CATÓLICA PORTO
BIOTECNOLOGIA

Valorization of agriculture byproducts: an integrated process

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World production of Agro-Food wastes
1,3 billions tn /year

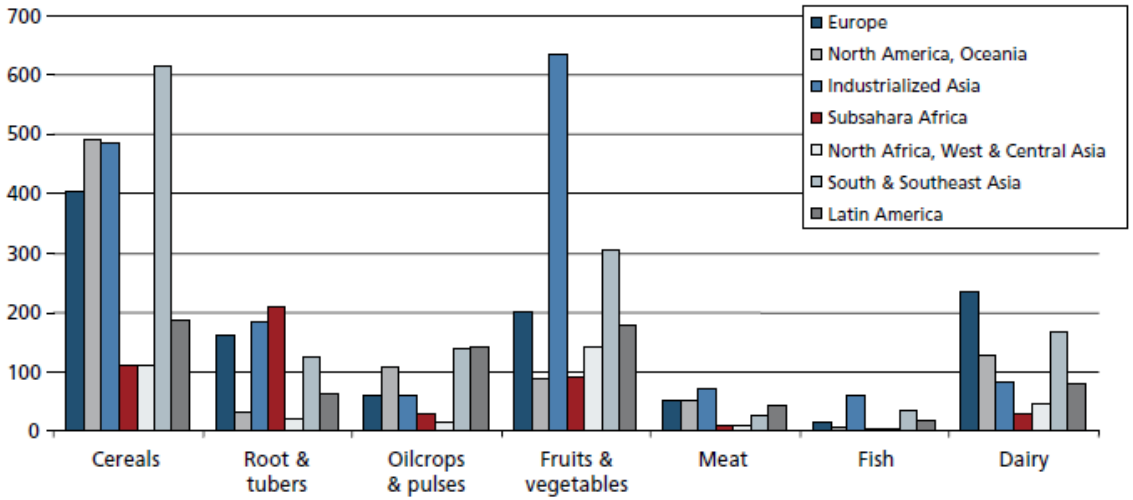
- 1/3 of food for human consumption is lost globally (as waste processing or loss in the chain)
- Losses much higher in the industrialized countries than to developing countries:
  - per capita in Europe and North America is 95-115 kg / year
  - per capita in sub-Saharan Africa and South / Southeast Asia 6-11 kg / year.

Only a portion is valorized toward different value-added products:

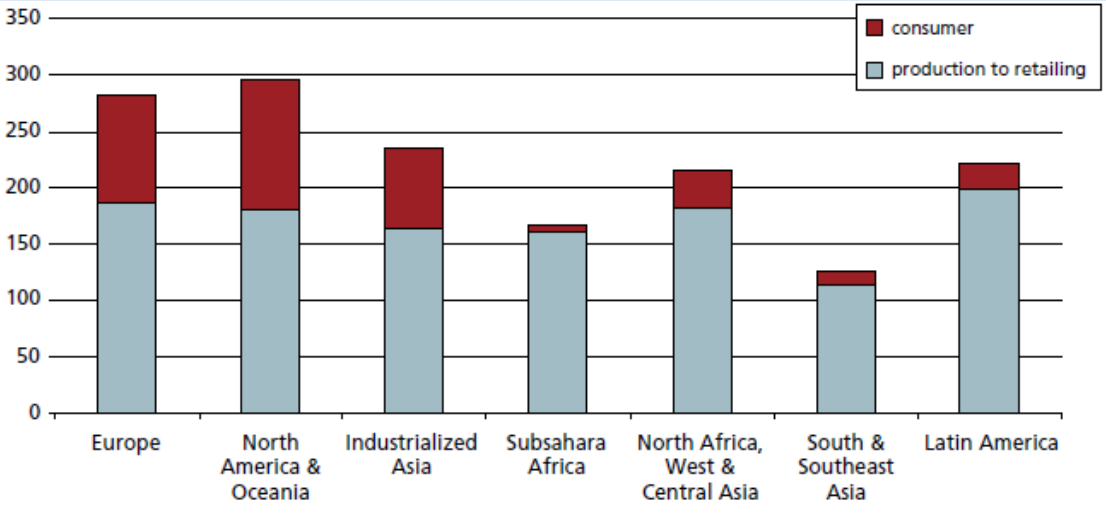
- Application in agriculture
- Animal feeding
- Composting - fertilizer
- Energy
- Compounds with added value

(Gustavsson et al, 2011)

Volumes of production losses and food waste from each sector, by region (million tonnes)



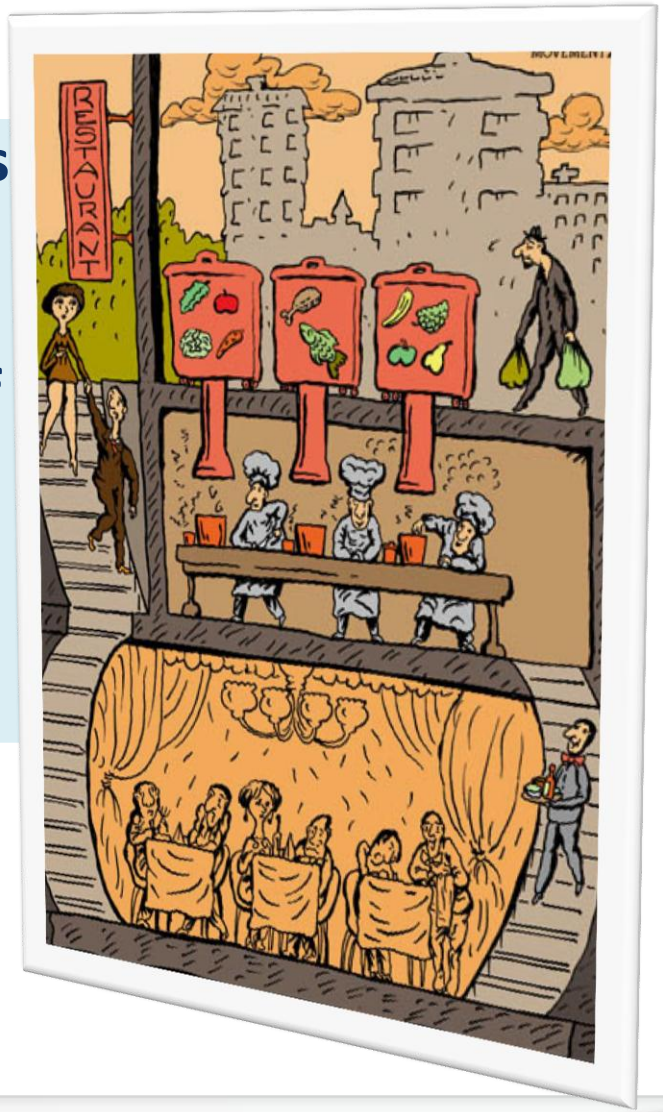
Losses and food waste in steps of pre-consumption and consumption in different regions (per capita, kg / year)



(Gustavsson et al, 2011)

… SO…

Food byproducts are considered as a cheap source of valuable components, since existing technologies allow the recovery of the target compounds and its recycling into the food chain as functional additives in different products.



Food By-products

Valorization ?

