Natural Antioxidants: Great Potential for Use in Seafood

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Oxidation in Fish Lipids

- Fish or seafood containing bioactive lipids are a main goal for food companies claiming for products with stable omega-3 oils
- However, it is a very susceptible material: HIGH PUFA content and HIGH HEME-Proteins content
- Generation of off-flavours

associated to Rancidity

- Fatty and semi-fatty species

Horse mackerel, mackerel, herring

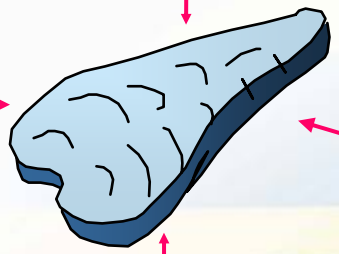
Antioxidants

- The use of antioxidants is emerging as an effective methodology for controlling rancidity in oils and food
- Their role is to inhibit or retard the progress of lipid oxidation
- They can inhibit the formation of free radicals
- They can interrupt the free radical chain
- Consumers and food industry request natural antioxidants substituting those synthetics

Natural Antioxidants in Fish Products

Metal Chelators

Reducing Hemoglobins



Scavenger of Free Radicals

Synergy with Endogenous Antioxidants

- Naturals and Efective
- Low cost
- Easy application: mix, inmersion, injection, vacuum, glasee, diet

Natural Antioxidants in SEAFOODplus

- Cinnamic acids present in vegetable extracts:

  Coumaric, Chlorogenic, Ferulic and Caffeic acids

- Catechins present in tea extracts:

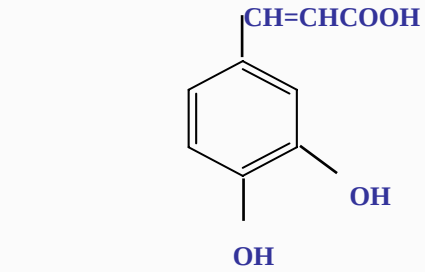
  Catechin, gallocatechin, catechin gallate, gallocatechin gallate

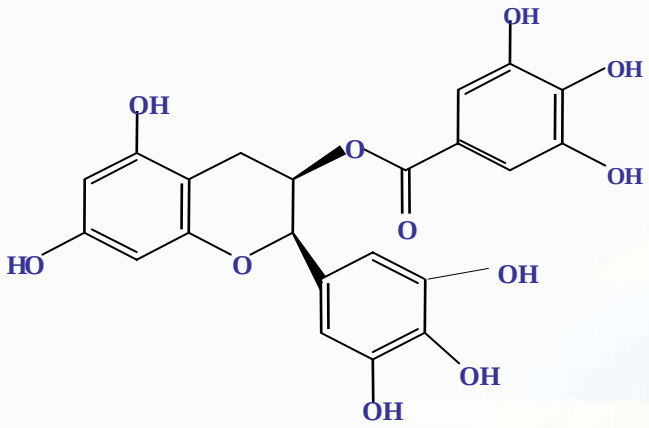
Naturals and Effective in other matrices

