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

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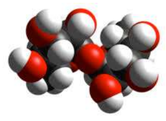
INTRODUCTION

In recent years, the growing awareness of the relationship between food and health has increased the consumer demand towards food products with enhanced nutritional and functional properties. Hence, the industries need to diversify their productions exploring new functional ingredients, formulations and processes. In this contest, no investigations have been focused on the optimization and application of freezing pre-treatments such as blanching (BL) and vacuum impregnation (VI) for the design and development of high quality and fortified frozen products.

AIM:

To investigate the use of green tea extract for the production of fortified frozen carrots. In order to limit quality loss induced by processing and frozen storage and to produce high quality frozen products, carrots were enriched also with trehalose. The solutes penetration into the vegetable was performed by using as freezing pre-treatments blanching in combination with vacuum impregnation.



Trehalose → protection of biological structures upon thermal stresses

Green tea → high content in epigallocatechins ➔ beneficial effects on human health (diabete, obesity, cancer, cardiovascular and microbial diseases prevention, antihypertensive and hypolipidemic effect)

M&M

- MATERIALS: Organic carrots (Daucus carota L., cv Romance) were selected (i.e. length of 18-20 cm and diameter of 1.5-2 cm), washed, peeled and cut in 0.5 cm thick slices. Green tea (Camelia sinensis) powder extract (GTE) was purchased from PromoPharma s.r.l. (Republic of San Marino) while trehalose from Adea s.r.l. (Busto Arsizio, Italy).
- SAMPLES PREPARATIONS: Carrot slices were blanched in water (BL_W) or trehalose 4% w/v (BL_{4T}) at 90 °C for 108 sec. Vacuum impregnation was carried out on BL_W or BL_{4T} samples by using as impregnant agent water (VI_W), trehalose 10% w/v (VI_{10T}), green tea extract 0.25% w/v (VI_E) or trehalose 10% w/v in combination with green tea extract 0.25% w/v ($VI_{10T\text{-}E}$). After pre-treatments, samples were packed in BOPP bags (film thickness: 30 mm) in air, frozen at -40 °C and stored at -18 °C up to 60 days.

- EVALUATIONS: mass transfers, trehalose content, colour (h°), firmness, residual peroxidase activity, total carotenoid content, total polyphenols content (TPC) by FC assay, antioxidant activity (AOA) by ABTS assay.
- STATISTICAL ANALYSIS: data were reported as mean and standard deviation and additionally analysed by ANOVA. Significant differences between means were calculated by LSD test at a significance level ≤ 0.05. Data were processed using the STATISTICA for Windows (Stat Soft™, Tulsa, OK) software.

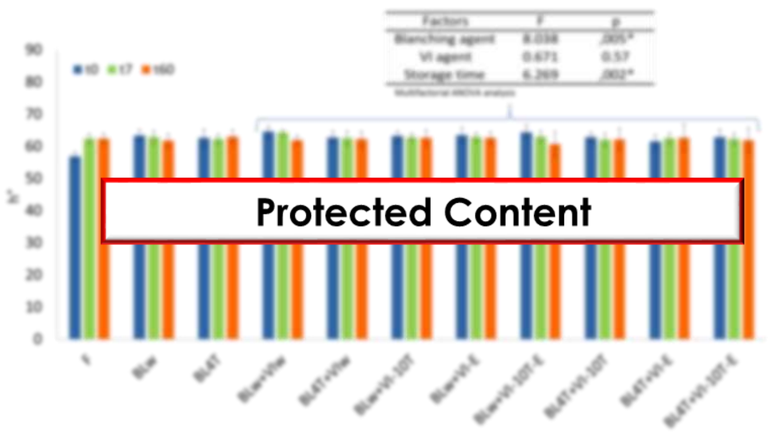
	BLANCHING (BL)		VACCUM IMPREGNATION (VI)		
Samples	WATER (W)	TREHALOSE 4% w/v (4T)	WATER (W)	TREHALOSE 10% w/v (10T)	GREEN TEA EXTRAXCT 0,25% w/v (E)
F					
BL_W	✓				
BL_{4T}		✓			
$BL_{W+}VI_W$	✓		✓		
$BL_{4T}+VI_W$		✓	✓		
BL_W+VI_{10T}	✓			✓	
$BL_{W+}VI_E$	✓				✓
$BL_W+VI_{10T\text{-}E}$	✓			✓	✓
$BL_{4T}+VI_{10T}$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

Table 1: experimental plan.