Extraction of bioactive substances (compounds or extract)

Enzymatic degradation pathway for release of novel compounds

Production of new products by fermentation

Recovery phases of high added components from food waste :

Macroscopic pre-treatment

↓

Macro- & Micro molecules separation

↓

Extraction

↓

Isolation and purification

- selection of extraction method to maximize yield of the target compounds,
- To be dequate to the demands of industrial processing,
- purify the high value ingredients eliminating impurities and toxic compounds,
- prevent deterioration and loss of functionality during processing and ensuring food grade nature of the final product

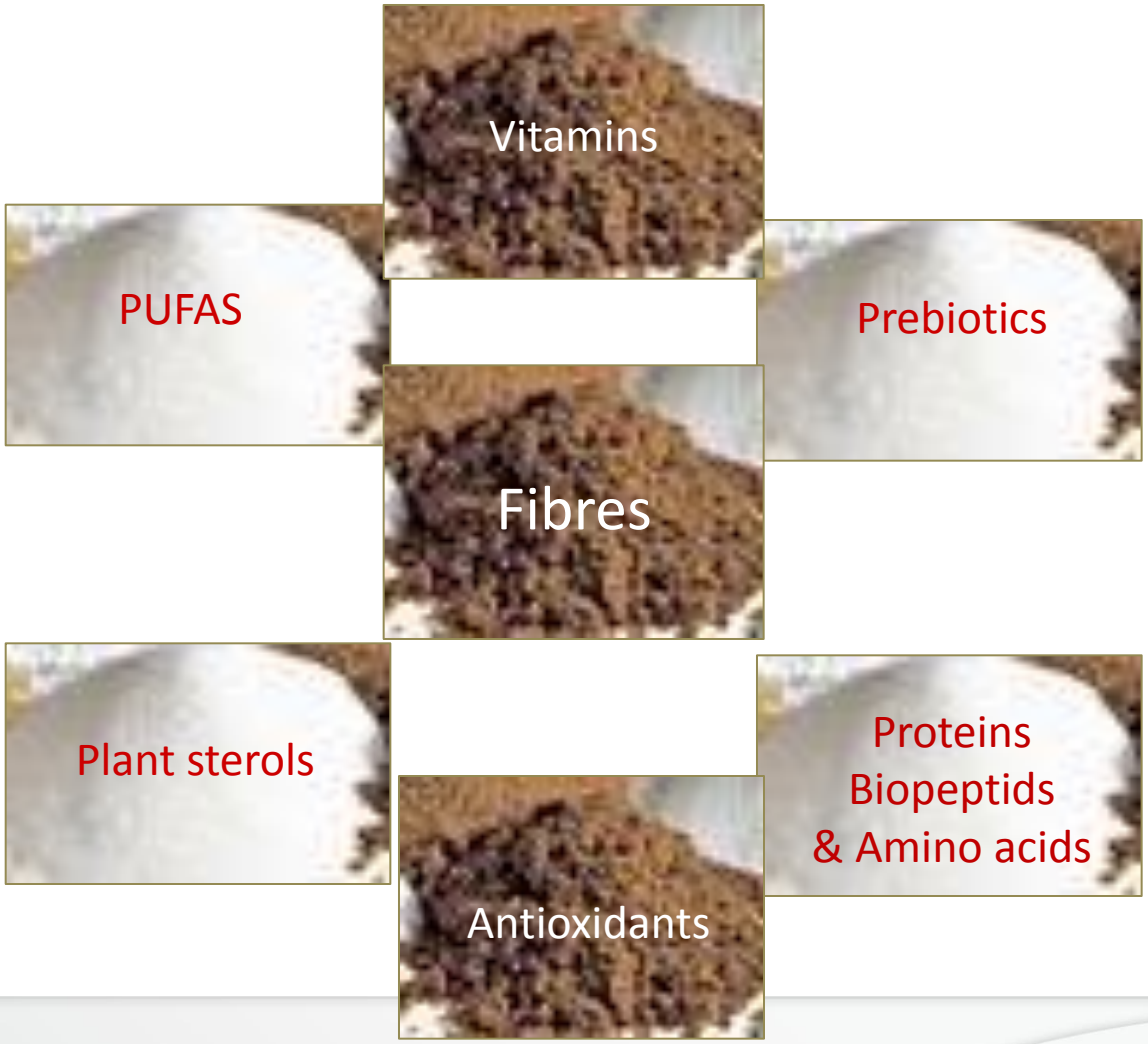
- In case of functional ingredient assess biological acti
  bioavailability and toxicity of the ingredient

Galanakis, C.M (2012). Trends in Food Science & Technology 26.

Extraction of bioactive substances (compound or extract)

The biological active compounds:

Functional ingredients!



Currently EFSA.....

Regulation (EC) N º 1924/2006 of the European Parliament and Council on nutrition and health claims

80% claims rejected

- **Probiotics & Intestinal Health**
- **Fruits and vegetables & various functions**
- **Cacao & blood pressure**
- **Glucosamine / chondroitin & joints**
- **Antioxidants**
- **Most of phytochemicals ...**

20% claims aproved

- **Vitamins / minerals & various functions**
- **Sugarless gum & dental health**
- **Melatonin & sleep / jet lag**
- **Fiber & levels of blood glucose**
- **Alpha-linolenic acid, beta-glucans, EPA & DHA cholesterol**
- **Olive oil polyphenols & TBARS**
- **Glucomannan & weight control**

Groups of byproducts and target ingredient

By-product Group	Selected sources	Target ingredient
(I) Cereals	Rice bran	Albumin & Globlin
		Hemicellulose
		Insoluble dietary fiber
	Wheat middling	Arabinoxylans
	Wheat straw	Hemicellulose
	Wheat bran	Glucuronoarabibinoxylans
	Oat mill waste	β-Glucans
	Malt dust	Glucose, arabinose e galactose
	Brewery's spent grains	Arabinoxylans
(II) Roots and tubers	Potato peel	Phenols
	Sugar beet molasses	Organic acids
(III) Oil crops & pulses	Sunflower seed	Phytosterols
	Soybean seed	Phytosterols
	Soybean oil waste	Phytosterols
	Soybean wastewater	Albumin
	Olive pomace	Phenols
	Olive mill wastewater	Phenols and pectins

Galanakis, C.M (2012). Trends in Food Science & Technology 26.

Grupos de subprodutos e ingrediente alvo

By-product Group	Selected sources	Target ingredient
(IV) Fruits e vegetables	Sugar beet molasses	Narirutin
	Orange peel	Hesperidin
		Apocaratonoid
		Limonen
	Lemon by-product	Pectin
	Apple pomace	Pectin
	Apple skin	Phenols
	Peach pomace	Pectin
	Apricot kernel	Protein
	Grape pomace	Dietética fiber
	Grape skins	Phenols
	Wine lees	Calcium Tartrate
		Enocianin
	Banana peel	Cyanidin-3-rutinoside
	Rejected and processed kiwifruits	Dietary Fiber
	Carrot	β- Caroten
		Phenols
	Tomato pomace	Lycopeno
	Tomato skin	Carotenoids
	Cauliflower floret & curd	Pectin

Byproducts Brewing Industry

Yeast - 2nd largest byproduct

31.5 - 47 millions hectoliters of yeasts

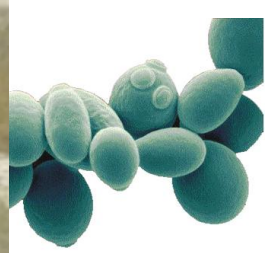
residues

(Jaehrig *et al.*, 2008).