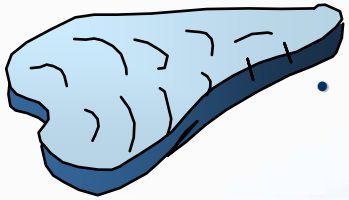
Cost

Application

Natural Antioxidants in SEAFOODplus







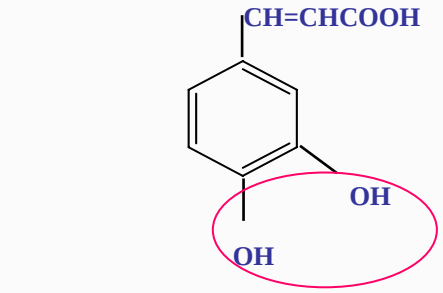
- Fish minced muscle
- Fish fillets

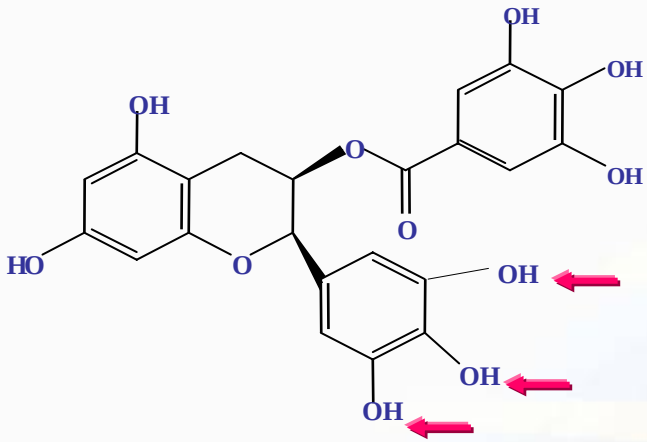
Inhibition of PUFA Oxidation

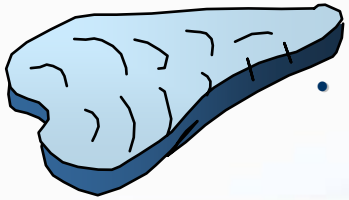
Extension of Shelf-Life of the Seafood Product

Protection of Biactive Lipids

Natural Antioxidants in SEAFOODplus







- Fish minced muscle
- Fish fillets

Different molecular features

Different in vitro properties

Different location

DIFFERENT EFFICIENCY

In vitro Efficiency of Natural Antioxidants

N° donated electrons: Reducing power

- Caffeic > Ferulic > Chlorogenic >> Coumaric
- Propyl gallate >>> BHT

In vitro Efficiency of Natural Antioxidants

Chelating Capacity (AEDT reference)

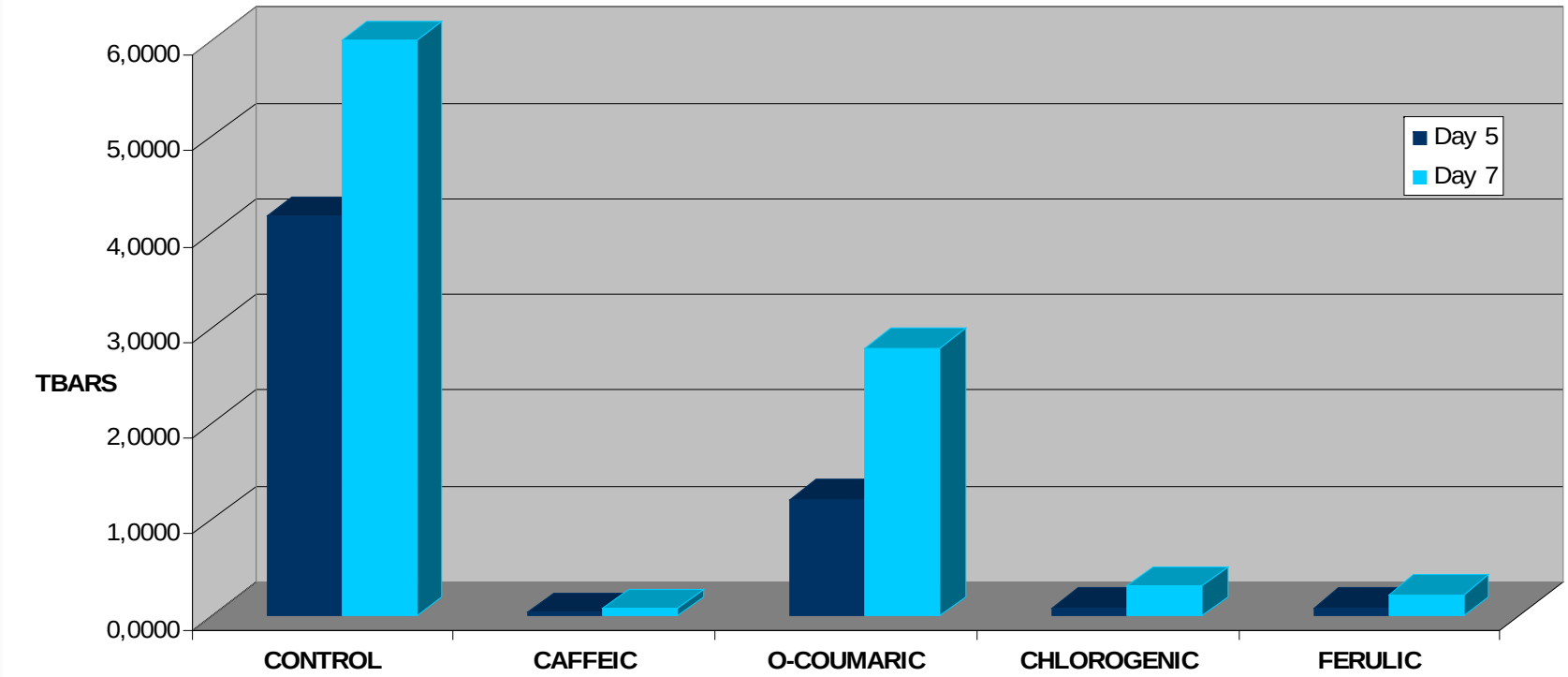
- Caffeic = Chlorogenic >>> Ferulic = Coumaric
- BHT > Propyl gallate

