Use of natural extracts for the improvement of quality, functional properties and stability of food products

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State of art

During last decade, in addition to growing awareness of food and drink has increased consumer demand for food products with enhanced ***nutritional*** and ***functional properties***[1], in addition, there has also been a growing interest in ***phenolic compounds*** and their role in the prevention of various degenerative diseases [2].

Hence, in last years the growing consumers' concerns with healthier and safer food along with ***sustainable production***, emphasized the role of agronomic practices as one of the main determinants of food quality and environment protection[3].

Hence, the industries need to ***diversify their productions*** exploring ***new functional ingredients, formulations and processes.***

(1) Roussos and Gasparatos. Apple tree growth and overall fruit quality under organic and conventional orchard management. Scientia Horticulturae 123 (2009) 247–252
(2) Magalhães et al. Fundamentals and Health Benefits of Xanthohumol, a Natural Product Derived from Hops and Beer Natural Product Communications 4 (2009) 561-610
(3) Romàna, Sànchez-Siles et al. The importance of food naturalness for consumers: Results of a systematic review. Trends in Food Science & Technology, 67 (2017) 44–57

Aim

To investigate the use of natural extracts for the production of high quality food products

Use of *natural extract* for the production of minimally processed/semifinished frozen products

Production of natural extracts to be used as ingredients in food formulations

EXPERIMENTAL PLAN

PART I → Enrichment of organic and conventional **apple** cubes with **lemon juice** solution by using as freezing pre-treatments dipping and vacuum impregnation.

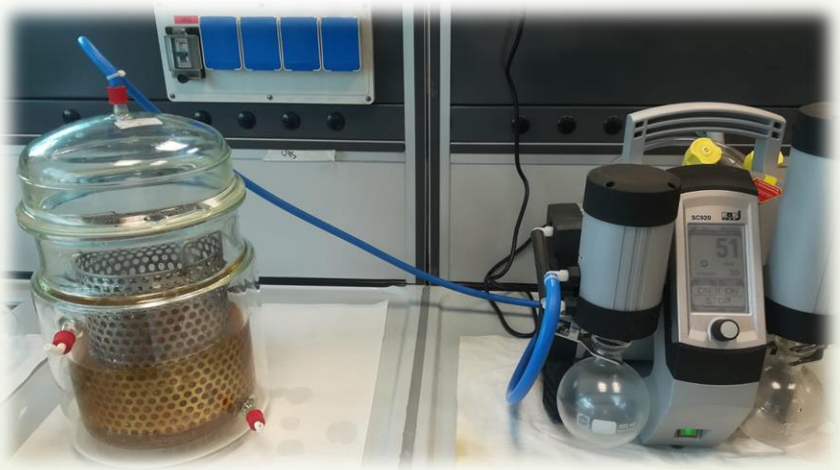
PART II → Enrichment of **carrots** slices with **green tea extract** by using as freezing pre-treatments blanching in combination with vacuum impregnation.

PART III → Production of *hops natural extracts* to be used as ingredients in *food formulations*.

PART I

- Enrichment of organic and conventional *apple* cubes with lemon juice solution by dipping and vacuum impregnation.

- ✓ Evaluation of the effect of these pretreatments on quality, total polyphenol content (TPC) and antioxidant activity (AOA) of frozen apples.



EXPERIMENTAL DESIGN

1) CHARACTERIZATION OF RAW MATERIAL

- Organic lemon juice
- Organic apples cv. *Golden Delicious* (ORG)
- Conventional apples cv. *Golden Delicious* (CONV)