GRAS - ***G****enerally* ***R****ecognized* ***A****s* ***S****afe*

Fonte:

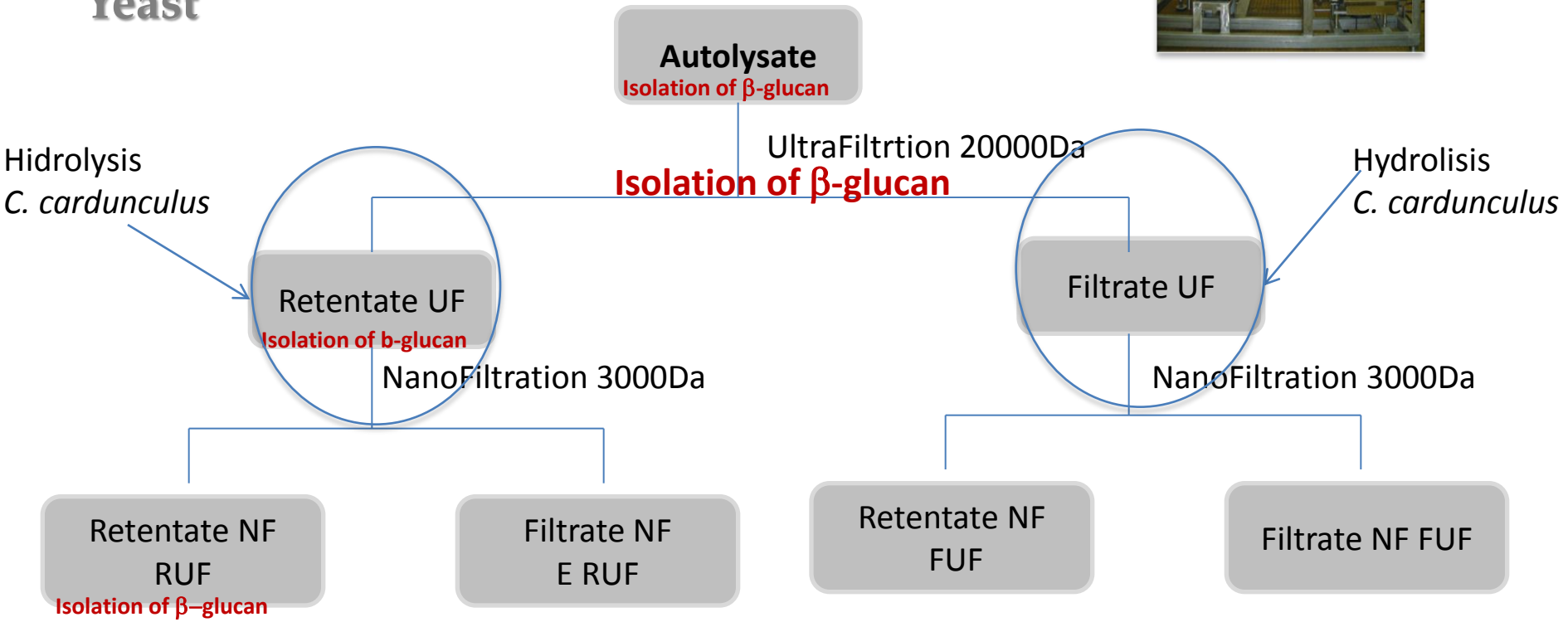
protein
fibers
carbohydrates
minerais
lipids …



Obtaining protein, protein hydrolysates and beta-glucans

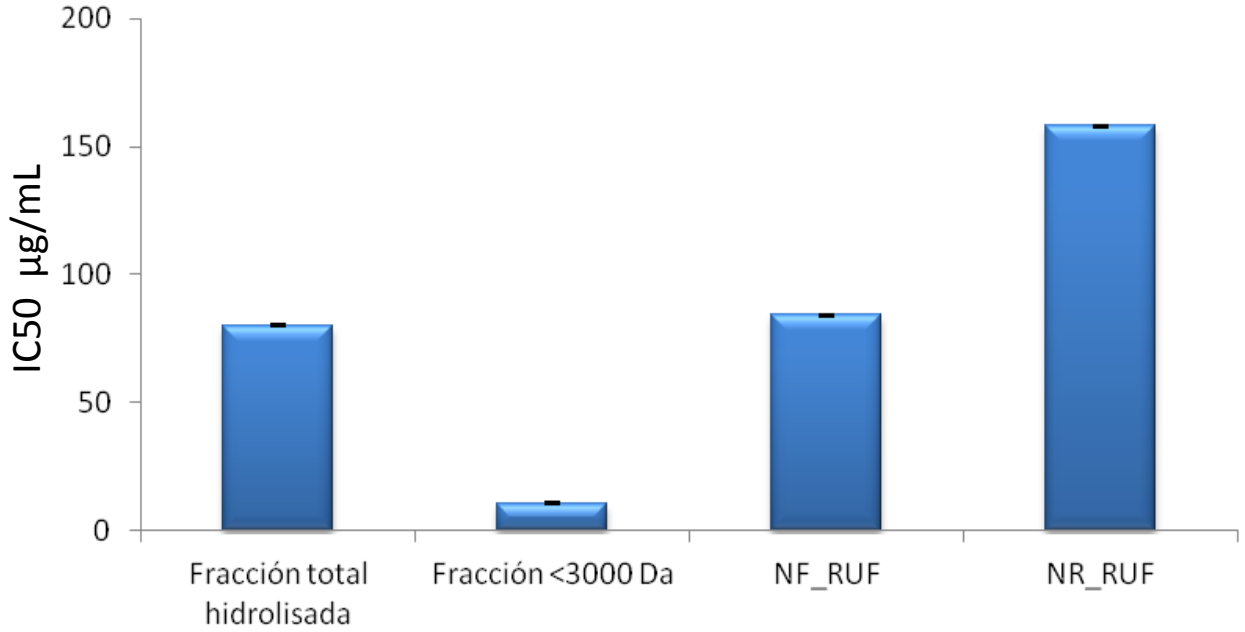
Process: Selective Ultrafiltration
Industrial - Semi scale

Yeast



Biological properties

In vitro study of the inhibitory activity of angiotensin-converting enzyme - ACEI peptide extracts



Low concentrations of protein to inhibit 50% of the effect of ACE

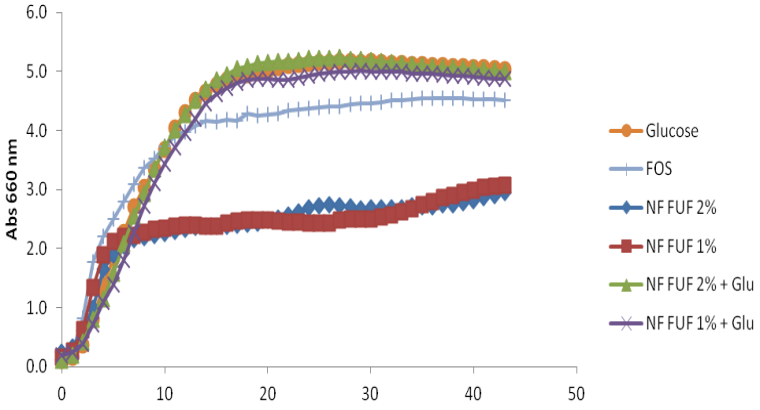
Smaller peptides (<3000 Da) greater effect on enzyme inhibition

