

# Valorisation of Agro-Industrial Subproducts by Membrane Processing

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# A New Paradigm

Residues and waste streams from agro-industries are not (just) an environmental burden

They are a source of value

This value may become relevant if we are able to recover / produce high added-value products (think ahead of energy from biomass)

Need for adequate technologies for a Circular Economy

# Which Valuable Compounds to Recover / Produce?

## *Small Molecules* (200 -1000 Da)

Flavours, (poly)phenols, (phyto)sterols, bioactive peptides, oligosaccharides, ...

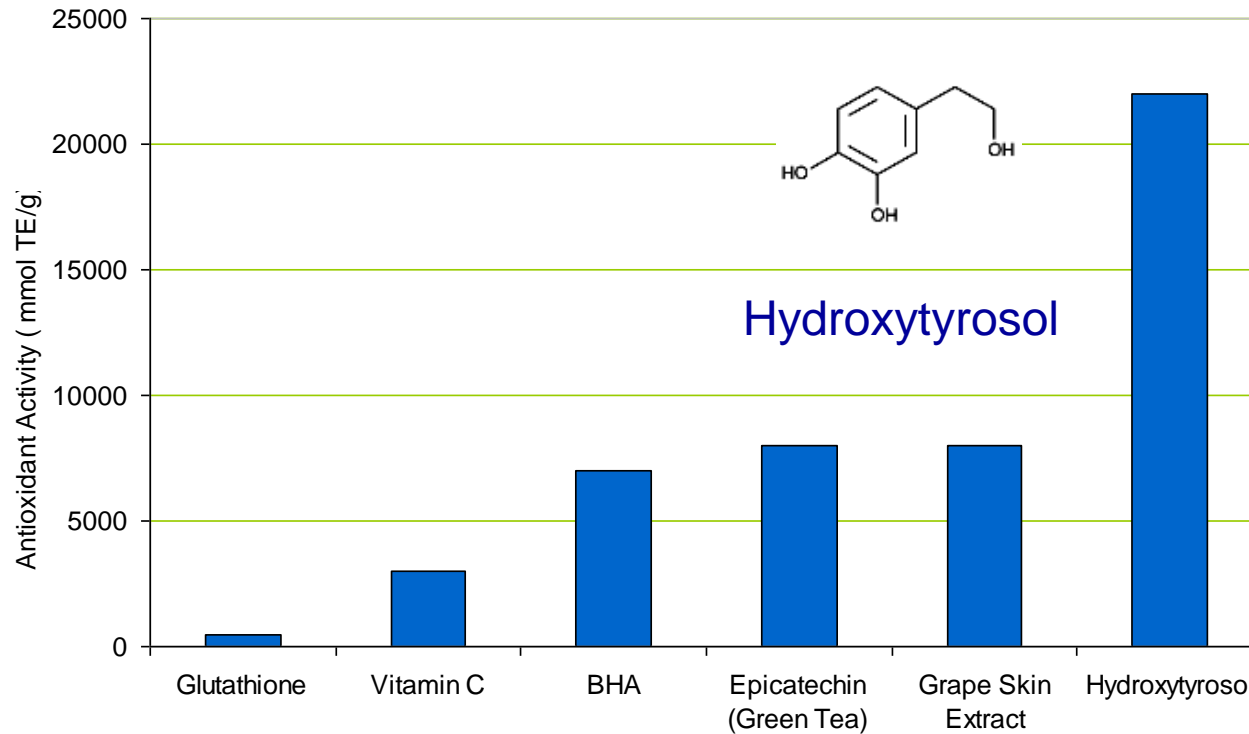
With anti-oxidant, anti-carcinogenic, anti-“bad” cholesterol properties, ...

## *Large Molecules*

Proteins, ...