2) PRE-TRATMENTS

- Dipping (DIP) 1min
- Vacuum impregnation (VI) 738 mbar 10sec

3) STORAGE

- −40 °C ; 15, 30, and 300 days

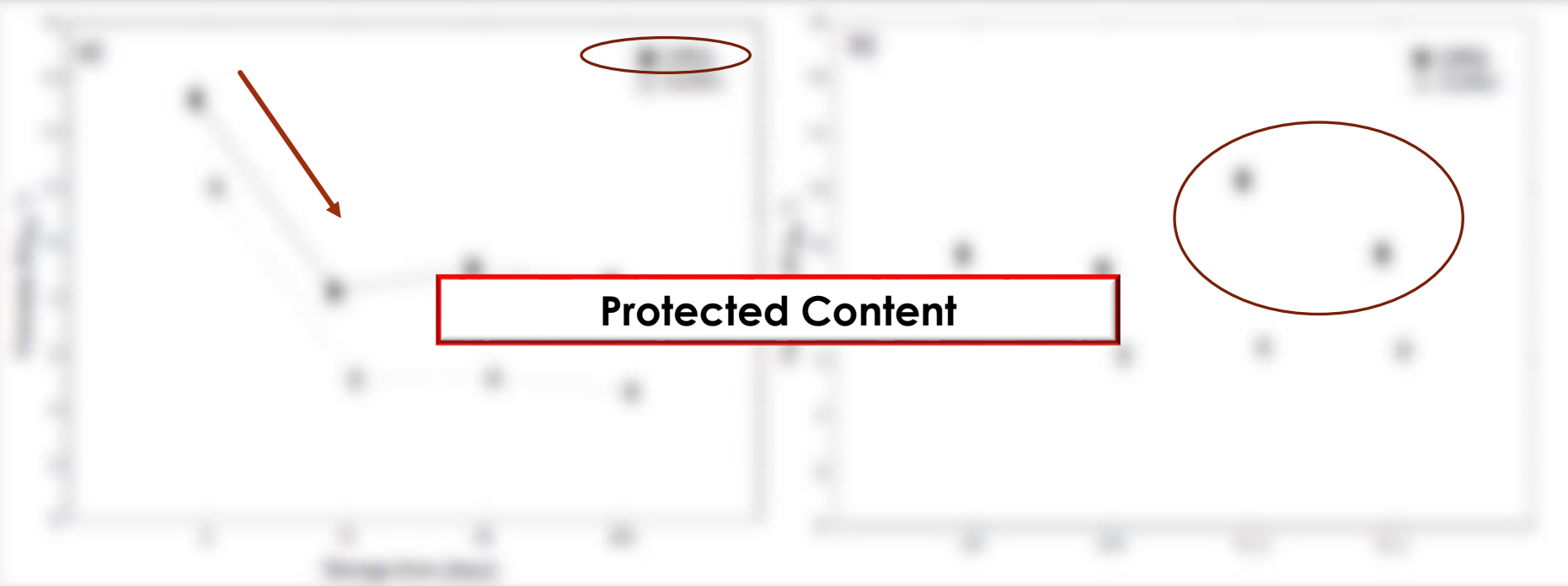
ANALYSIS

- Citric acid content
- Starch index
- Titratable acidity
- Soluble solids (°Brix)
- pH

ANALYSIS

- Moisture content
- Sugars determination
- Organic acid determination
- Colour analysis
- Mechanical properties
- Total poliphenol content
- Antioxidant activity
- PPO assay
- Identification and quantification of polyphenols (free and conjugated)

MAIN RESULTS: PHYSICAL PROPERTIES



Effective hypothesis decomposition of factorial ANOVA for the combined effects of storage time×agricultural method (A) and the combined effect of type of pretreatments × agricultural method (B) on the firmness of organic (ORG) and conventional (CONV) apples. Vertical bars denote 95% confidence. NP, not pretreated; DIP, dipped in diluted lemon juice; VI C, vacuum impregnated in water; VI L, vacuum impregnated in diluted lemon juice.

Journal of Food Science
A Publication of the Institute of Food Technologists
Food Engineering, Materials Science, & Nanotechnology

Effect of Dipping and Vacuum Impregnation Pretreatments on the Quality of Frozen Apples: A Comparative Study on Organic and Conventional Fruits

Lilia Neri, Veronica Santarelli, Carla D. Di Mattia, Giampiero Sacchetti, Marco Faieta, Dino Mastrocola, Paola Pittia

MAIN RESULTS: PHYSICAL PROPERTIES

Effective hypothesis decomposition factorial ANOVA for the combined effects of storage time × agricultural method (A) and the combined effect of type of pretreatments × agricultural method (B) on the h° of organic (ORG) and conventional (CONV) frozen apples; effective hypothesis decomposition for the individual effect of pretreatment on h° after freezing and thawing (C). Vertical bars denote 95% confidence. NP, not pretreated; DIP, dipped in diluted lemon juice; VI C, vacuum impregnated in water; VI L, vacuum impregnated in diluted lemon juice.