Biological properties

- Prebiotic Activity: peptides + beta-glucans

To promote the growth of beneficial bacteria

All fractions <3000 and 1000 have activity



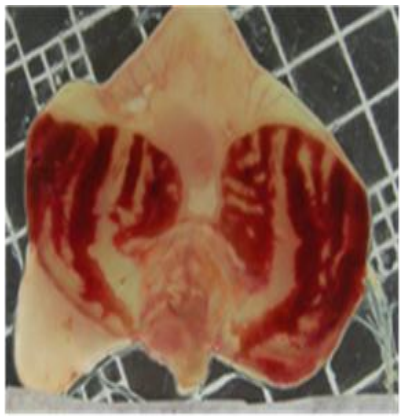
Biological properties

Anti-ulcerative activity

Model in vivo induced ulcers with ethanol

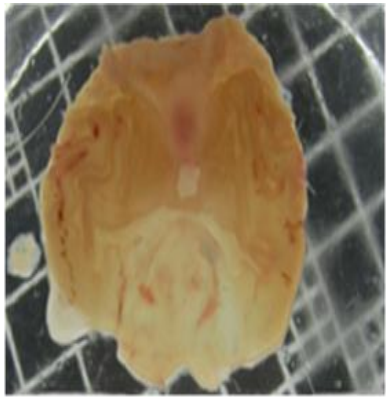
Yeast (NF-RUF) activity

Effective ↓ against ulcerative lesions



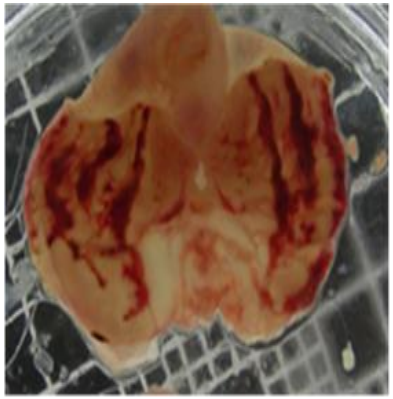
Salina

Control Positivo



Levadura - NF RUF

DE_{50} 800mg/kg



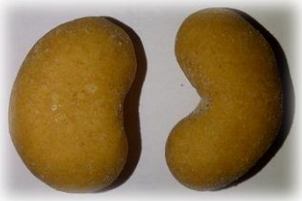
Levadura - NR RUF

Possible involvement of sulfhydryl groups in action and anti-ulcerative action on prostaglandins

Market application

Incorporation of peptide extracts, and beta-glucans:

- Snack with cashew and peptide extract with reduced content of sodium



- Cereal bars with peptide yeast extract

- Fruit smoothies with peptides

Valorisation of by-products from fruit and plants

Myrtillus – Blueberry with inovation

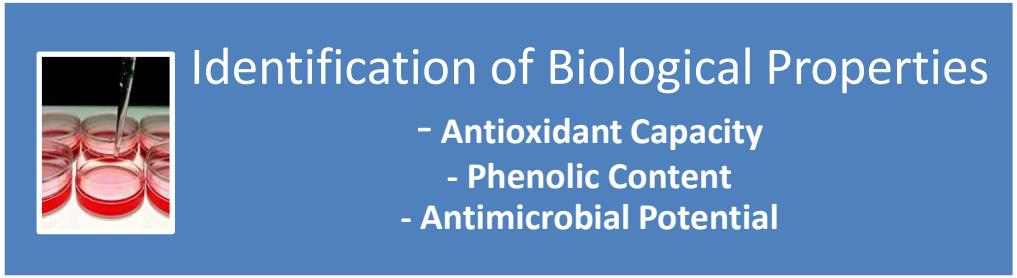
Companies: Mirtilusa, FRULACT University: ESB-UCP, FM, UTAD