In vitro Efficiency of Natural Antioxidants

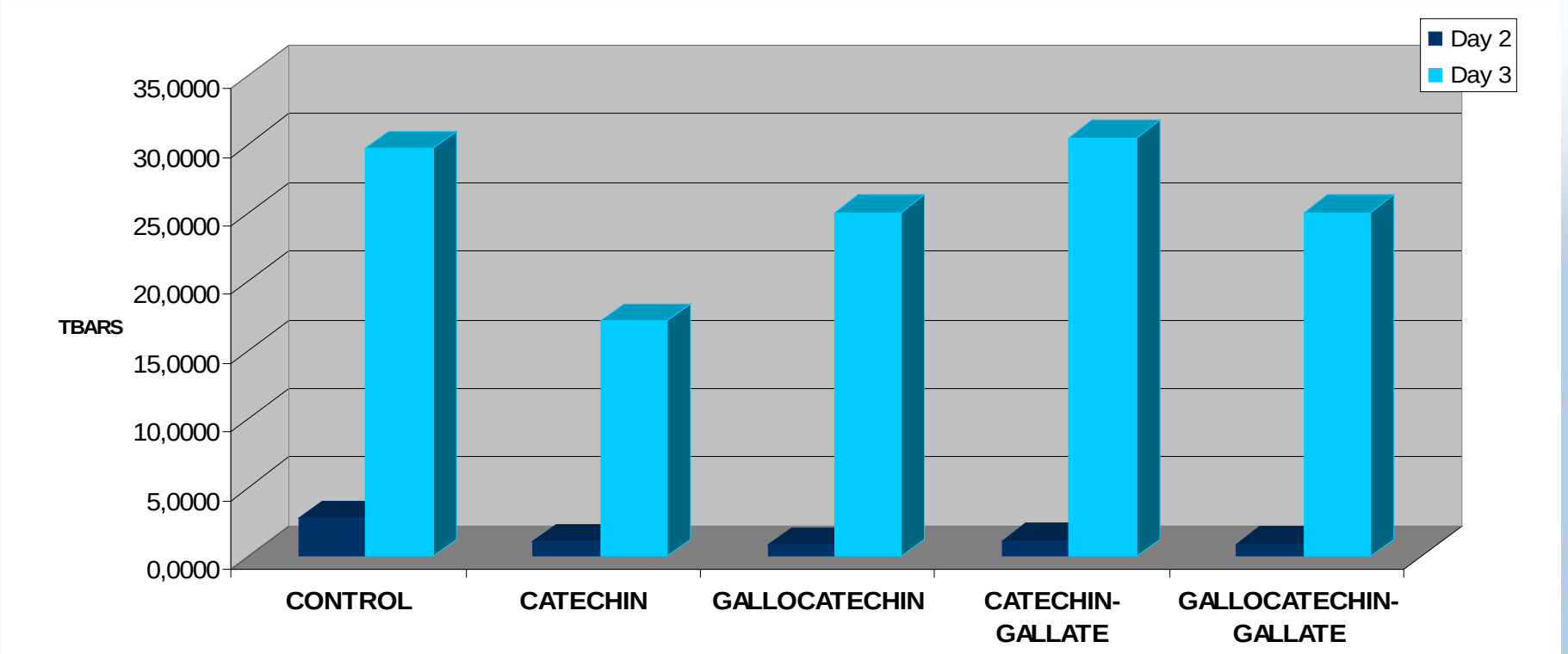
Partitioning Coefficients: Polarity

- Caffeic = Chlorogenic >> Coumaric >> Ferulic
- Propyl gallate > BHT

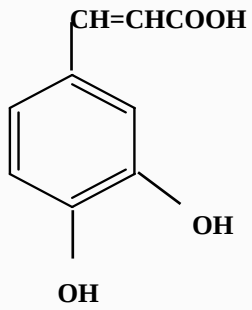
Efficiency of Antioxidants on Fish Muscle