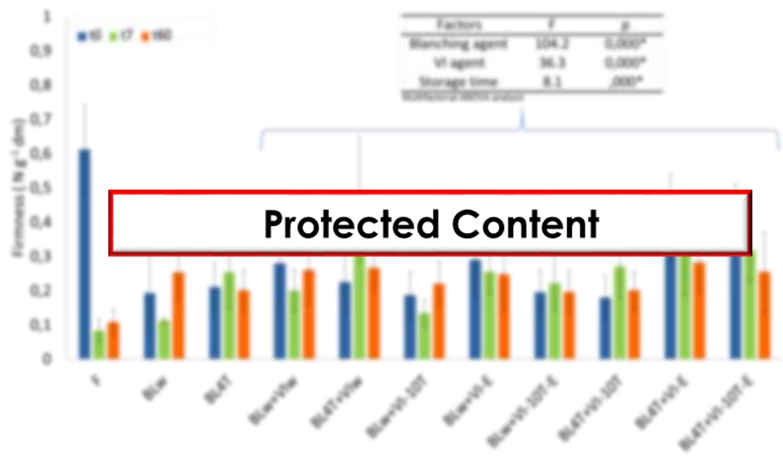
MAIN RESULTS

Physical properties

- TREHALOSE ENRICHMENT: Both BL and VI allowed to effectively enrich sliced carrots with trehalose; however, such enrichment was reduced when green tea was enclosed to the VI impregnating agent.

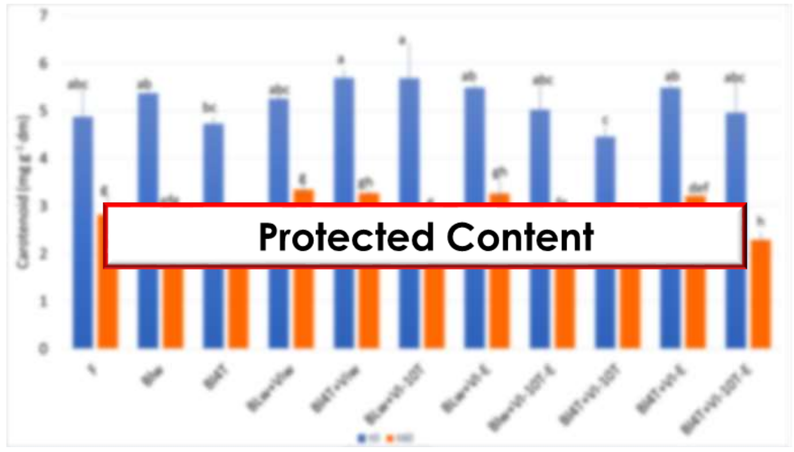


- COLOUR: BL and VI pre-treatments determined a slight increase in the h° (+11.2% on average).
- After freezing and frozen storage blanching in trehalose solution positively affected h° of sliced carrots.