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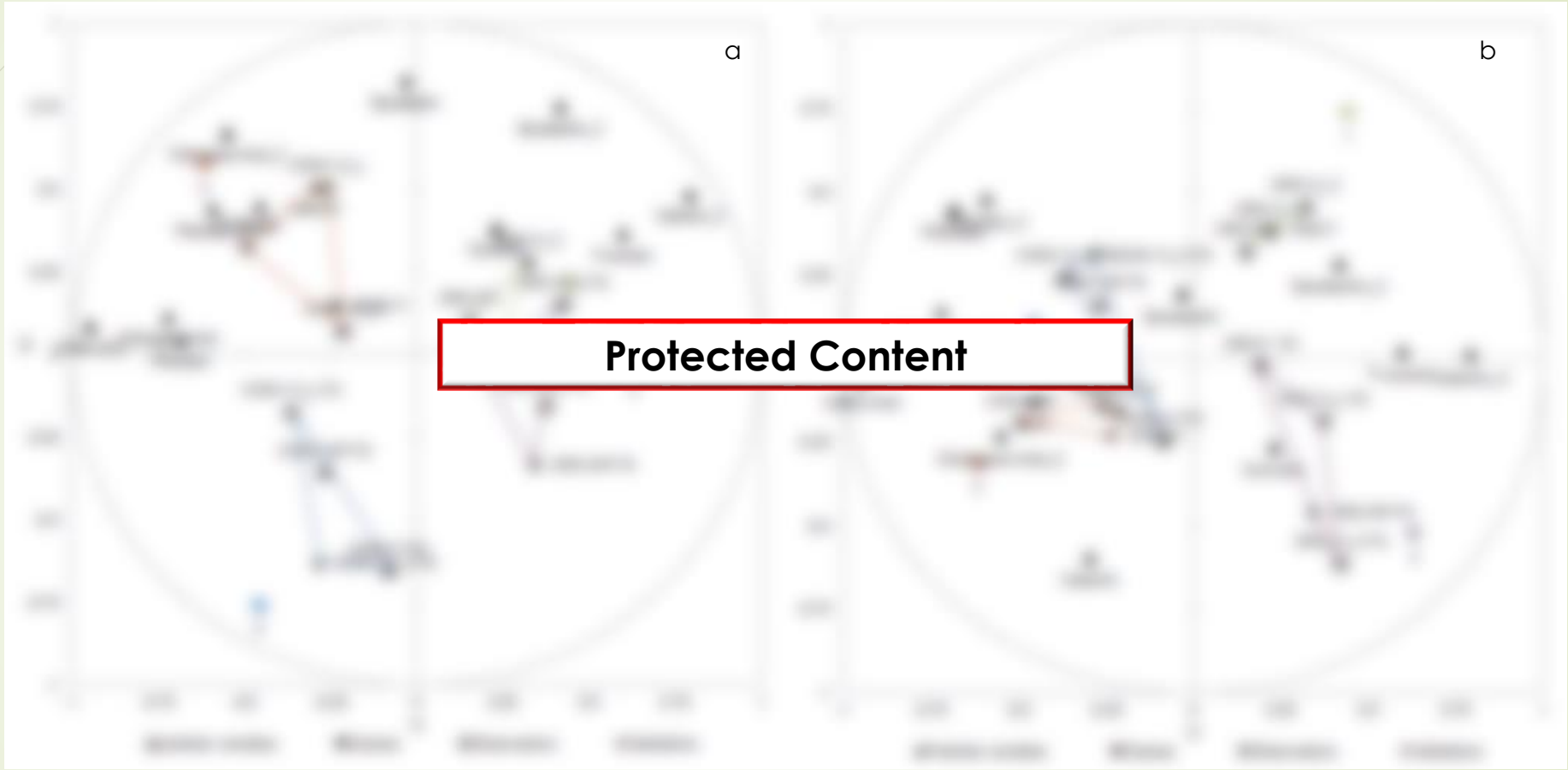
CONCLUSION

