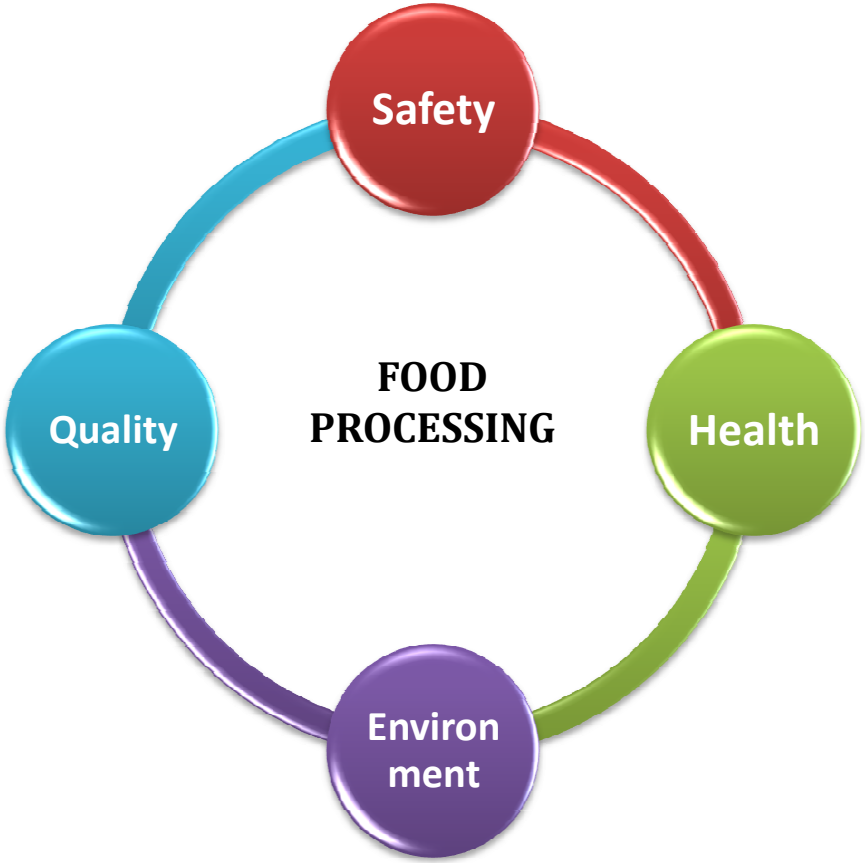


The aim of this work is to make an overview on some synergistic technologies that can constitute a technological process to develop functional foods, enhancing the technological and/or nutritional functionality of the food products in which they are applied.

The effect of **homogenization, vacuum impregnation and drying operations** on bioactive compounds of mandarin juice has been studied focusing on the structure changes produced and its relationship on the product functionality.

EVOLUTION TOWARDS FUNCTIONALITY





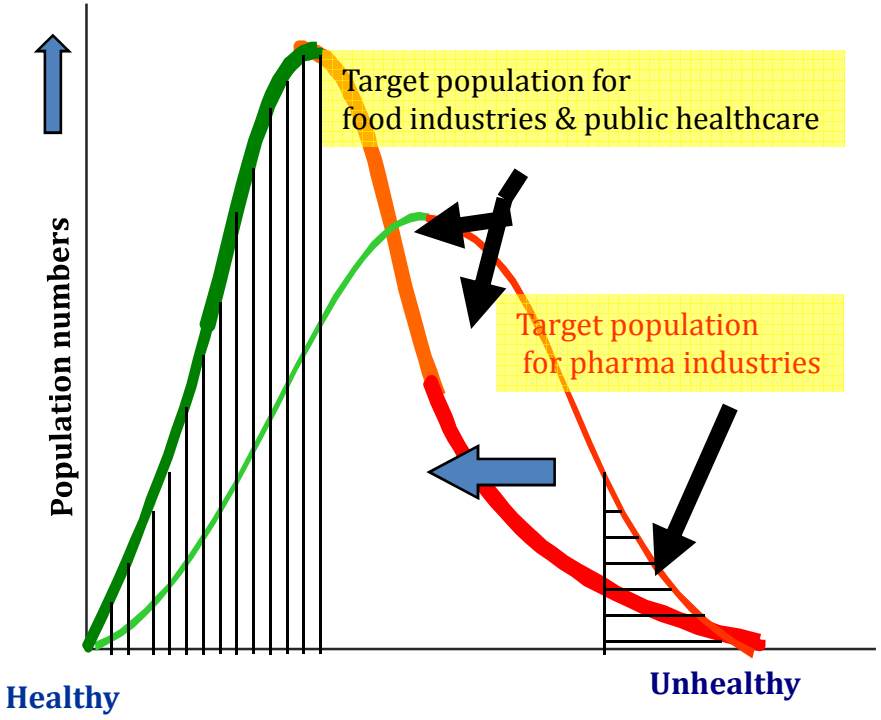


Figure. A vision for improving population health (ETP Food for life).