Biopolymers (with film-forming capability)

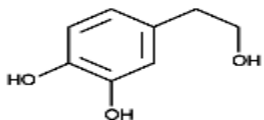
# Bioactive Phenolic Compounds from Olive Waste Streams: Hydroxytyrosol



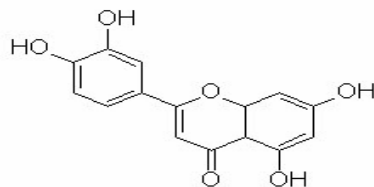
Data produced by Brunswick Laboratories, Wareham, MA

**Hydroxytyrosol is the natural compound with the highest anti-oxidant activity identified**

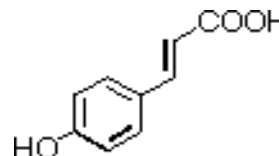
# Recovery of Small Bioactive Phenolic Compounds by Nanofiltration



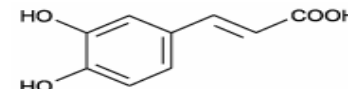
Hydroxytyrosol



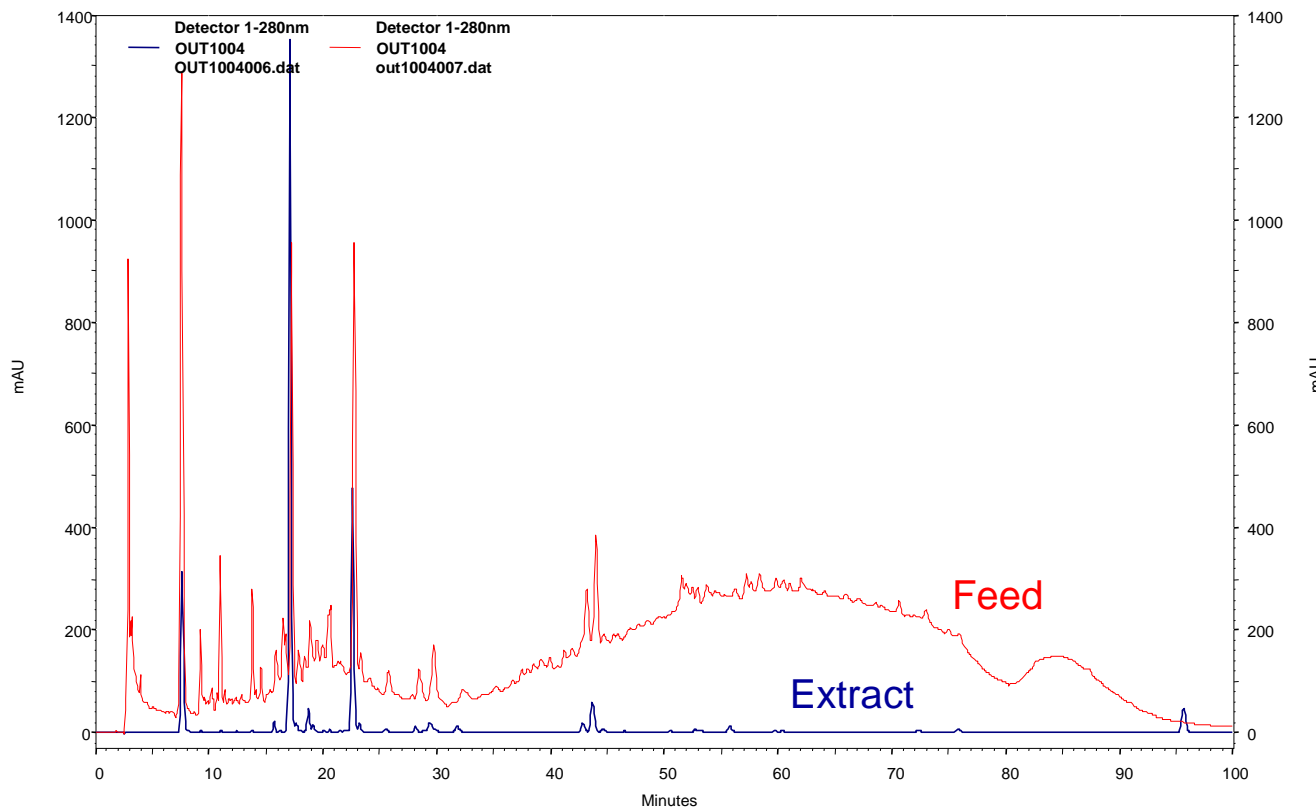
Quercetine



Coumaric acid

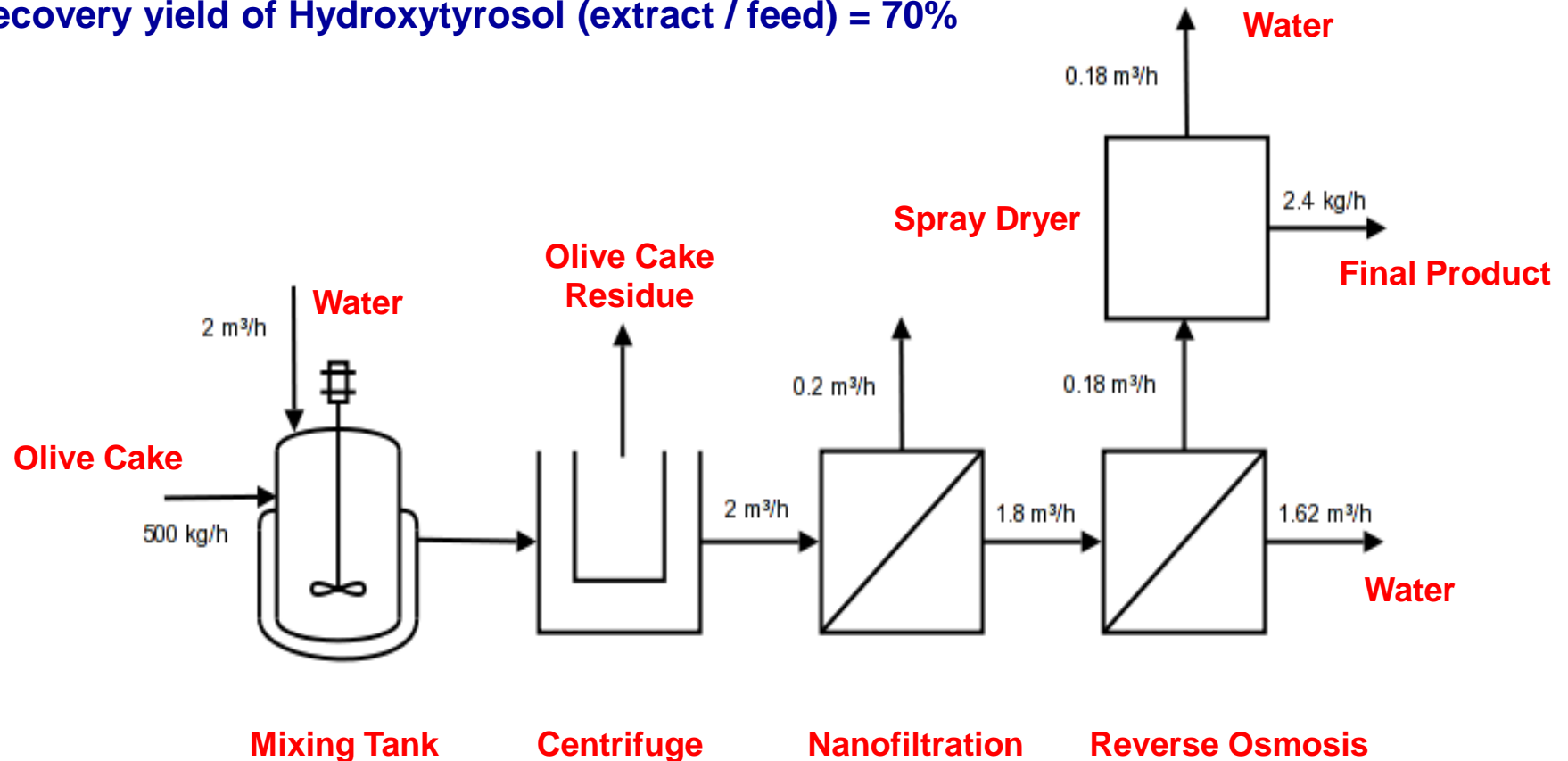