- ✓ Pretreatments, freezing, and frozen storage similarly affected the apples independent of the agricultural farming method, but *organic* samples showed *higher mechanical strength* than the conventional ones after processing.
- ✓ Conventional apples better preserved their hue during freezing, but hue differences between organic and conventional apples were negligible and, after thawing, no differences in lightness and hue were observed.

MAIN RESULTS: FUNCTIONAL PROPETRIES



Scores (rectangles) and loadings plot (triangle) of the PLS-DA model along the first and second (2a) and first and third (2b) components. Class 1 (green circles): fresh and pre-treated organic apples; Class 2 (red circles): fresh and pre-treated conventional apples; Class 3 (violet circles): frozen organic apples; Class 4 (blue circles): frozen conventional apples.

Contents lists available at ScienceDirect

Food Chemistry

journal homepage: www.elsevier.com/locate/foodchem

Response of organic and conventional apples to freezing and freezing pre-treatments: Focus on polyphenols content and antioxidant activity

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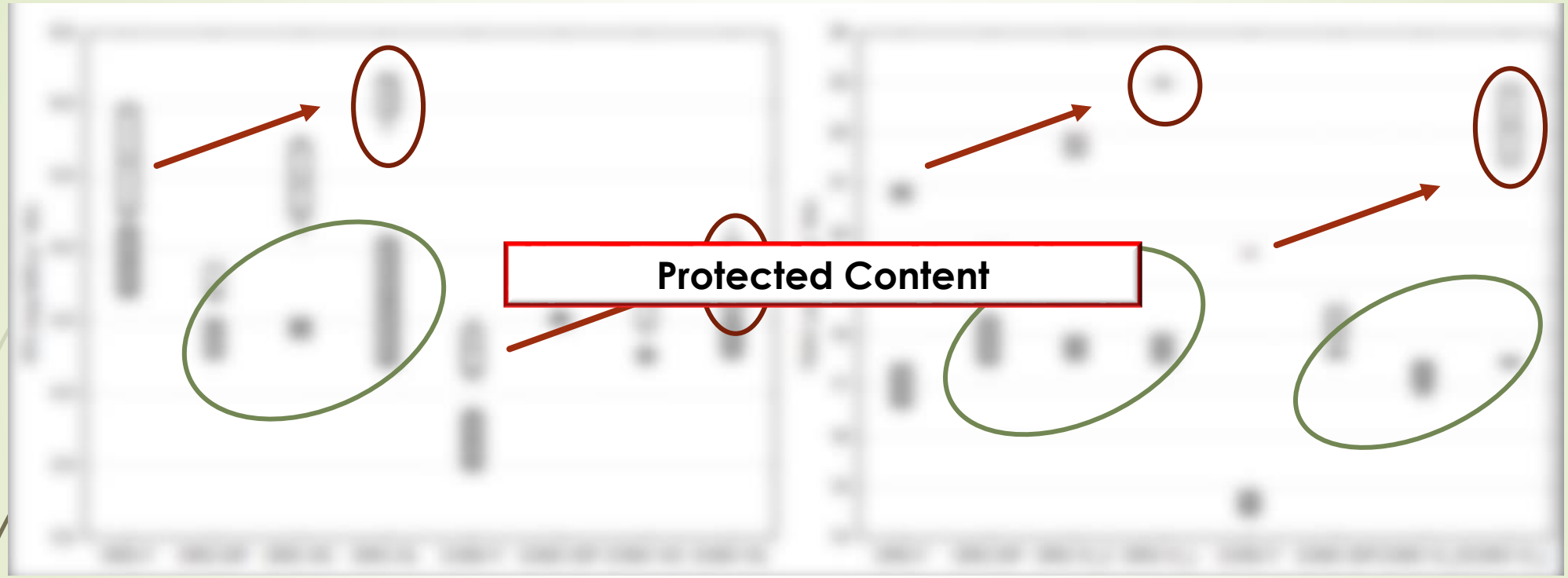
MAIN RESULTS: FUNCTIONAL PROPERTIES