EVOLUTION TOWARDS FUNCTIONALITY

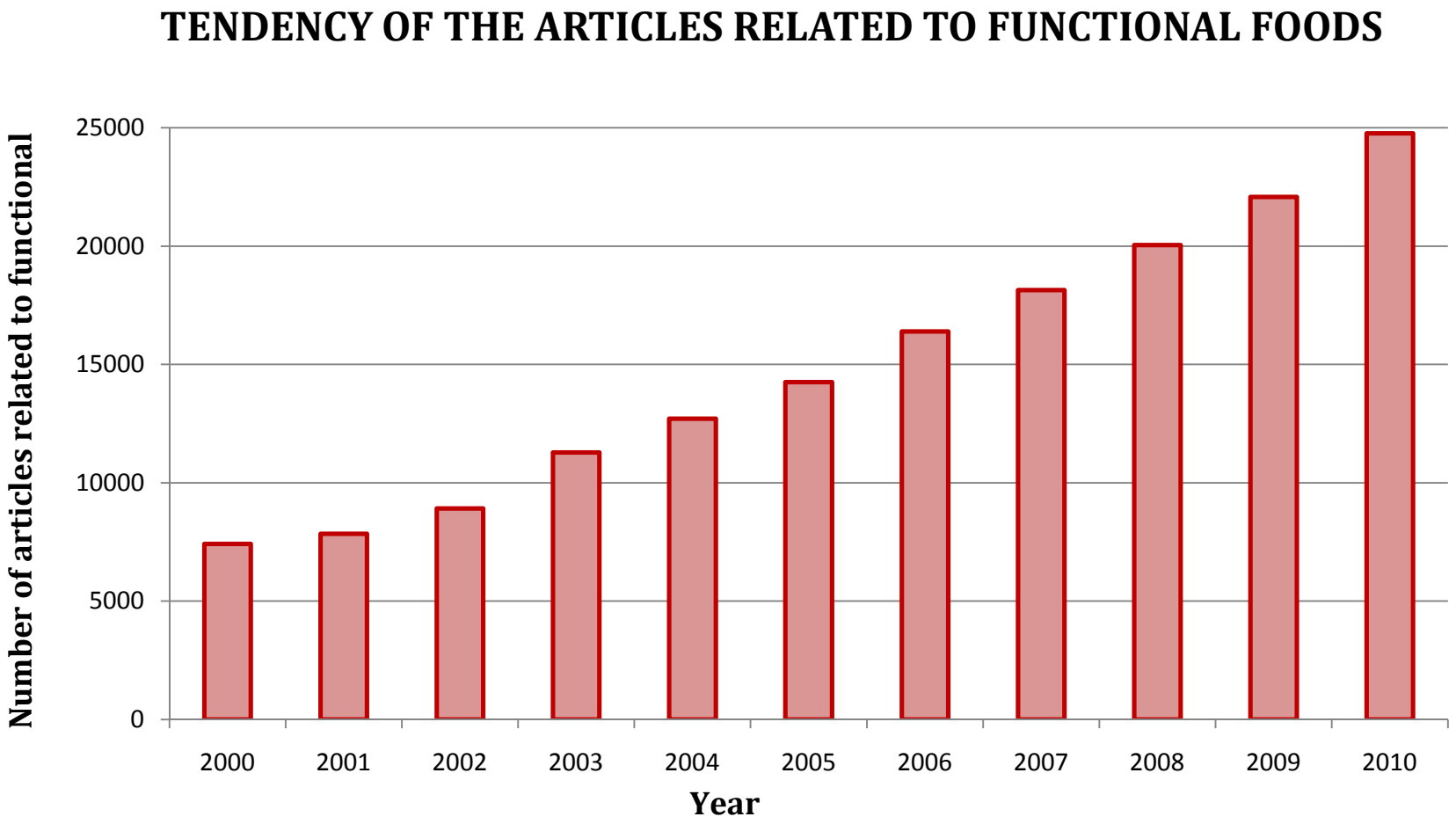
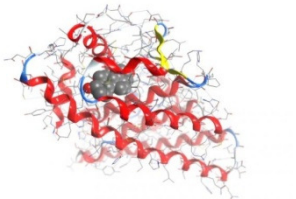


Figure. Tendency of the articles related to functional food with the time

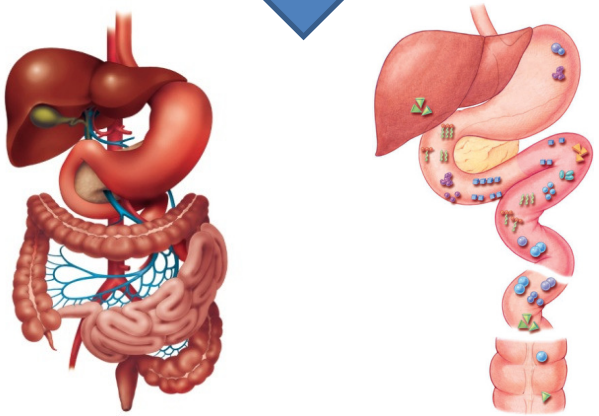
Functional foods development: great interest for consumers, industry, governments and universities.

EVOLUTION TOWARDS FUNCTIONALITY

Formation of structures



Protection



Delivery in the appropriate target site

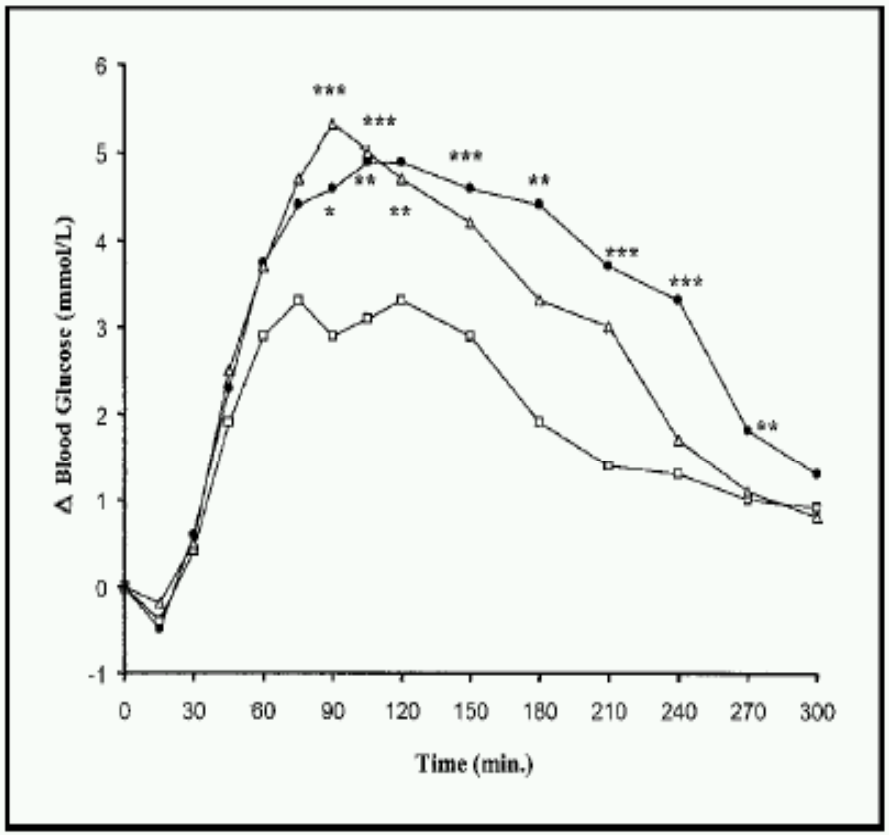
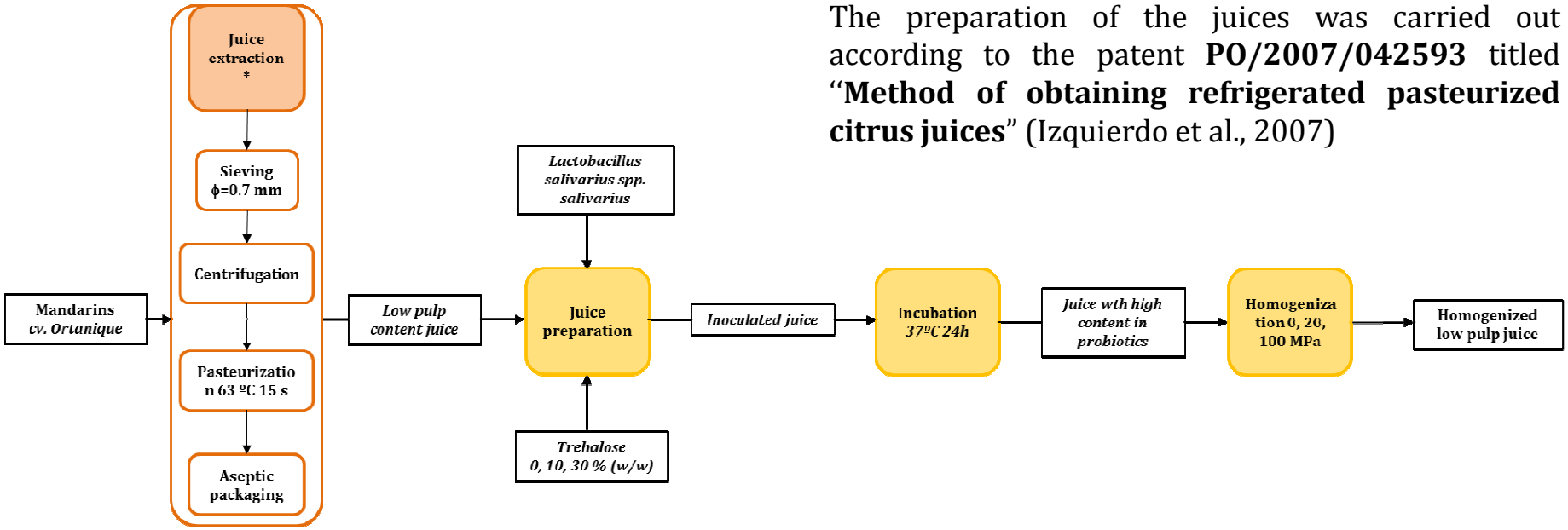