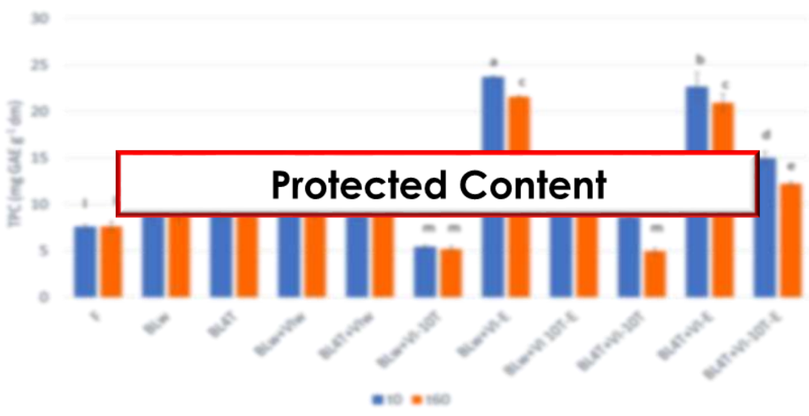


- FIRMNESS: The blanching treatments significantly impaired the carrots' firmness. $BL_{4T}+VI_E$ and $BL_{4T}+VI_{10T\text{-}E}$ sample evidenced a higher firmness compared to the other pre-treated samples.
- After freezing and frozen storage, all the samples showed a drastic firmness decrease.
- All the samples blanched in trehalose solution showed after 7 days of frozen storage a higher firmness than the water blanched ones; however, after 60 days, no differences were found among these samples.

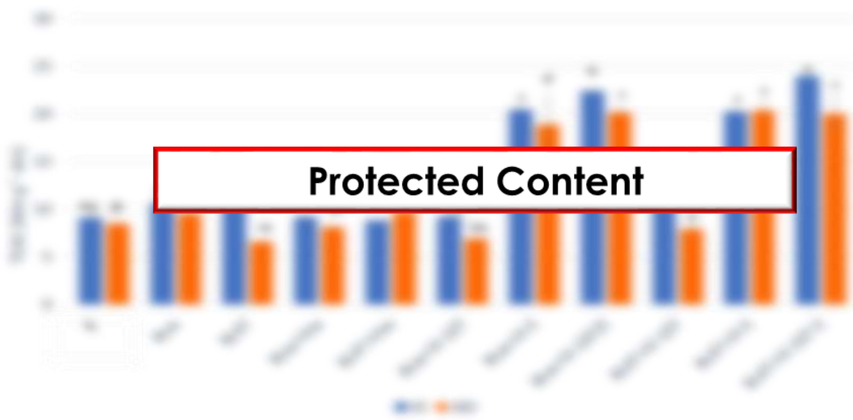
Functional properties



- CAROTENOIDS: No differences in total carotenoids were observed among fresh and pre-treated samples.
- After freezing and frozen storage a significant decrease of carrots' carotenoid content was evidenced



- TPC: VI treatment in green tea solutions determined a significant increase in polyphenols, which resulted three times higher than in the fresh vegetable. On the contrary, the use of trehalose in VI treatments negatively influenced the TPC.
- After freezing and 60 days of frozen storage, no effect was observed on TPC of fresh and blanched carrots whilst samples blanched and VI with GT extract solutions evidenced a significant decrease of the TPC.



- AOA: blanching in trehalose solution and VI with GT extracts solution positively affected the carrots AOA;
- After freezing and frozen storage a significant AOA reduction was observed as an effect of both the carotenoids and polyphenols decrease. Despite these variations, the samples blanched and VI in GTE extract solutions after freezing and frozen storage showed AOA values doubled respect to fresh carrots.

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.
- Trehalose showed a cryoprotective effect on the physical properties of the frozen samples only when its addition occurred by blanching.
- After freezing and frozen storage all the samples evidenced a significant loss of carotenoids while the total polyphenol content decreased only on carrots previously fortified with green tea polyphenols. Despite these variations, blanching and vacuum impregnation in green tea extract allowed to obtain after 60 days of frozen storage carrots with an antioxidant activity doubled compared to the fresh vegetable.

REFERENCES

Neri, L., Hernando, I., Pérez-Munuera, I., Sacchetti, G., Mastrocola, D., Pittia, P. (2014). Mechanical properties and microstructure of frozen carrots during storage as affected by blanching in water and sugar solutions. Food Chemistry. 144, 65-73.

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