Box and whisker plot of total polyphenol content (1a) and antioxidant activity as expressed by TEAC (1b) of organic (ORG) and conventional (CONV) apples before (empty boxes) and after freezing and frozen storage for 300 days (lined boxes). F: fresh; DIP; dipped in diluted lemon juice; VI_C: vacuum impregnated in water; VI_L: vacuum impregnated in diluted lemon juice.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CONCLUSION

- ✓ Organic and conventional fresh apples could be distinguished based on their different profiles in free and conjugated polyphenols while no difference in total polyphenols measured by HPLC analysis and in antioxidant activity was observed.
- ✓ In general, both freezing and frozen storage impaired the functional properties of frozen apples with conventional fruits being more affected than the organic ones.
- ✓ When pre-treatments were applied before freezing, the differences between the functional properties of organic and conventional frozen products resulted almost negligible.


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PART II

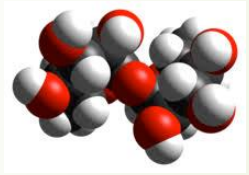
- Enrichment of carrots slices with green tea extract by using as freezing pre-treatments blanching in combination with vacuum impregnation

- ✓ Evaluation of the effect of these pretreatments on quality, total polyphenol content (TPC) and antioxidant activity (AOA) of frozen carrots.

Green tea

high content in epigallocatechins

beneficial effects on human health (diabete, obesity, cancer, cardiovascular and microbial diseases prevention)



Trehalose

protection of biological structures upon thermal stresses

Under submission

EXPERIMENTAL DESIGN

1) OPTIMIZATION OF PROCESS PARAMETERS

- Process conditions (blanching, vacuum impregnations)
- Impregnat solutions* (threalose, green tea solution)

*2) CHARACTERIZATION OF RAW MATERIAL***

- Organic carrots (Daucus carota L., *cv Romance*)

2) PRE-TRATMENTS

- Blanching (90°C x 108 sec)
- Vacuum impregnation (50 mbar 10 min+10 min post vacuum time)

3) STORAGE

- −18 °C ; 7 and 60 days

ANALYSIS

- Moisture content**
- Density and porosity**
- Viscosity and surface tension measurment*
- Colour analysis
- Total carotenoid content
- Mechanical properties
- Total poliphenol content
- Antioxidant activity
- Identification and quantification threalose
- POD, PME assay

Under submission

SAMPLE PREPARATION

	BLANCHING (BL)		VACCUM IMPREGNATION (VI)		
Samples	WATER (W)	TREHALOSE 4% w/v (4T)	WATER (W)	TREHALOSE 10% w/v (10T)	GREEN TEA EXTRAXCT 0,25% w/v (E)
F					
BL_W	✓				
BL_{4T}		✓			
$BL_{W+}VI_W$	✓		✓		
$BL_{4T}+VI_W$		✓	✓		
BL_W+VI_{10T}	✓			✓	
$BL_{W+}VI_E$	✓				✓
BL_W+VI_{10T-E}	✓			✓	✓
$BL_{4T}+VI_{10T}$		✓		✓	
$BL_{4T}+VI_E$		✓			✓
$BL_{4T}+VI_{10T-E}$		✓		✓	✓