Figure 1. Blood glucose rise above baseline after each of the three test meals: spaghetti □——□; white bread ●——●; and potatoes △——△; $*P < 0.05$, $**P < 0.025$, $***P < 0.01$ versus spaghetti.

Ricardi, G., Clemente, G. & Giacco, R. 2003. Nutr. Rev. 61(5), S56-S60

MATERIALS AND METHODS



The preparation of the juices was carried out according to the patent **PO/2007/042593** titled "**Method of obtaining refrigerated pasteurized citrus juices**" (Izquierdo et al., 2007)

RAW MATERIALS

Mandarin juice (cv. Ortanique)

L. Salivarius spp. Salivarius

Trehalose 0, 10 30 % (w/w)

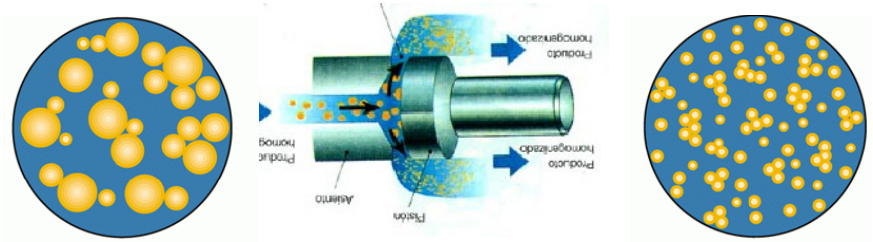
PROCESS OPERATIONS

Homogenization pressures 0, 20, 100 MPa

Vacuum impregnation Pv: 50 mbar

Air drying 40 ºC 24 h

HOMOGENIZATION



BEFORE

AFTER

Homogenization is a process that involves applying pressure to liquids to fragment the solid particles and oil droplets into smaller particles.

increasing the yield of citrus juices

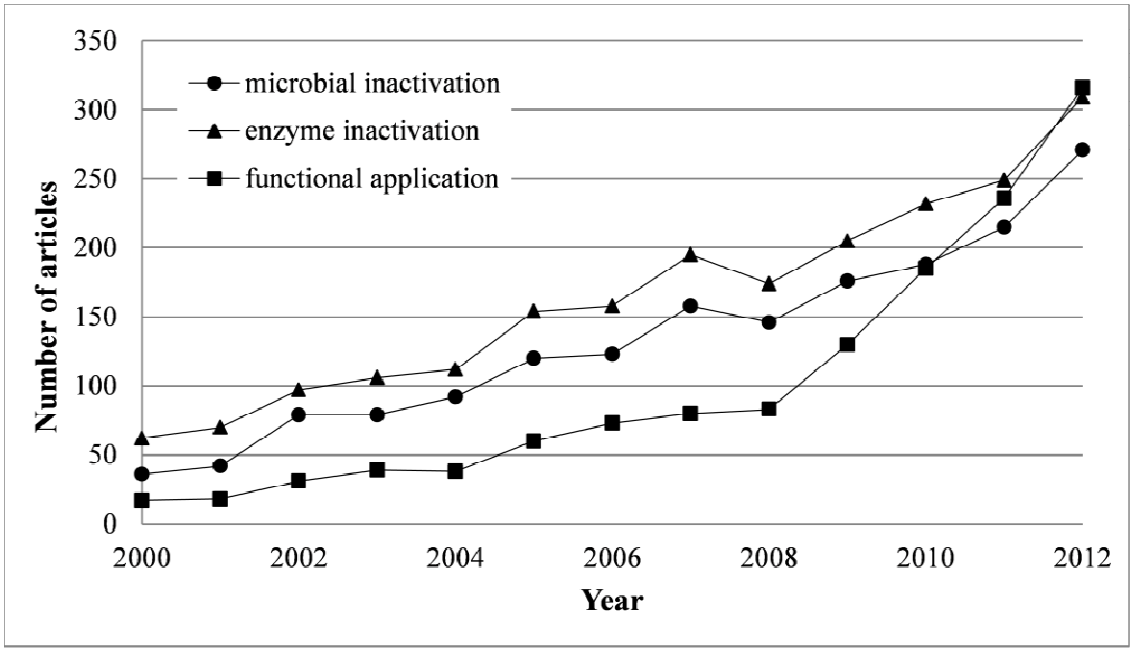
improving some quality factors of citrus juices,