- There are two major byproducts of Blueberry

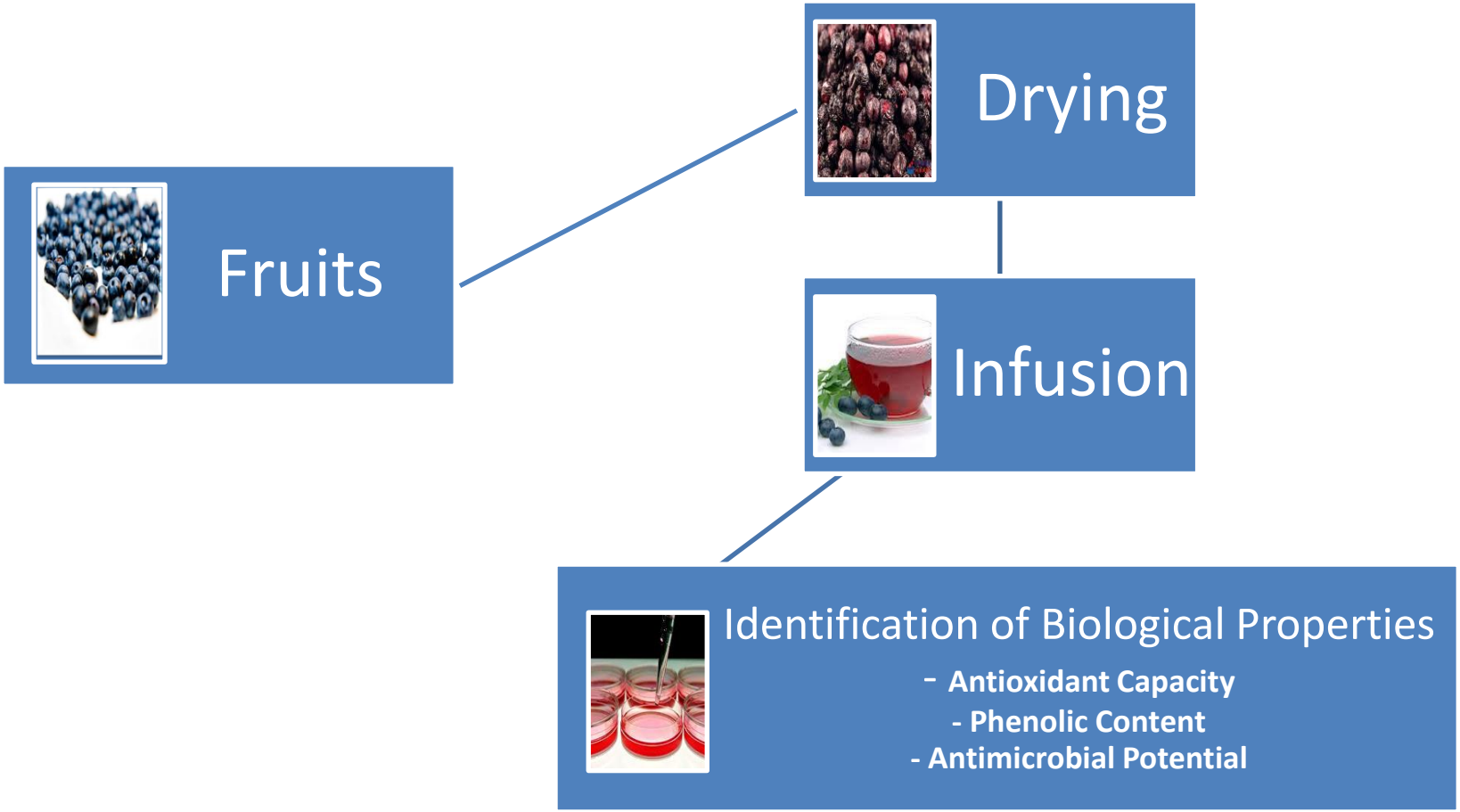
Overripe fruit / Lower quality

Leaves

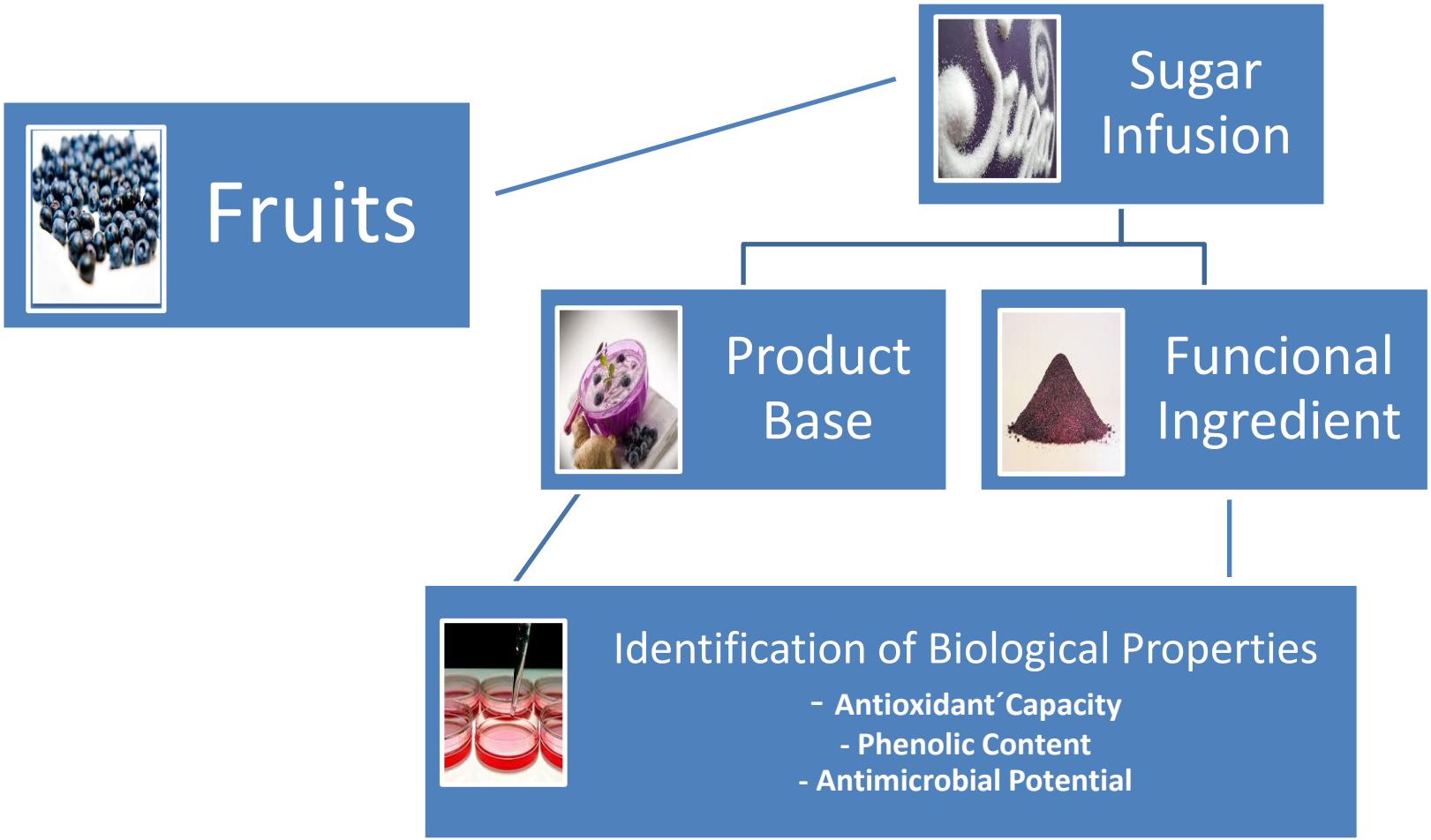
Myrtillus – Blueberry with inovation



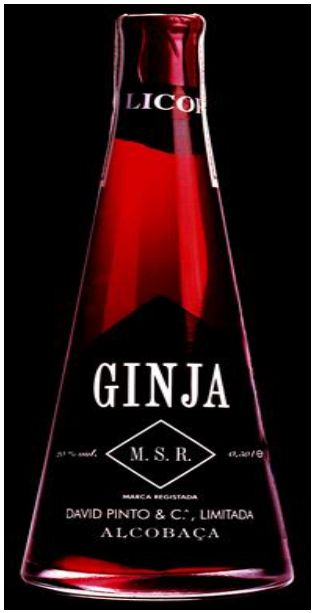
Myrtillus – Blueberry with inovation



Myrtillus – Blueberry with inovation

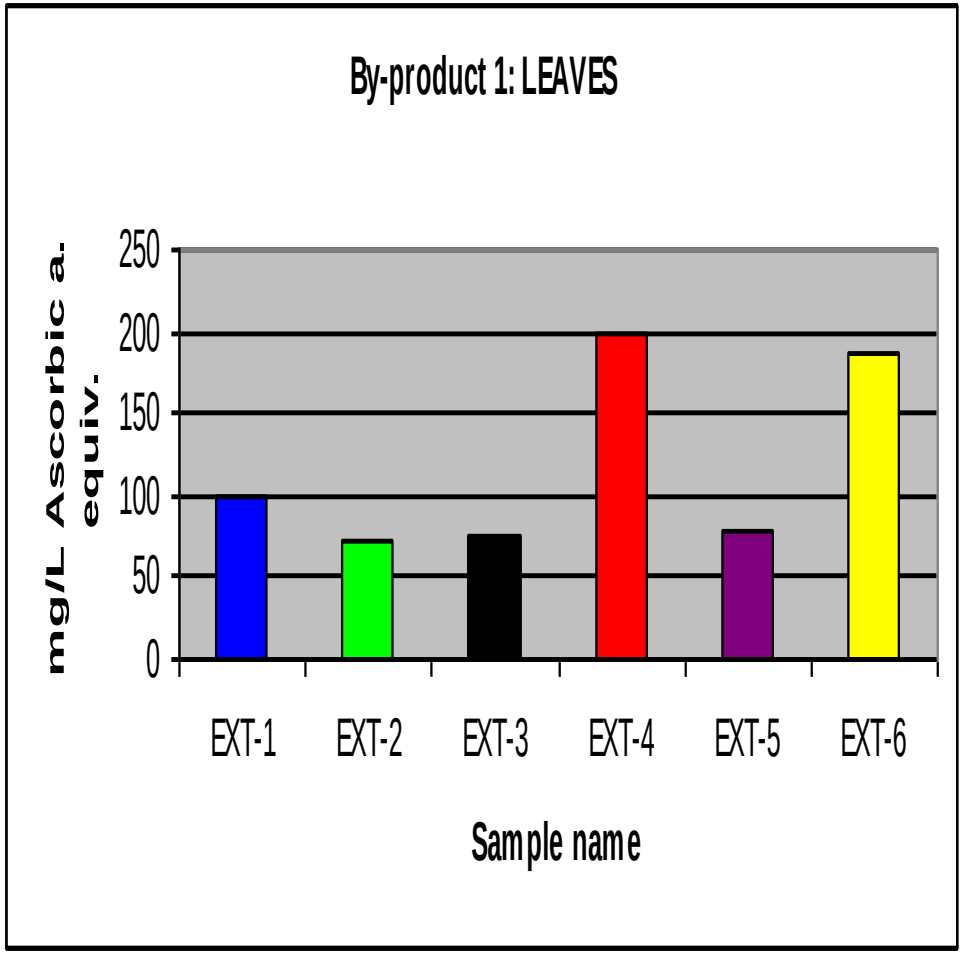


Ginja cherry and Ginjinha



- **Ginja cherry: Portuguese cherry (*Prunus cerasus*, L. Rosaceae).**
- **Used to make ginjinha, a traditional Portuguese liquor.**
- **By-products: stems and leaves.**
  - **Normally burned.**
- **Extraction of High Added Value compounds.**