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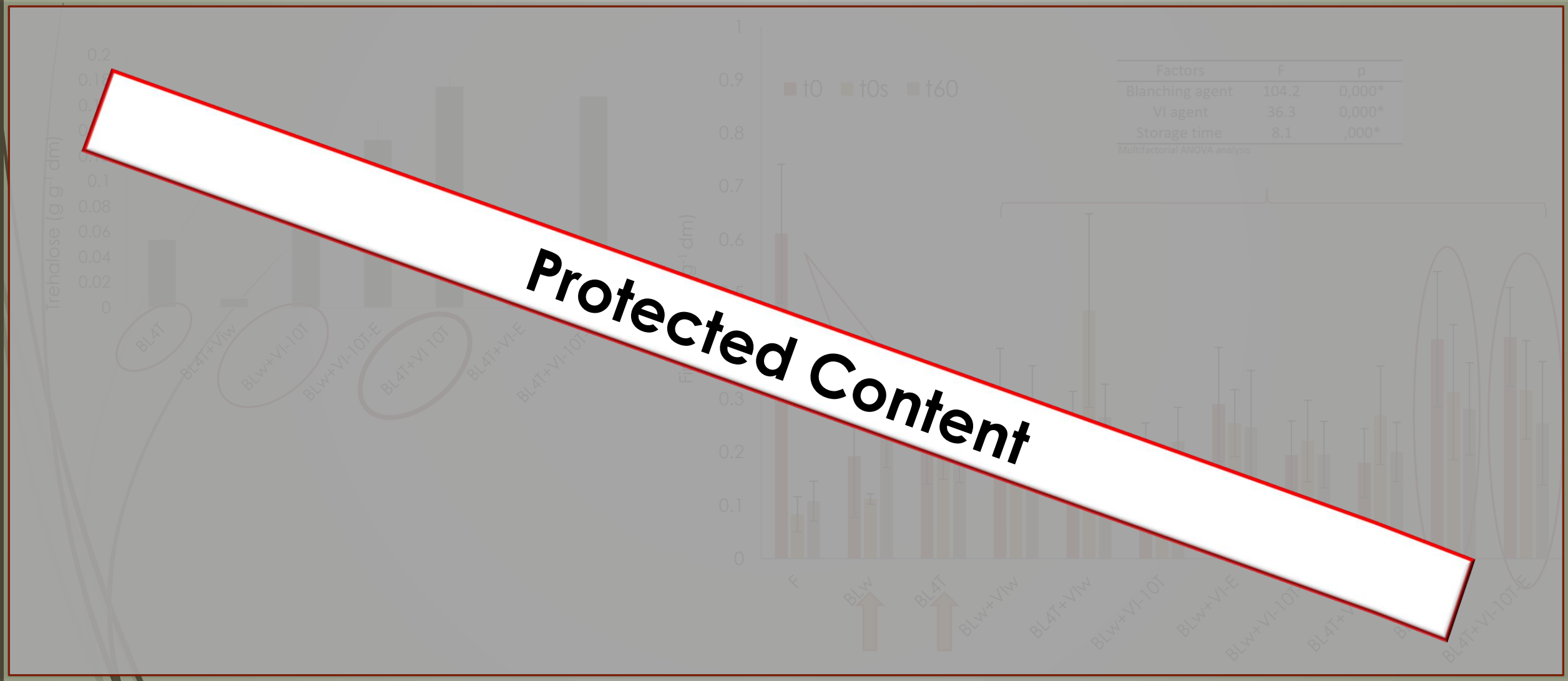
MAIN RESULTS