viscosity

colour

cloudiness

stability of suspended solids

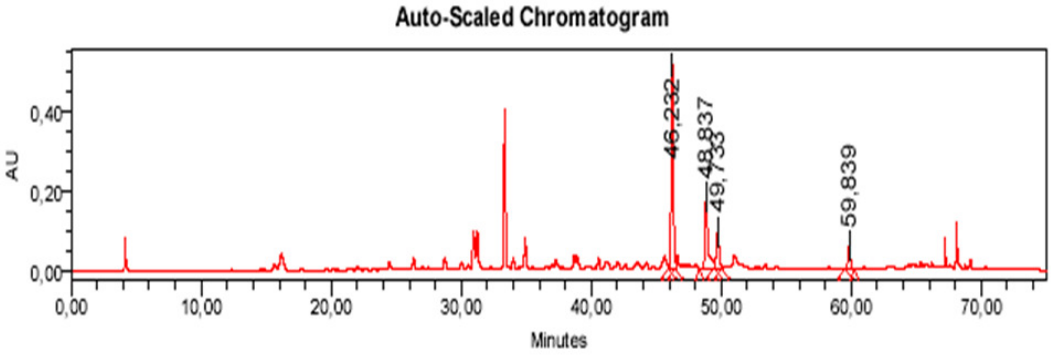


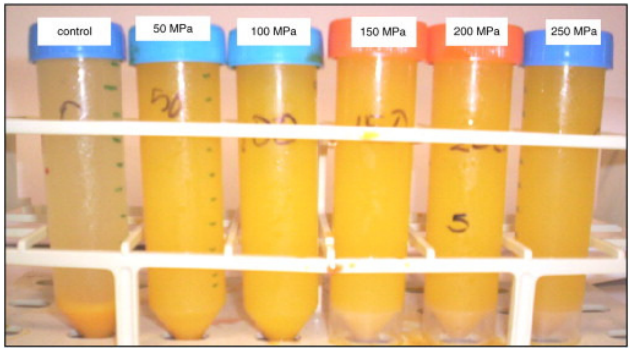
12 Pressure Treatments in Juice Processing