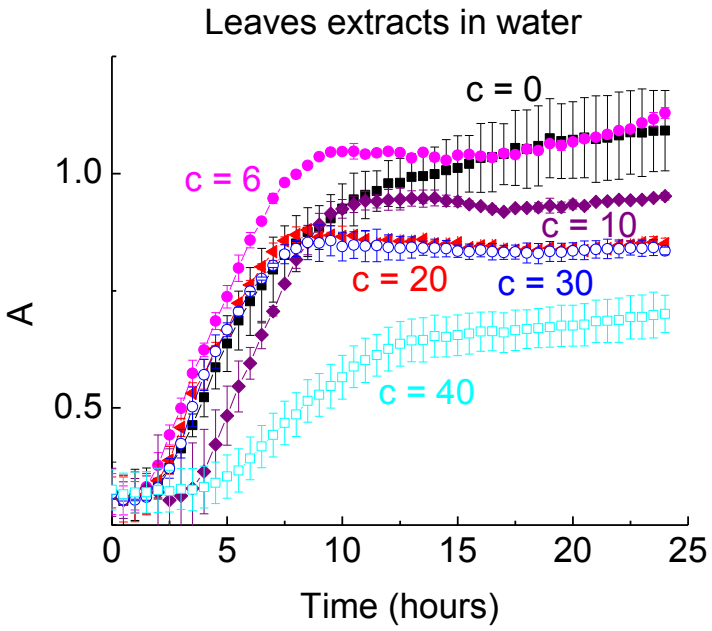
Different solvents have been used for the extraction of phenolic compounds – extracts with high antioxidant activity

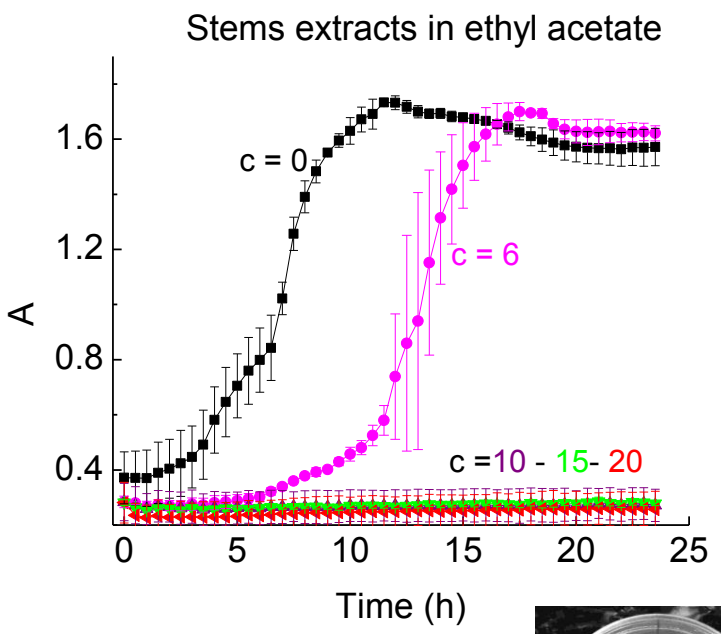


Identified compound	Classification
p-coumaric acid	phenolic acid
gallic acid	phenolic acid
ferulic acid	phenolic acid
naringenin	flavanoid
catechin	flavanoid
quercetin	flavanoid
isorhamnetin	flavanoid
chlorogenic acid	flavanoid
apigenin-7-O-glucoside	flavanoid
naringenin-7-O-glucoside	flavanoid
luteolin-7-O-glucoside	flavanoid

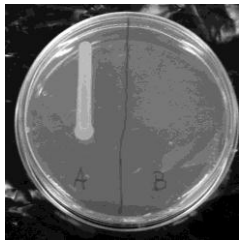
Antibacterial activity

Examples of growth curves for Methycillin Resistant *Staphylococcus aureus* (MRSA).





Note: all concentrations are expressed in mg/ml.