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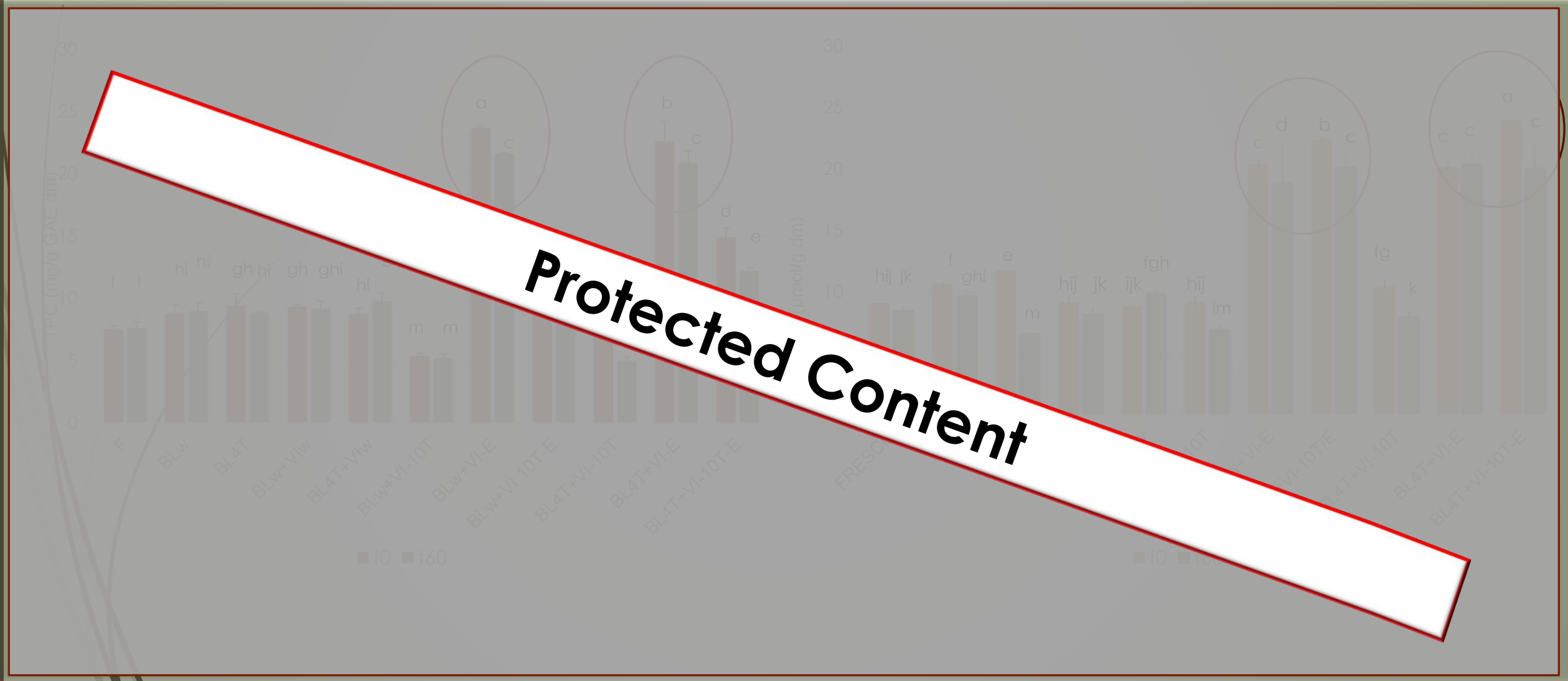

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CONCLUSION

- Blanching in trehalose solution and VI treatment with green tea extract slightly affected the quality properties of carrots and allowed to increase considerably the carrots' functional properties and to preserve the firmness of the plant tissue.

- *Despite these variations, blanching and vacuum impregnation in green tea extract allowed to obtain after frozen storage carrots with an antioxidant activity doubled compared to the fresh vegetable.*

Under submission

PART III

- Production of *hops natural extracts* to be used as ingredients in food formulations.

- *Humulones, lupulones, isohumulones and xanthohumol*

Biological properties, therapeutic/pharmaceutical utility, antioxidant, anti-inflammatory, anti-microbial and anti-tumoral effects