Homogenization Pressures Applied to Mandarin and Blueberry Juices

Juan Manuel Castagnini, Ester Betoret, Noelia Betoret, and Pedro Fito-Maupoey

HOMOGENIZED MANDARIN JUICE





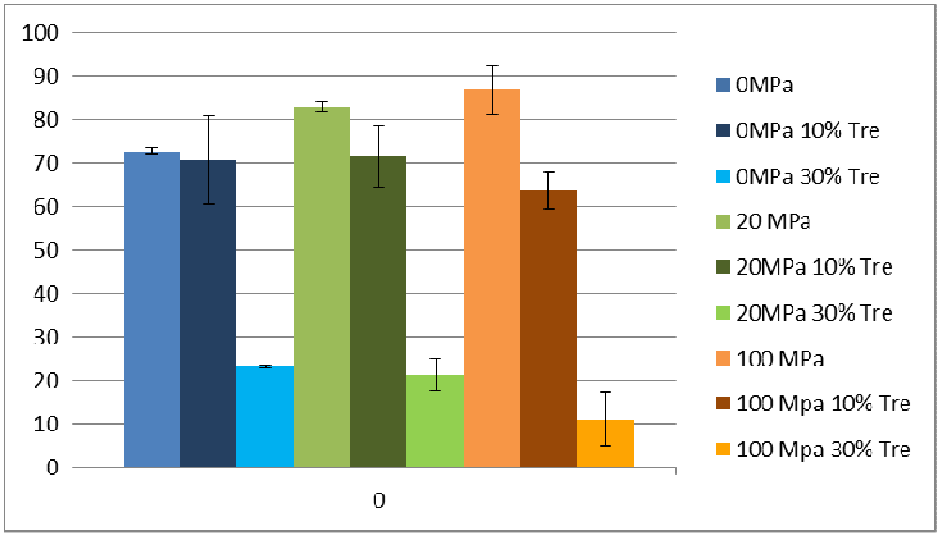


Figure. *Content of hesperidin in mandarin juice samples*

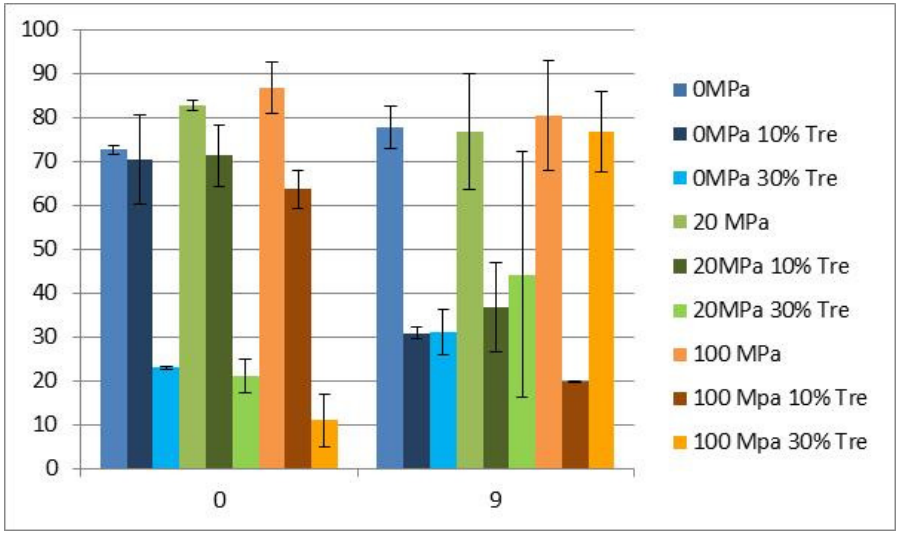


Figure. *Content of hesperidin in mandarin juice at 0 and 9 days of storage.*

HOMOGENIZED MANDARIN JUICE WITH PROBIOTIC MICROORGANISMS

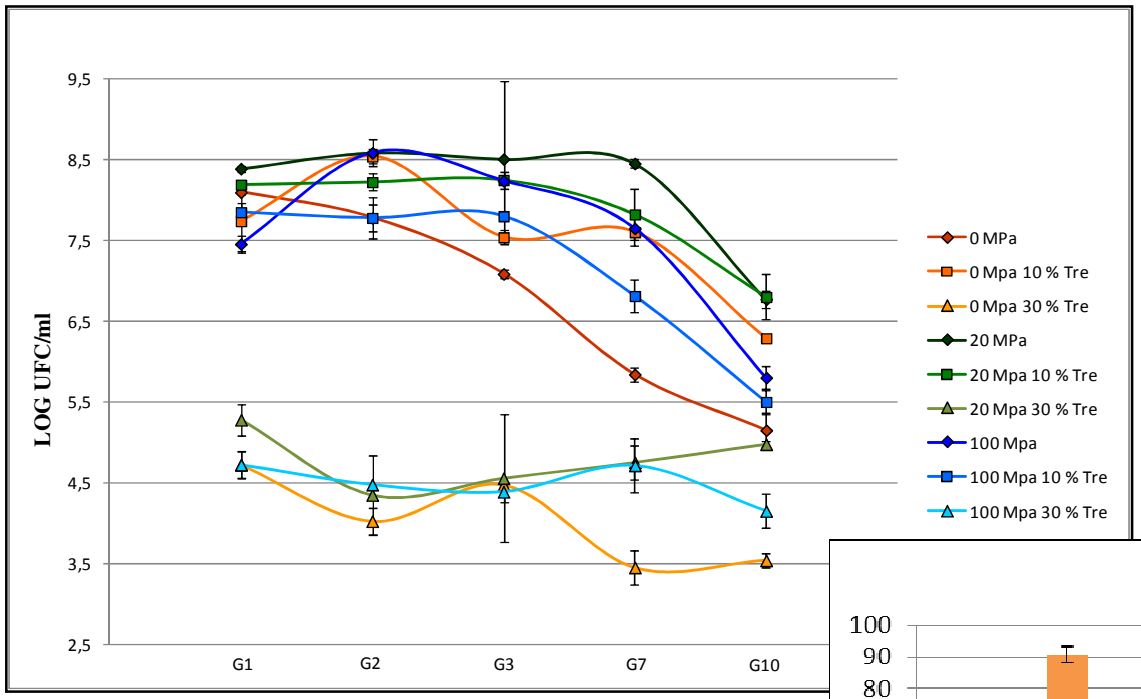


Figure. Growth of *L. Salivarius spp salivarius* in the different mandarin juice samples.

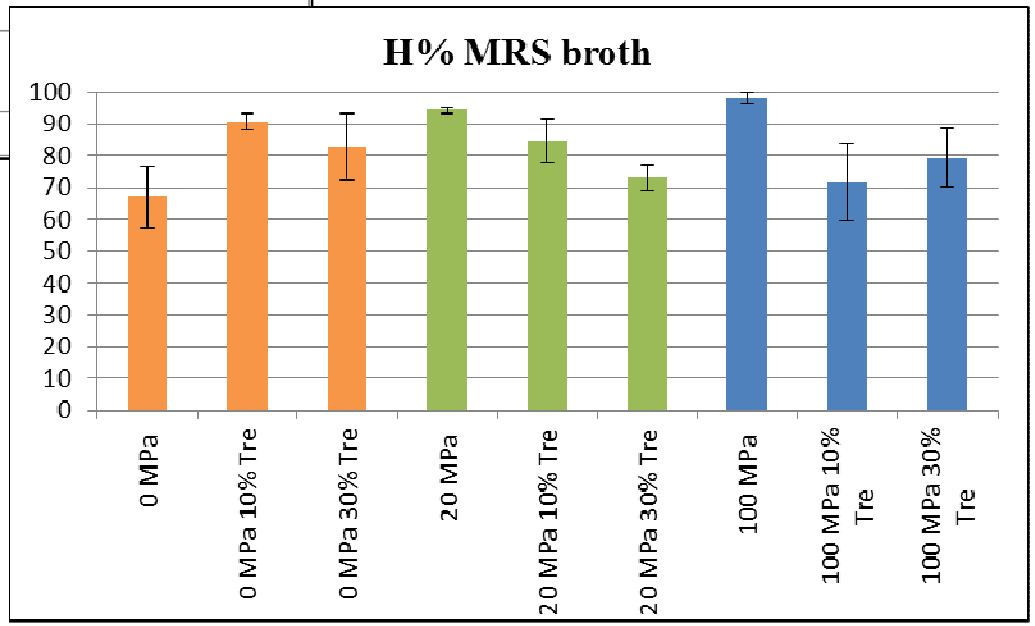
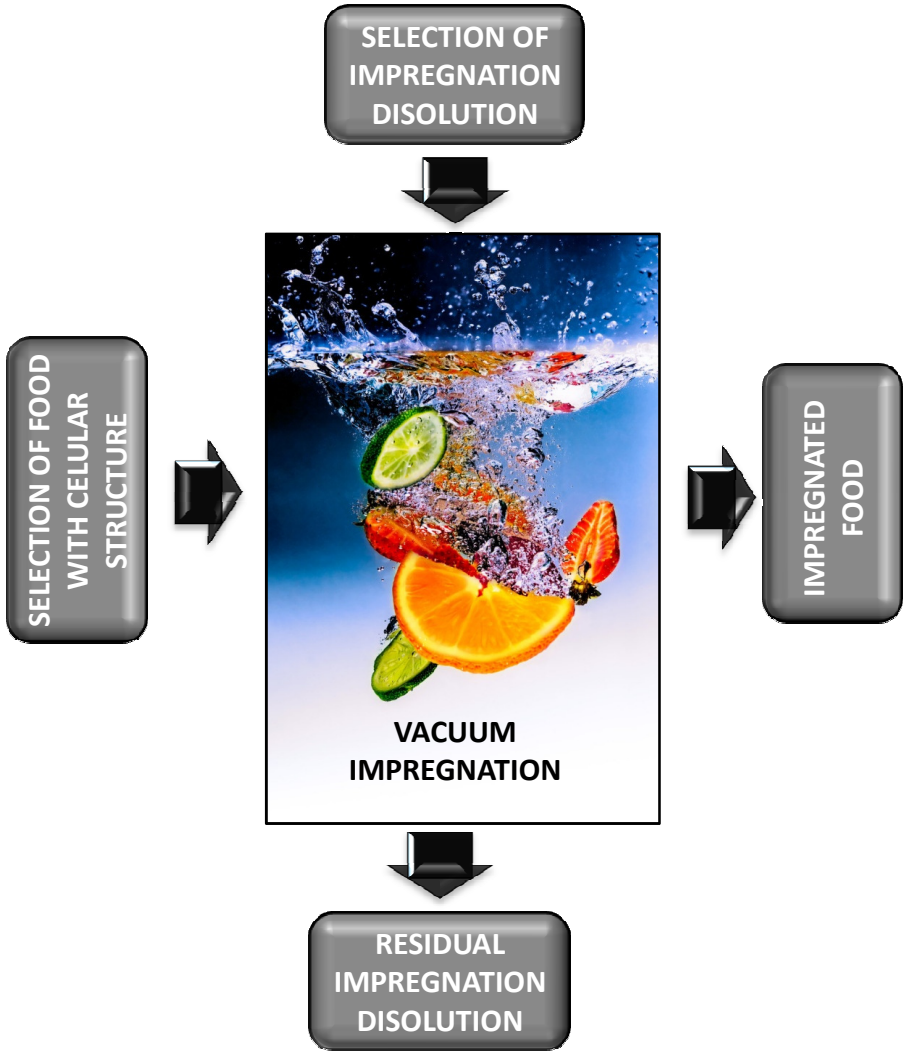


Figure. Hydrophobicity of *L. Salivarius spp salivarius.*

VACUUM IMPREGNATION

VACUUM IMPREGNATION ALLOWS, BY MEANS OF PRESSURE GRADIENTS, TO INCORPORATE COMPONENTS INTO STRUCTURAL MATRIX OF FOODS WITHOUT MODIFYING ITS ORGANOLEPTIC PROPERTIES SUBSTANCIALLY.