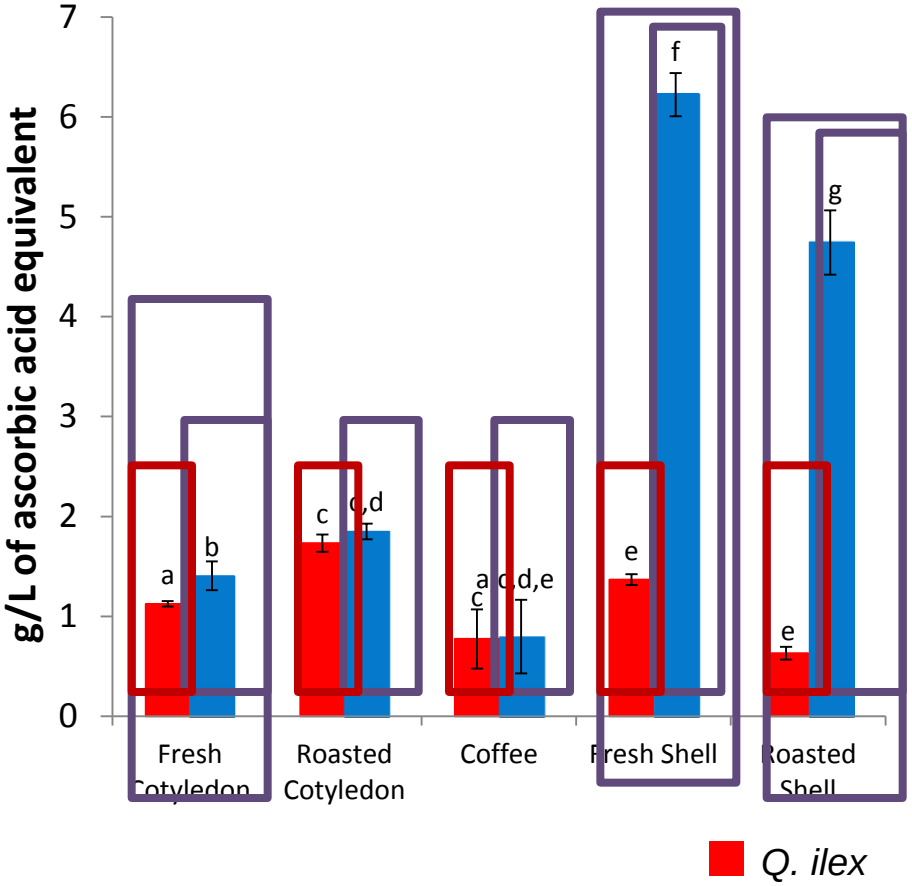


Valorization of acorns (*Quercus)*

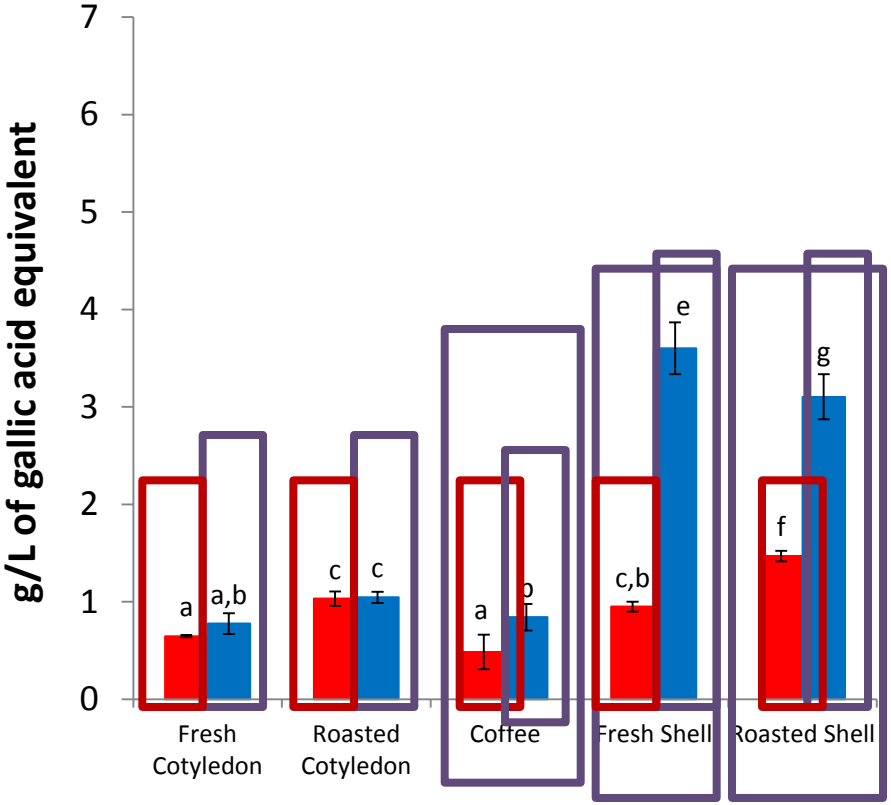
- Rich
  - Phenolic compounds
  - Antioxidants
- Valorization of Acorns
- Functional Foodstuffs

- *Valorization*
  - Antioxidant cold drink
  - Antioxidant “coffee”
  - Antimicrobial extracts
  - Flour without gluten
  - Prebiotics