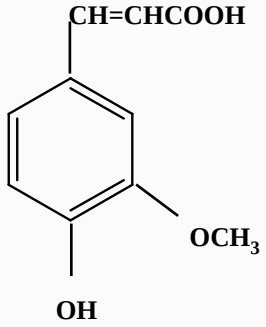
Efficiency of Antioxidants on Fish Muscle



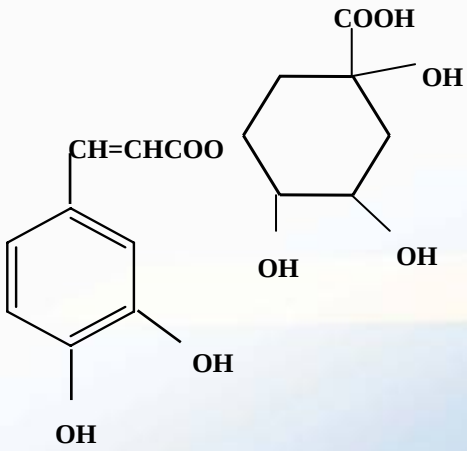
Efficiency of Antioxidants on Fish Muscle



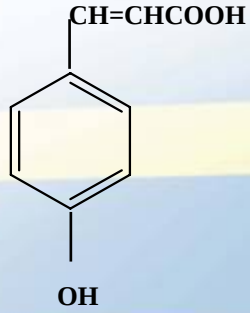
Caffeic acid



Ferulic acid



Chlorogenic acid



Coumaric acid

Decreasing effectiveness

Efficiency of Antioxidants on Fish Muscle

- Effectiveness is confirmed in frozen horse mackerel and salmon at –10°C
- Confirming data in frozen horse mackerel and salmon at –18°C

In collaboration with Nick Hedges, Unilever

In vitro and *In muscle* Efficiency of Antioxidants

Rate of formation of oxidation products/mol antioxidant against In vitro activity

	Cinnamic Acids
Reducing power	- 0.97*
Chelating activity	- 0.57
Polarity	0.13

Nº donated electons: is significantly correlated

Chelating ability and polarity: are not correlated

Synergy with Endogenous Antioxidants

- In vivo, fish contains an antioxidant system that stabilizes its high content of unsaturated lipids. α-Tocopherol, ubiquinone, carotenoids, glutathione and ascorbate.
- In post mortem conditions, those endogenous antioxidants are consumed sequentially.

Can our antioxidants reinforce the action of the Endogenous System?