Caffeic acid



# Recovery of a Natural Extract by Nanofiltration / Reverse Osmosis

Recovery yield of Hydroxytyrosol (extract / feed) = 70%





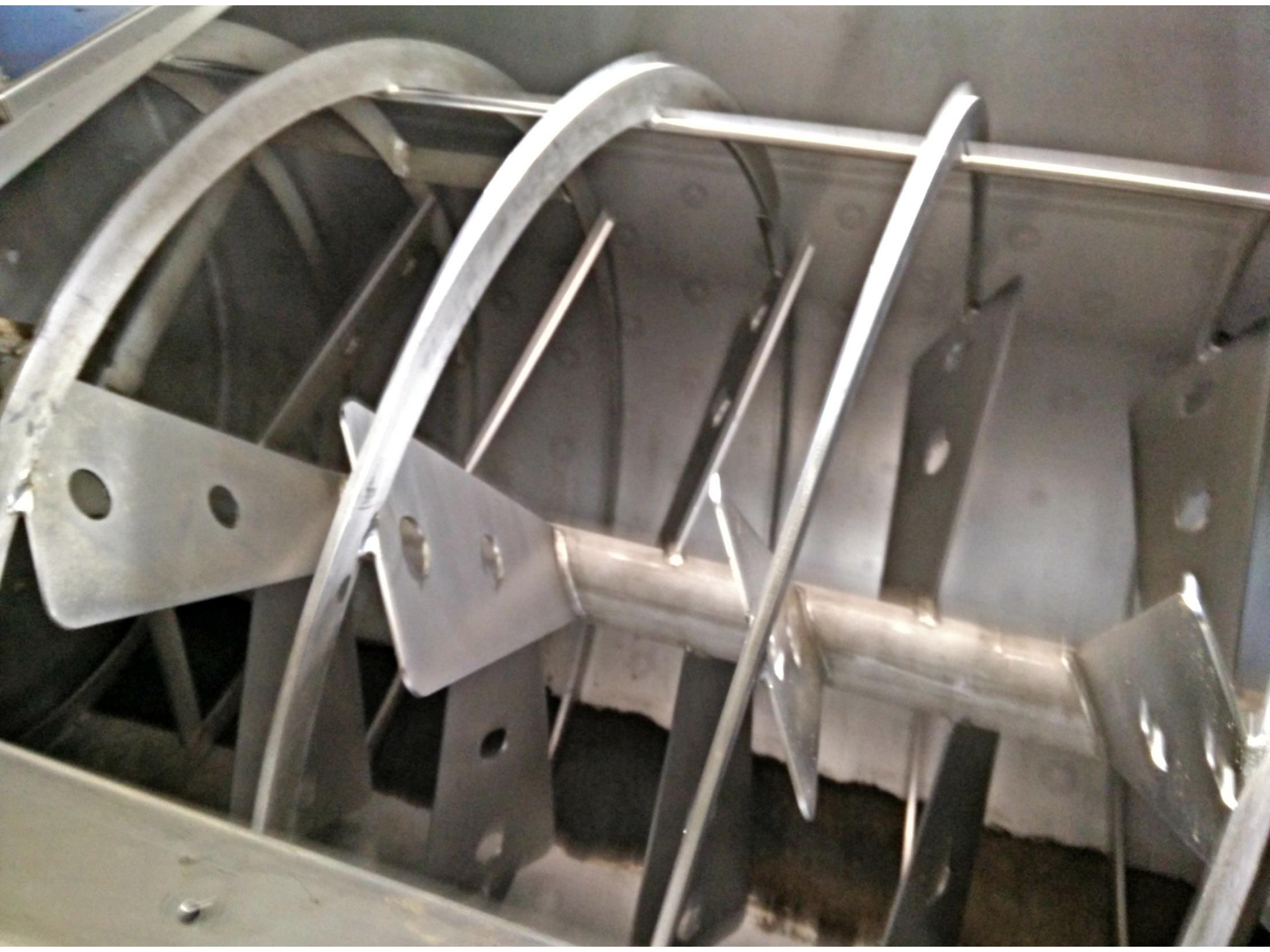






 **Flottweg**  
Separation Technology











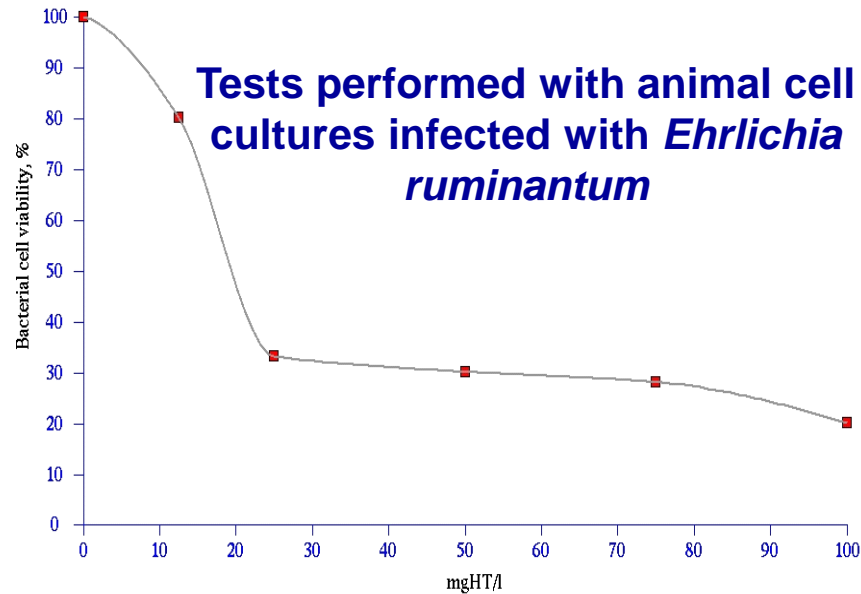
# Evaluation of the Extract Produced by NF/RO

	HT	Extract
Anti-oxidant activity	+++	++++
Inhibition of "bad" cholesterol	+	+++
Prevention of cardiovascular diseases	+	+++
Prevention of arteriosclerosis	+	+++
Anti-microbial activity	+	+++
Anti-inflammatory activity	++	+++
Anti-carcinogenic activity	++	+++