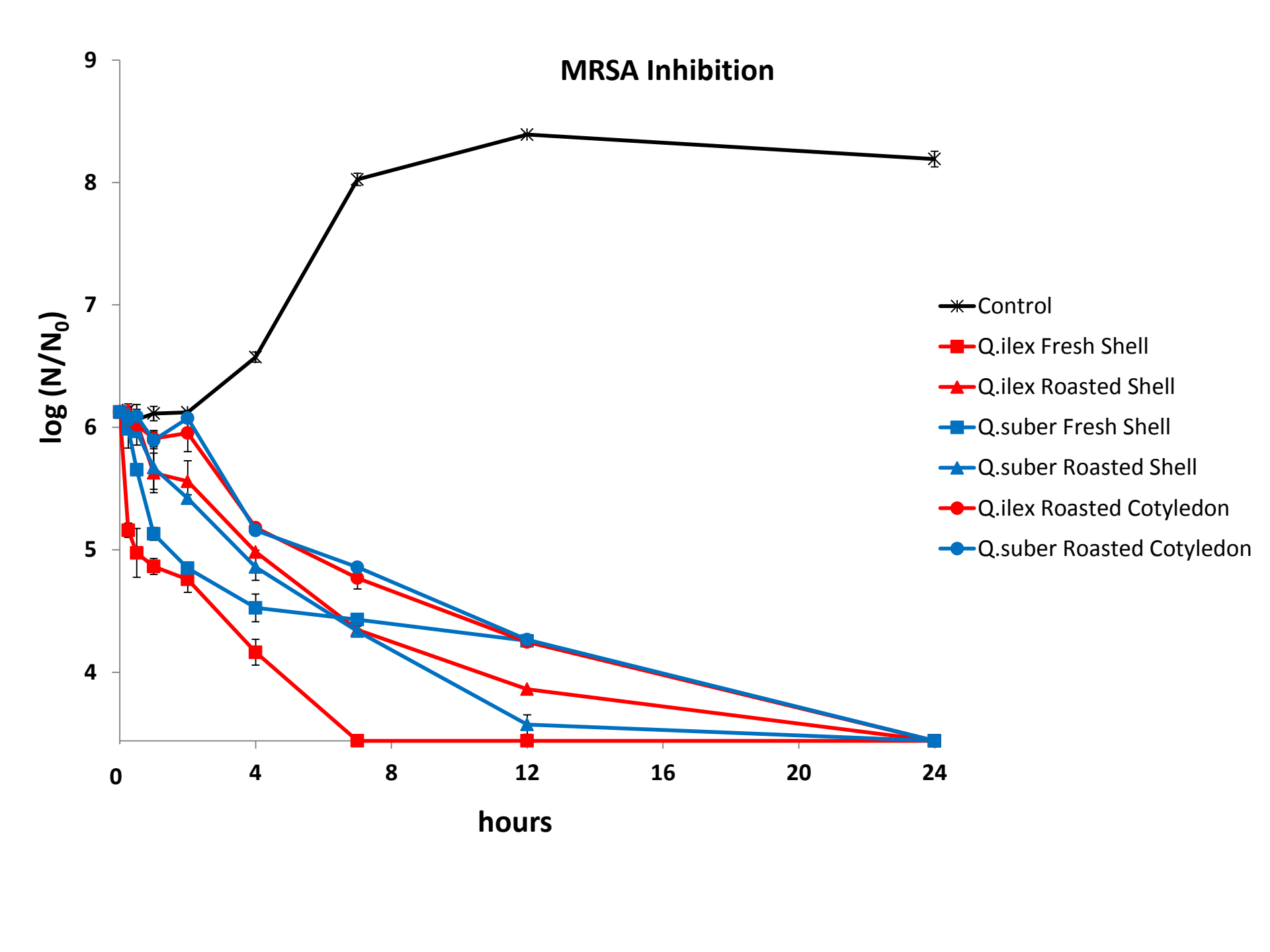
Antioxidant Capacity



Phenolic Content



Q. ilex *Q. suber*

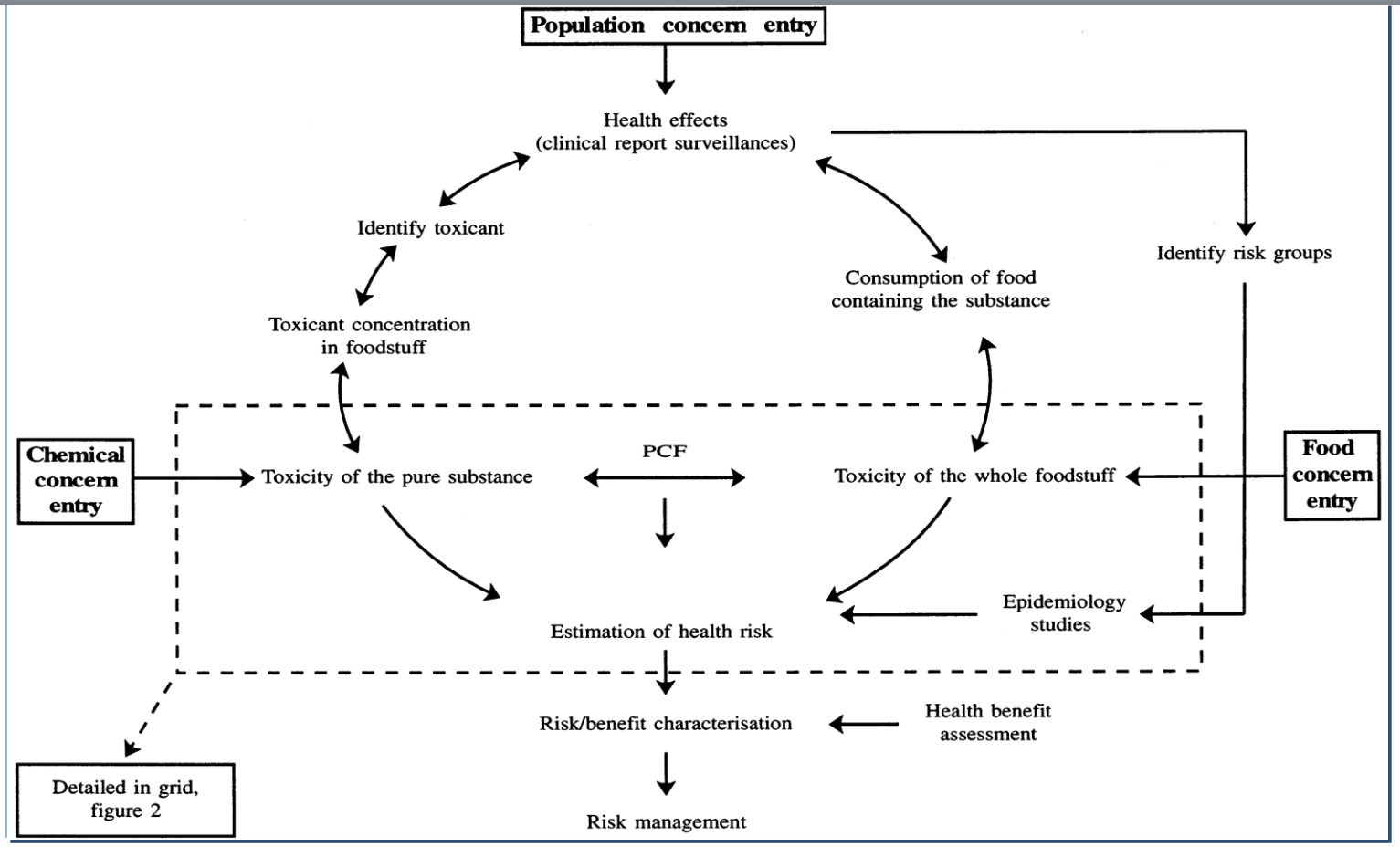

MRSA Inhibition
log (N/N0)
9
8
7
6
5
4
0
4
8
12
16
20
24
hours
Control
Q.ilex Fresh Shell
Q.ilex Roasted Shell
Q.suber Fresh Shell
Q.suber Roasted Shell
Q.ilex Roasted Cotyledon
Q.suber Roasted Cotyledon

Valorization of Grape Pomace

I. Grape Pomace → II. Flour → III. Bread

Valorization of Grape Pomace - composting

Toxicity and safety through the product chain



- Heavy metals
- Toxic Phenolics
- Pesticides
- Biogenic amines
- Cyanide and other compounds
- Oxidation products
- Microorganisms
- Aflotoxins

Environmental Toxicology and Pharmacology 5 (1998) 155–172

http://www.fp7-gratitude.eu/research-areas

Research Areas | Gratitude | caroços de ginja - Pesquisa do ...

Gratitude

Reducing Losses from Roots and Tubers

Home | Project Overview | About the project | Information | Partner log in | S-S Interaction

Welcome Anonymous, you are here: » About the project » Research Areas

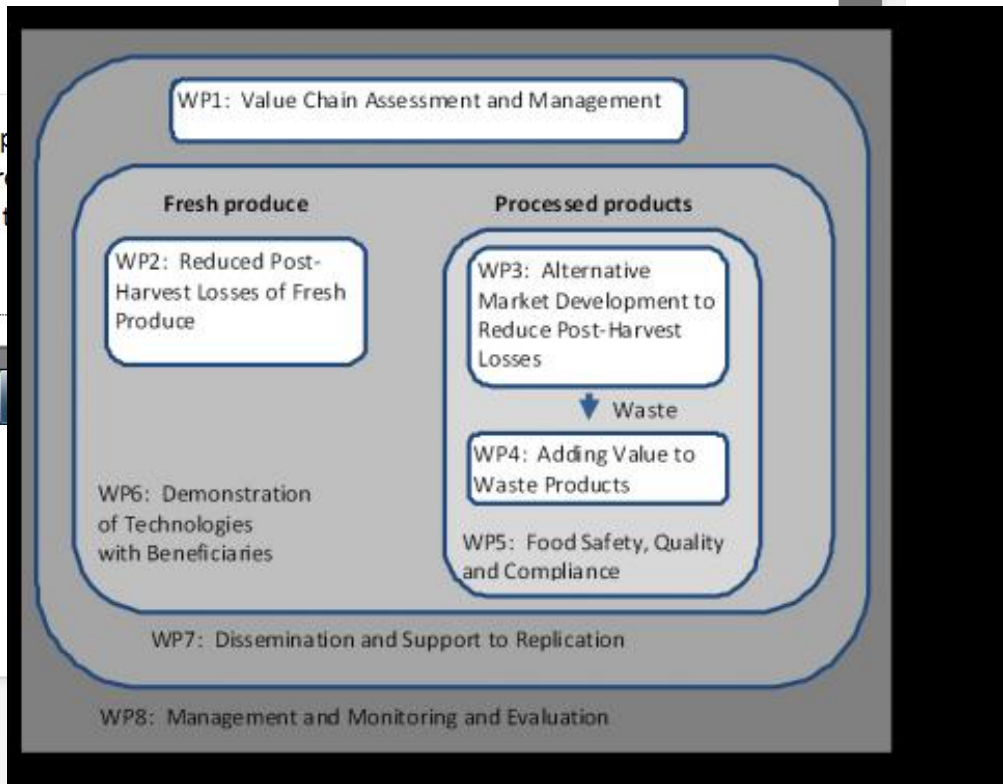
SEARCH SITE

LATEST NEWS

'Gratitude' launch, a success

Research Areas

The research areas are defined by work p
give a breakdown of the different work ar
package aims to achieve one or more of t
packages as follows:



http://www.fp7-gratitude.eu/


Assure: new high added value products from waste are safe and that appropriate food safety and quality management systems are in place
Good Hygienic Practices (GHP)
HACCP
Good Manufacturing Practice (GMP)

Thank you for your attention!

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