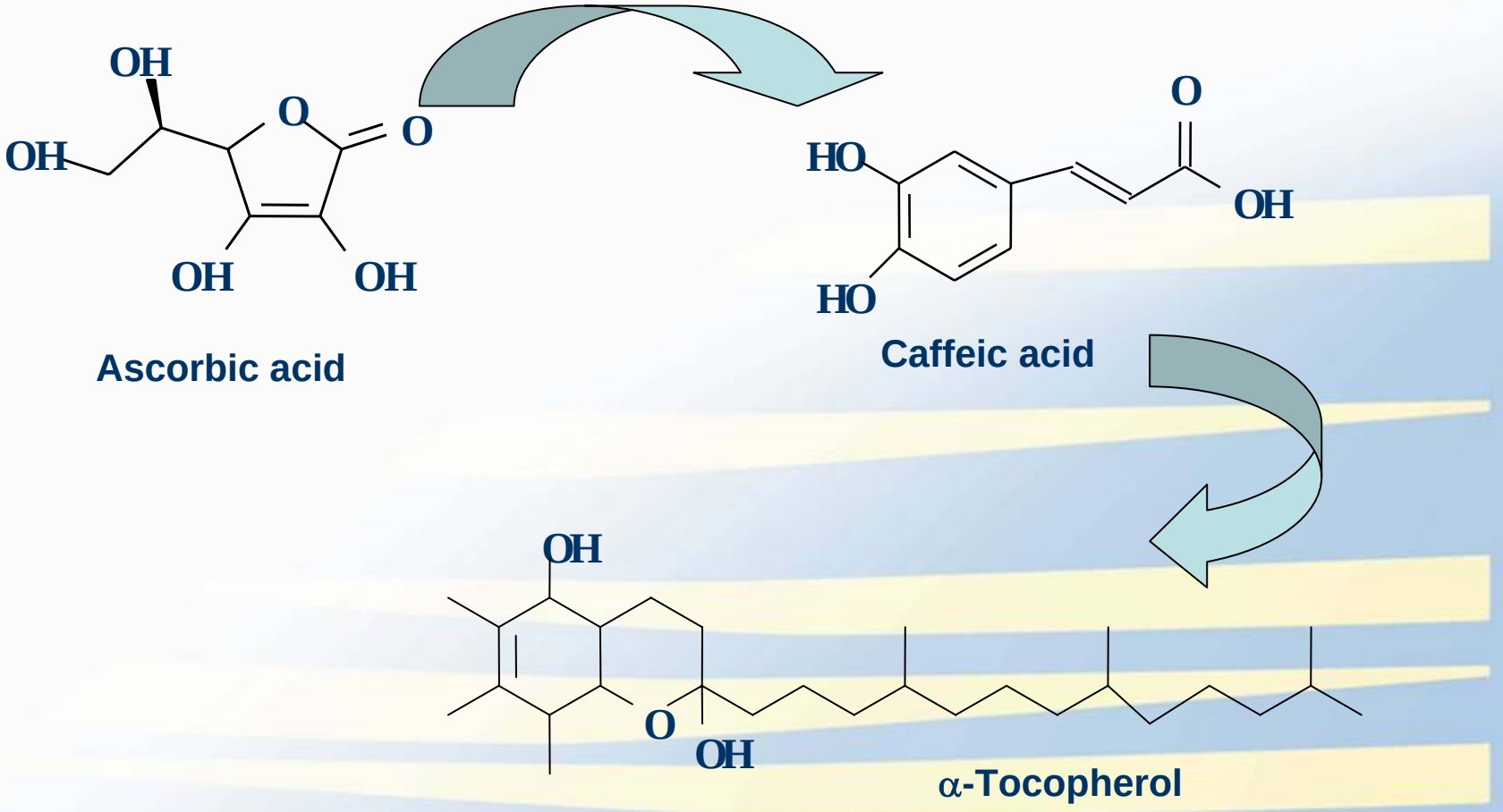
Cinnamic Acids and Tocopherol

- Tocopherol is being preserved in presence of caffeic acid
- Ascorbic Acid is being consumed in presence of caffeic acid

Synergy with endogenous antioxidants

- Consumption of Ascorbic acid does not influence the rate of oxidation
- α-Tocopherol seems to be the most important factor for stabilising lipid oxidation
- What is happening in the Endogenous balance in presence of Caffeic Acid?

Possible Mechanism



Concentration ratio

- Experiments with different horse mackerel fishes
- Preliminary data shows there is not a single correlation between the percent of fat/ppm antioxidant and the rate of oxidation. Other parameters must be considered

Functionality

- Chlorogenic Acid and Caffeic Acid Are Absorbed in Humans. Olthof et al, J Nutr 2001, 131: 66-71.
- Absorption of phenolic acids in humans after coffee consumption. Nardini et al, J Agric Food Chem 2002, Sep 25; 50(20): 5735-41.
- Anti-apoptotic activity of caffeic acid, ellagic acid and ferulic acid in normal human peripheral. blood mononuclear cells: A Bcl-2 independent mechanism. Khanduja et al, Biochim Biophys Acta-Gen Subj 2006, 1760 (2): 283-289.
- Inhibition of DNA methylation by caffeic acid and chlorogenic acid, two common catechol-containing coffee polyphenols. Lee et al, Carcinogenesis 2006, 27 (2): 269-277.

CONCLUSIONS

- It is possible to design Natural Antioxidants for Fish Products
- Molecular features plays a significant role on efficiency: The ability for donating electrons seems to be a significant parameter for selecting the highest efficient antioxidant
- The mechanisms involved in the action of Antioxidants in muscle must be understood: Effect of the endogenous reductor system
- An increase on the functional properties of the fish product can be achieved by the employment of bioactive compounds such as phenolics or flavanoids.

Acknowledgements

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THANKS

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SPAIN

A better life with seafood…

www.seafoodplus.org