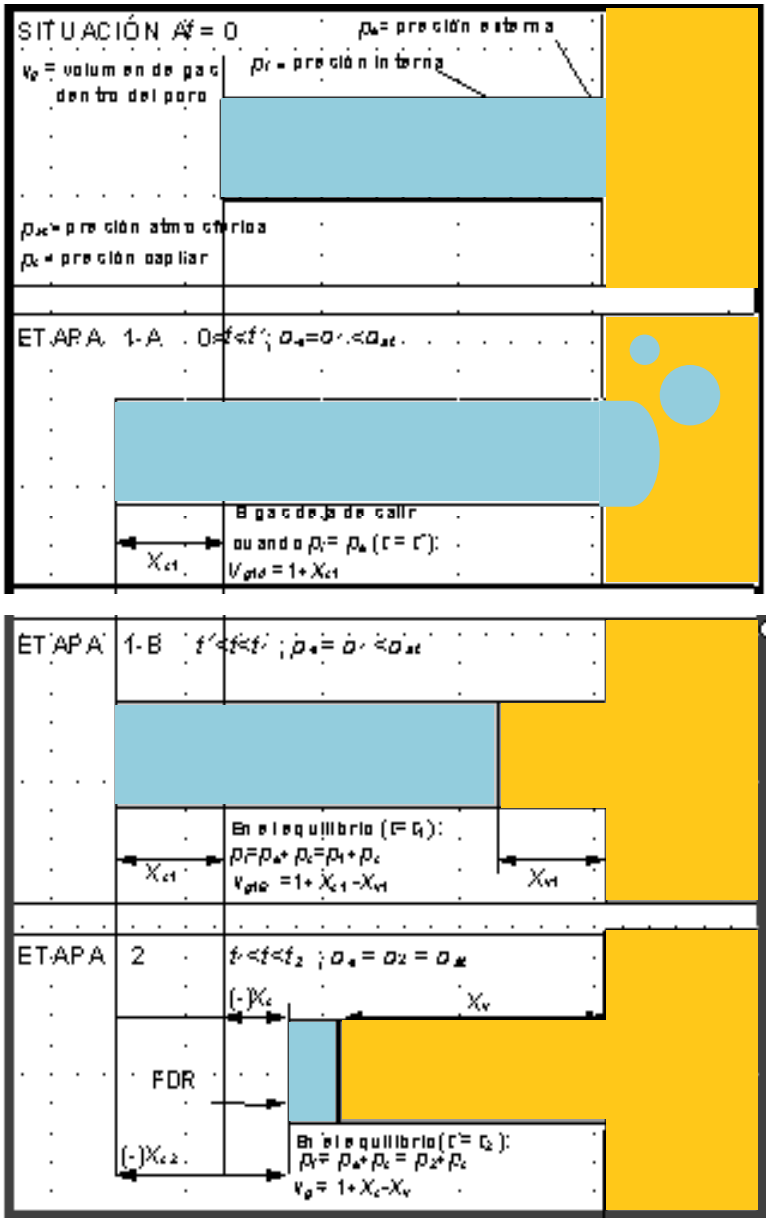


(Fito et al., 2001). PATENT ES 2 169 640 A1

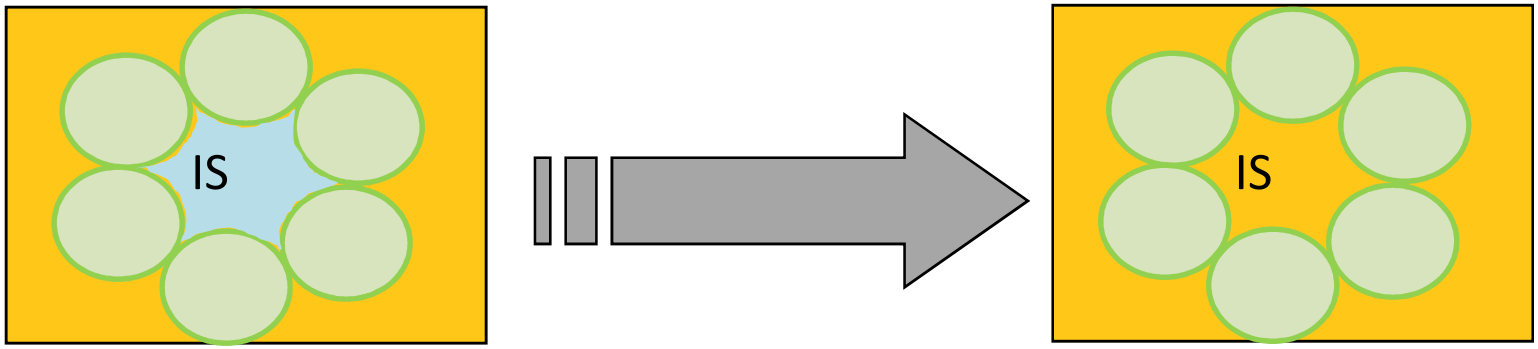
MODEL IN A RIGID MATRIX

Vacuum Period
T=10 min; P=50 mbar

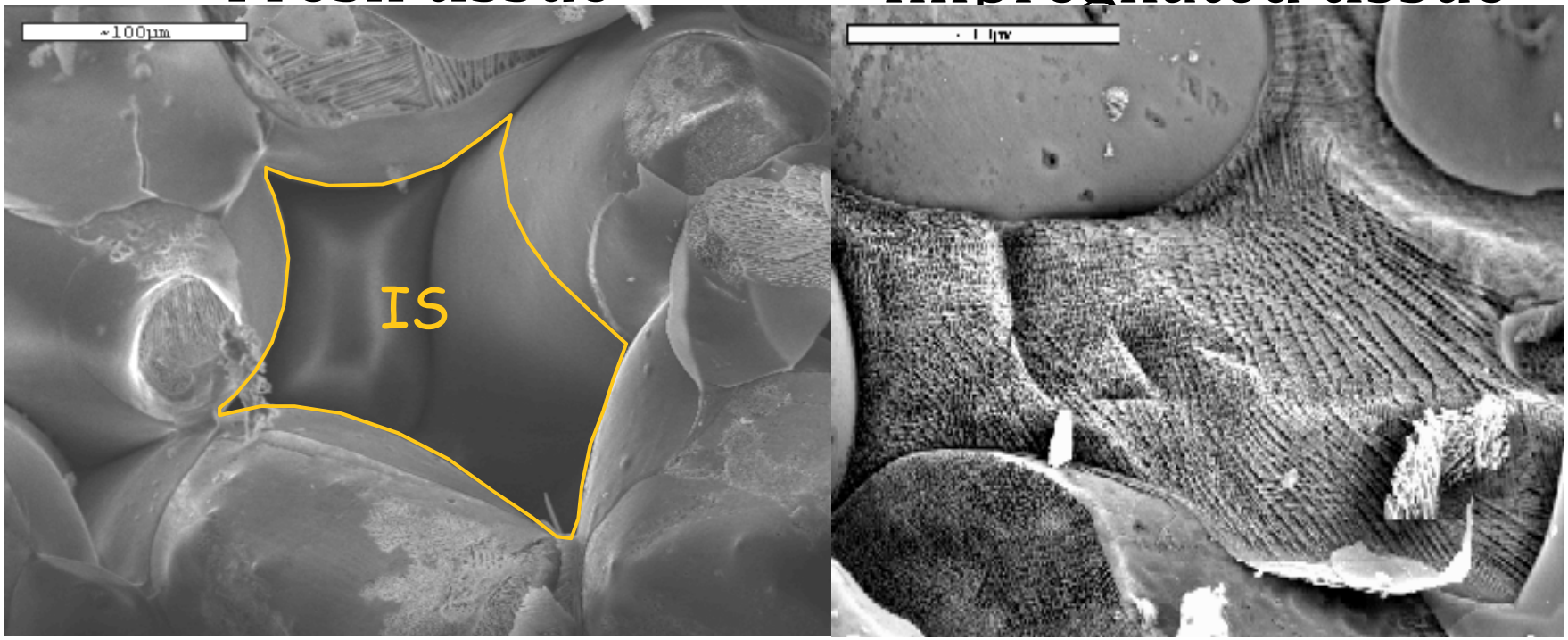
Atmospheric Period
T=10 min; P=1000 mbar



VACUUM IMPREGNATION



Fresh tissue Impregnated tissue



IS: Intercellular space

VACUUM IMPREGNATION

The effect of VI on bioactive compounds:

- To achieve nutritional functionality

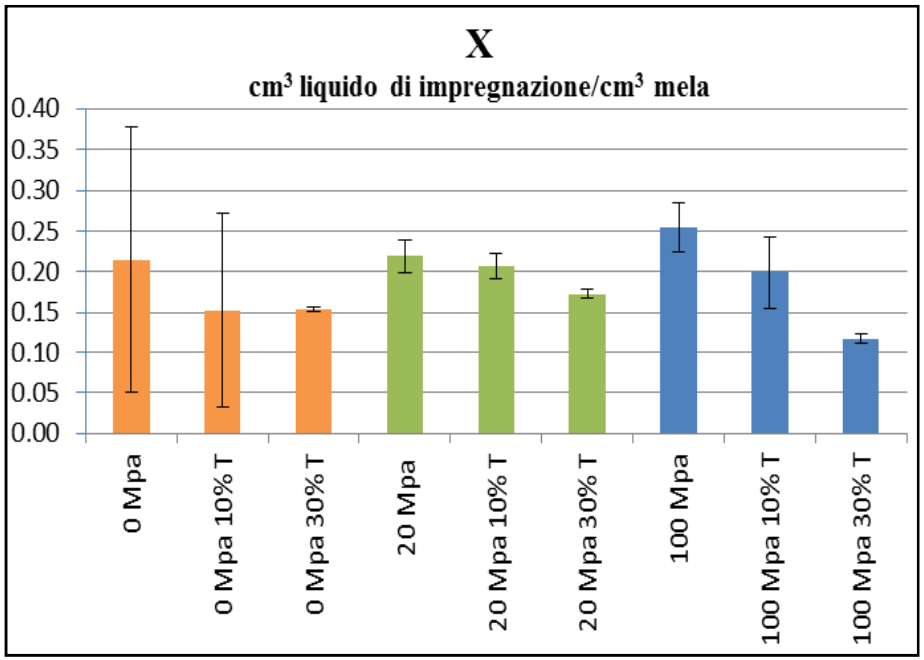


Figure. Volume of juice incorporated into apples by vacuum impregnation in relation to the homogenization pressure applied (mean ± standard deviation).

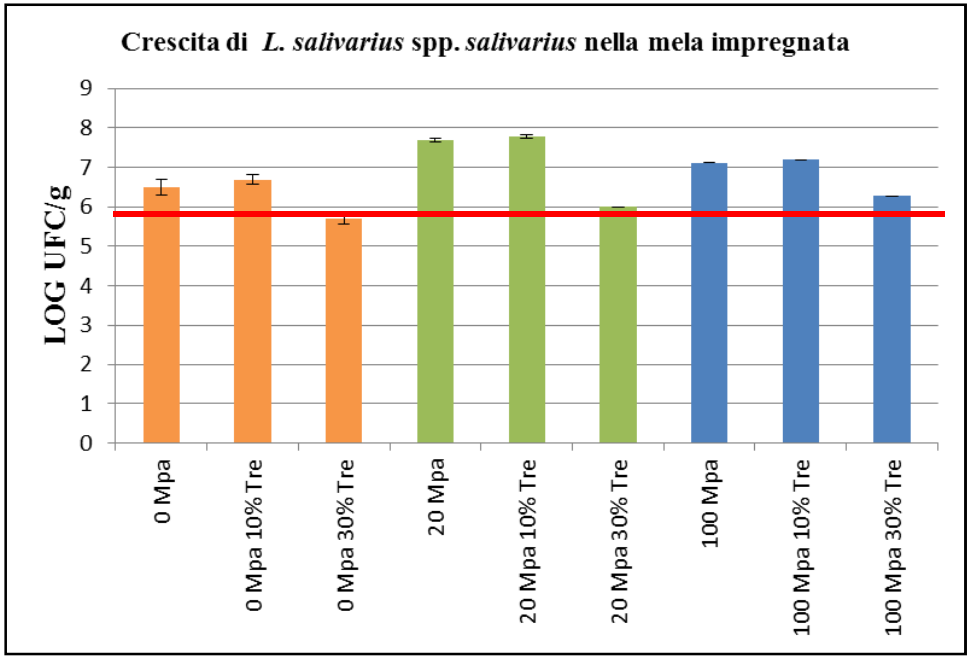
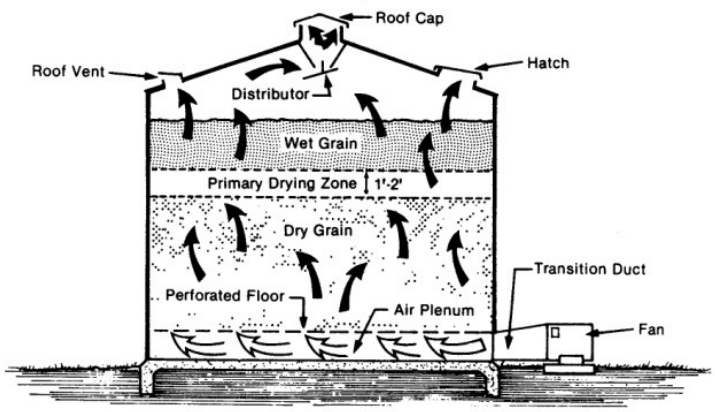


Figure. Content of microorganisms in the impregnated apple (mean ± standard deviation).