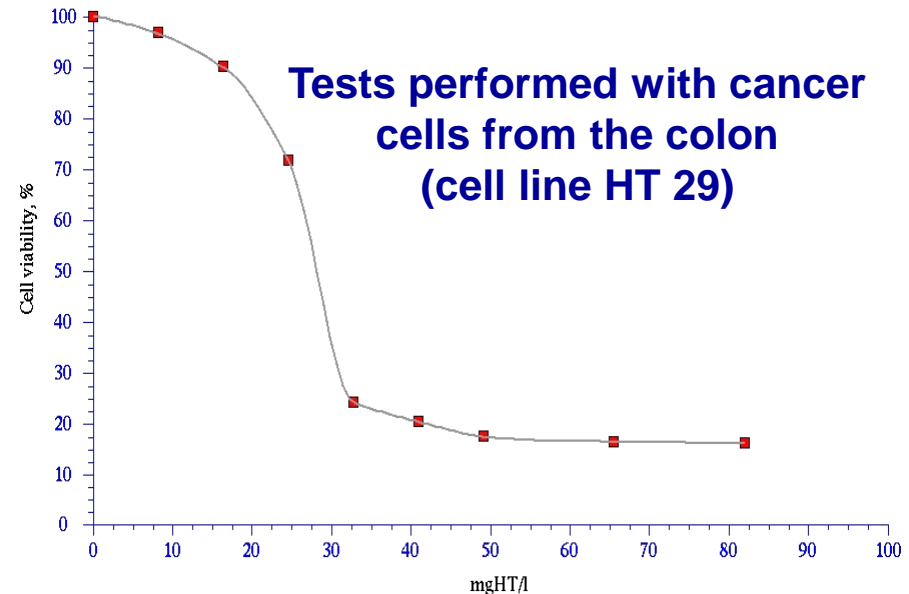


# Anti-Inflammatory and Anti-Carcinogenic Activity

Tests performed with animal cell cultures infected with *Ehrlichia ruminantum*



Tests performed with cancer cells from the colon (cell line HT 29)



## SCIENTIFIC OPINION

**Scientific Opinion on the substantiation of health claims related to polyphenols in olive and protection of LDL particles from oxidative damage (ID 1333, 1638, 1639, 1696, 2865), maintenance of normal blood HDL-cholesterol concentrations (ID 1639), maintenance of normal blood pressure (ID 3781), “anti-inflammatory properties” (ID 1882), “contribute to the upper respiratory tract health” (ID 3468), “can help to maintain a normal function of gastrointestinal tract” (3779), and “contributes to body defences against external agents” (ID 3467) pursuant to Article 13(1) of Regulation (EC) No 1924/2006<sup>1</sup>**

**EFSA Panel on Dietetic Products, Nutrition and Allergies (NDA)<sup>2, 3</sup>**



US008066881B2

(12) **United States Patent**  
**De Magalhães Nunes Da Ponte et al.**

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(45) **Date of Patent:** **Nov. 29, 2011**

(54) **METHOD OF OBTAINING A NATURAL  
HYDROXYTYROSOL-RICH CONCENTRATE  
FROM OLIVE TREE RESIDUES AND  
SUBPRODUCTS USING CLEAN  
TECHNOLOGIES**

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Crespo, Lisboa (PT)**

(\*) **Notice:** Subject to any disclaimer, the term of this  
patent is extended or adjusted under 35  
U.S.C. 154(b) by 0 days.

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integrated olive mill waste management recovering natural  
antioxidants and producing organic fertilizer" Internet Citation



(11) **EP 1 910 257 B1**

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(54) **METHOD OF OBTAINING A NATURAL HYDROXYTYROSOL-RICH CONCENTRATE FROM OLIVE TREE RESIDUES AND SUBPRODUCTS USING CLEAN TECHNOLOGIES**

VERFAHREN ZUR ERHALTUNG VON EINEM NATÜRLICHEN HYDROXYTYROSOLREICHEN KONZENTRAT VON ÖLBAUMRÜCKSTÄNDEN UND NEBENPRODUKTEN UNTER BENUTZUNG DER SAUBEREN TECHNOLOGIEN

METHODE POUR OBTENIR UN CONCENTRE NATUREL RICHE EN HYDROXYTYROSOL A PARTIR DE RESIDUS ET DE SOUS-PRODUITS D'OLIVIER UTILISANT DES TECHNOLOGIES PROPRES

(84) Designated Contracting States:  
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR  
HU IE IS IT LI LT LU LV MC NL PL PT RO SE SI  
SK TR

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Largest World Pharma market: anti-cholesterol products

**\$ 35 000 MILLIONS** em 2012

10 % in natural products - **\$ 3 500 MILLIONS**

# **As an academic what do I need from an investor?**

To bring his experience and strengths to the business

Advice for market oriented product development

Advice for Branding

Funding



*O azeite que tempera  
o bem-estar.*



## What is entrepreneurship about:

(controlled) Risk-taking

Networking

Turning problems “upside-down”