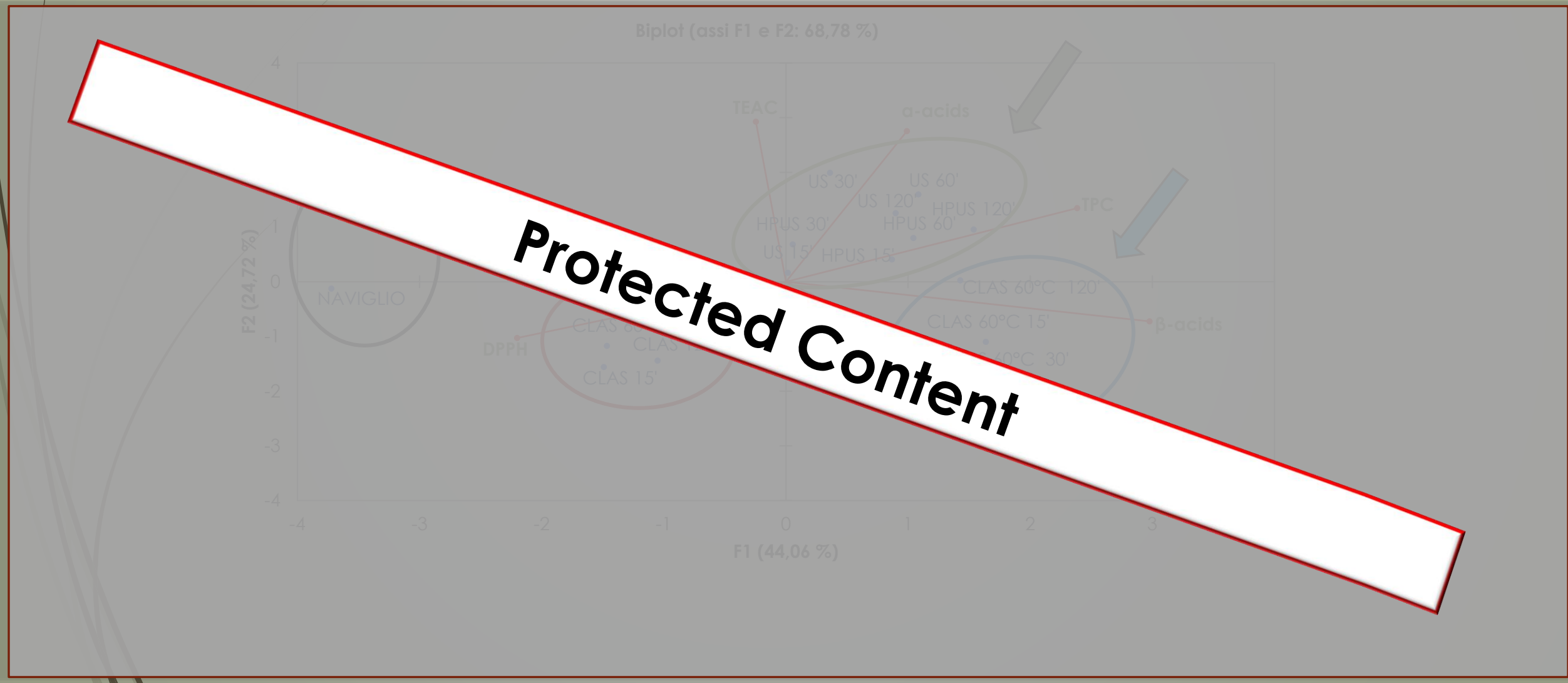
EXPERIMENTAL DESIGN

EXTRACTION METHOD	TIME (min)	SOLVENT
1) CONVENTIONAL		
ON- STIRRING → 25°C / 60°C	15	
	30	
	60	EtOH 100%
2) NON-CONVENTIONAL		EtOH 50%
	120	
ULTRA SOUND (US)		H2O 100%
HIGH POWER ULTRA SOUND (HPUS)		
HPP		
NAVIGLIO		

- Chemical and functional characterization of the extracts

- Single and total polyphenol (HPLC-DAD)
- TPC content*
- Total flavonoids content*
- Antioxidant activity (ABTS and DPPH)*
- Volatile compounds: β–myrcene, humulene, β-caryophyllene,… (GC-MS)*
- α- and β-acids (HPLC-DAD)

PRELIMINARY RESULTS



Ongoing…

- Identification and quantification of phenolic compounds (i.e. *Xanthoumol*)
- Identification and quantification of α-acids and β-acids (i.e. *humulones*, *lupulones*)

FUTURE PLANS

- Production of *emulsified food products* enriched with selected hops ingredients and evaluation of the effect of hop ingredients on *emulsions' quality and stability*.

THANKS FOR YOUR ATTENTION