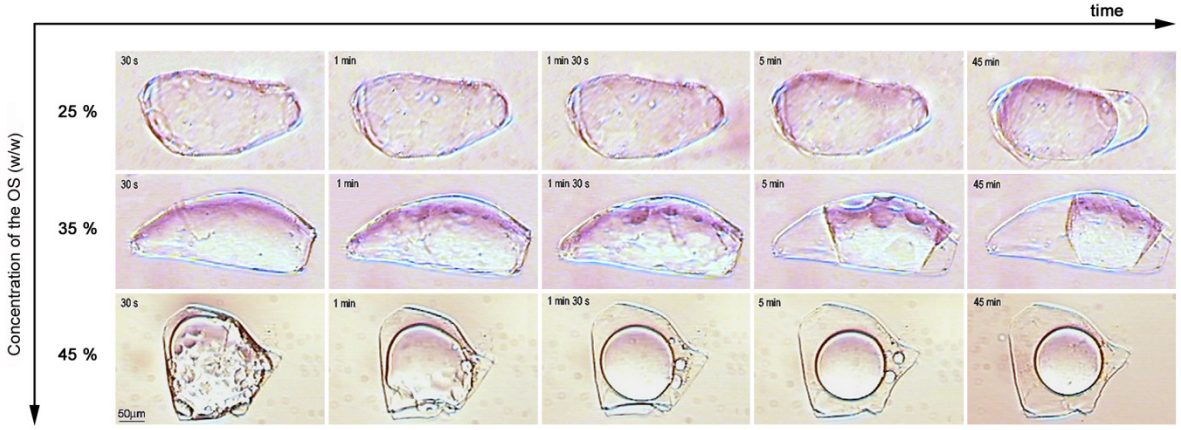
AIR DRYING



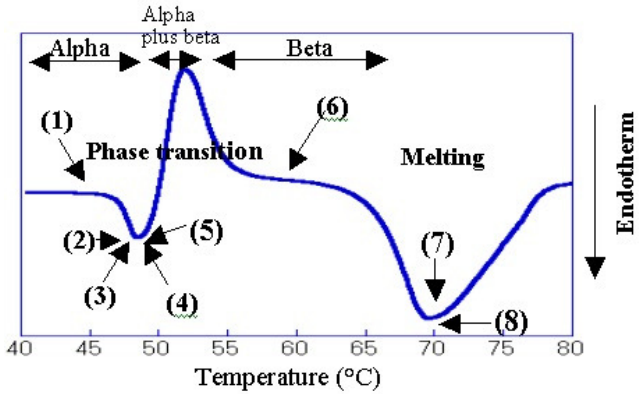
Drying is an energy intensive unit operation in food processing to reduce product moisture content to a level that is safe for storage and transportation, to avoid microbial multiplication and inactivate microbial activity.

Drying technology is applied in the food industry not only for preservation but also to manufacture foods with certain characteristics.

Changes in **cellular structures**



Changes in **chemical structures**



DRYING

Incorporation of trehalose, homogenized mandarin juice and probiotic microorganisms

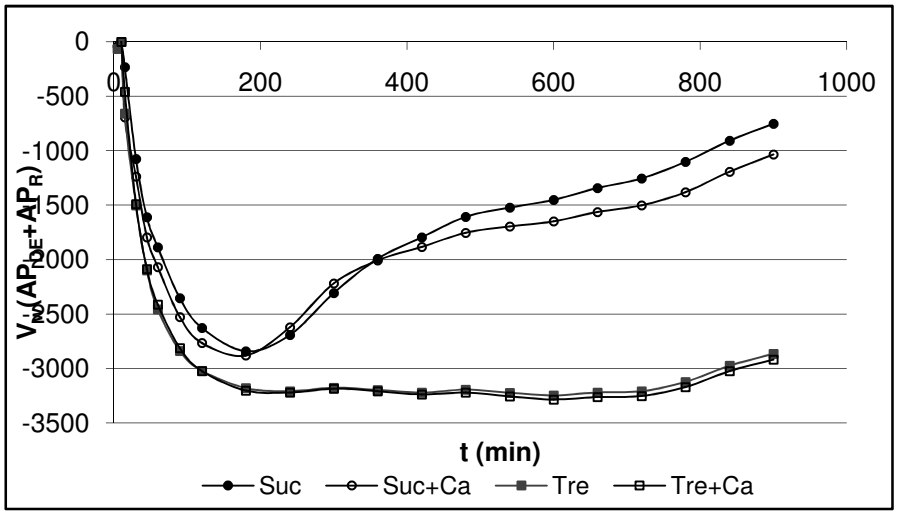


Figure 5. Evolution of the free energy to generate structural deformation/breakages efforts versus time.

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Analysis by non-linear irreversible thermodynamics of compositional and structural changes occurred during air drying of vacuum impregnated apple (cv. Granny Smith): calcium and trehalose effect.

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SNACK WITH TREHALOSE SOLUTION

The free energy in Tre and Tre+ca samples is maintained until the end of drying, showing a **BIGGER DEFORMATION CAPACITY** of the samples thus **PREVENTING THE CELLULAR DISRUPTION AND BREAKAGES**.

SNACK WITH HOMOGENIZED MANDARIN JUICE

40 G OF VI SNACK have the same beneficial compounds that **250 ML OF MANDARIN JUICE**

SNACK WITH PROBIOTIC MANDARIN JUICE

Drying at 40 ºC 24 hours snack of apple and mandarin juice with content of L. salivarius spp. Salivarius higher than **10^6 UCF/g**

CONCLUSIONS

Applying **HIGH PRESSURES HOMOGENIZATION** leads, in many cases, structural changes that improve the bioaccessibility and/or the bioavailability of bioactive compounds such as probiotic microorganisms.

The **VACUUM IMPREGNATION** operation allows the incorporation of technological and/or bioactive compounds into natural structures taking advantage of both the protective effect of these ones and the synergistic effect of certain compounds.

The negative effects related to the application of extreme temperatures in **DRYING OPERATIONS** can be minimized by incorporating ingredients that protect structural elements or creating protective structures, it is possible to manage drying conditions in order to obtain snack with high content in bioactive compounds.

Grazie per la vostra attenzione!!!

Gracias por su atencion!!!

Gràcies per la vostra atenció!!!

Thank you for your attention!!!

Ďakujem vám za pozornosť!!!

Je vous remercie de votre attention