Influence of ozone pre-treatment on the quality of frozen strawberries (*Fragaria ananassa* D.)

Alexandre E.M.C., Fundo J., Santos D.M., Brandão T.R.S. and Silva C.L.M.*
Escola Superior de Biotecnologia, Universidade Católica Portuguesa, Rua Dr. António Bernardino de Almeida 4200-072 Porto, Portugal
*E-mail: clsilva@esb.ucp.pt

Introduction

Freezing is one of the best food preservation processes. For maximum quality retention, washing treatments may precede freezing. In the case of fruits, the use of disinfectants such as hydrogen peroxide and weak chlorine solutions is common for cleaning and purifying purposes. More recently, ozone is gaining importance in the food processing domain, due to its strong oxidising characteristics, being one of the most natural purification and disinfectant agents for fresh produce and water treatment (Suslow, 1999).

Ozone may be used as an alternative non-chemical treatment, with the potential of increasing shelf life of the processed foods. Several studies have shown that ozonation is in fact an appropriate method to guarantee food quality and safety (Khadre *et al.*, 2001; Guzel-Seydim *et al.*, 2004; Manousaridis *et al.*, 2005).

Objective

- The main objective of the work was to study the influence of ozone in aqueous solution, used as a pre-treatment to freezing and frozen storage, on strawberries quality parameters (pH, colour, anthocyanines and texture).

Materials and Methods

- Strawberries (*Fragaria ananassa* D.), acquired in a local market, were separated randomly in three groups, as follows:

Group I freezing at -30 ºC for 40 minutes (blast and fluidized bed freezer; FT36, Armfield, UK); storage at -7 or -30 ºC for 77 days

Group II treatment with ozonated water (2 ppm) at 15 ºC for 2 minutes, followed by a procedure similar to group I

Group III treatment with water at 15 ºC for 2 minutes, followed by a procedure similar to group I (used as control of group II)

Ozone generator

- Experiments of group II were carried out using a pilot equipment. An ozone generator (OZ5, SPO3, Sociedade Portuguesa de Ozono, Portugal) was interconnected to a container (158 L) filled with tap water.
- Ozone was continuously incorporated into water (at ~ 15ºC), and its content was indirectly measured by potential difference (SZ 265, B&C Electronics).

Strawberries, after treatment and at different storage periods, were analysed in terms of:

pH Measured by potenciometry (GLP 22, Crison), after samples homogenisation and filtration.

Colour Measured using the Hunter (L, a and b) scale, with a colourimeter (CR-300, Minolta) at surface (10 replicates) and in homogenised samples (3 replicates).

The total colour difference [$TCD = \sqrt{(a-a_0)^2+(b-b_0)^2+(L-L_0)^2}$, being index 0 indicative of initial reference values of fresh product] was the parameter considered for colour evaluation.

Anthocyanins were assayed by spectrophotometric technique (spectrophotometer UV-1601, Shimadzu).

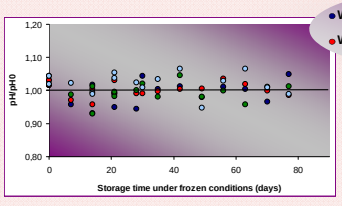
Texture **hardness, springiness, cohesivity, gomosity and elasticity** were evaluated through texture profile analysis, using a texturometer (TA - XT2plus, Stable Micro Systems Lda, UK), equipped with a 5 kg load cell and a 10 mm diameter cylindrical probe (30 replicates).

- The experimental results obtained, from all treatments, were compared by analysis of variance (two-way ANOVA, Analysis Tool Package, Excel 2000, Microsoft®, USA).

Results and Discussion

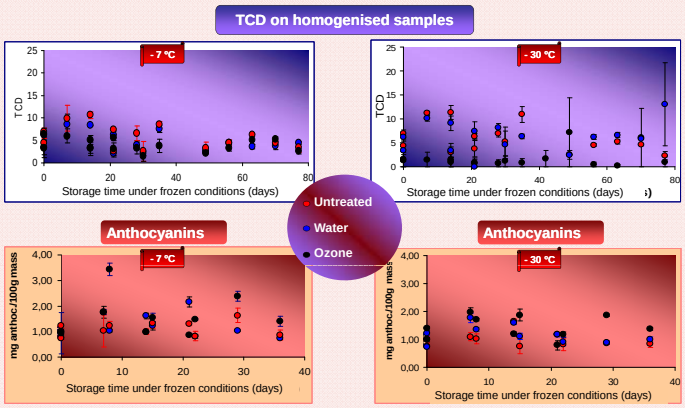
Influence of treatments and frozen storage on pH

- pH values were normalized in relation to fresh products' values (pH_0).
- No tendency was observed on pH values of samples submitted to the different treatments and during frozen storage at -7ºC or -30ºC.



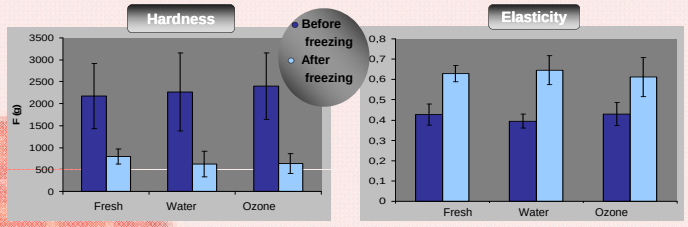
Influence of treatments and frozen storage on colour and anthocyanins

- Samples treated with water or ozonated water did not show significant differences in colour or anthocyanins content, when compared to fresh strawberries.
- During frozen storage, the total colour difference and anthocyanins content of samples treated with water or ozonated water were identical to the ones observed for untreated samples.
- No significant temperature effect was detected.
- Conclusions were similar for colour measurements at product external surfaces or in homogenized samples.



Influence of treatments and frozen storage on texture

- Ozone pre-treatment did not affect texture parameters, when compared to fresh samples.
- The freezing process affected hardness and elasticity of strawberries, independently of the pre-treatment used. Hardness of frozen samples decrease approximately 75% when compared to fresh strawberries. Elasticity increase significantly.
- This was also observed along storage at -7 or -30 ºC.



Conclusion

- Aqueous ozone did not affect the pH, colour, anthocyanins content or texture parameters of frozen stored strawberries.

These results will complement studies concerning the effect of aqueous ozone on fruit's safety, aiming at application of this technology as an alternative to thermal treatments.

References

- Guzel-Seydim, Z.; Greene, A.K; Seydim, A.C. 2004. Use of ozone in food industry. *Lebensm.-Wiss. u.-Techno.*, 37: 453-460.
- Khadre, M.A.; Yousef, A.E.; Kim, J.G. 2001. Microbiological aspects of ozone. Aplications in food: A review. *Journal of Food Science*, 66 (9): 1242-1252.
- Manousaridis, G.; Nerantzaki, A.; Paleologos, E.K.; Tsiotsias, A.; Savaidis, I.N.; Kontominas, M.G. 2005. Effect of ozone on microbial, chemical and sensory attributes of shucked mussels. *Food Microbiology*, 22:1-9.
- Suslow, T.V. 1999. Ozone applications for postharvest disinfection of edible horticultural crops. *Perishables Handling Quarterly*. 99: 1-14.

Acknowledgments

The authors acknowledge the financial support through Programa Operacional Agricultura e Desenvolvimento Rural – Projecto AGRO nº822 (Novas Tecnologias de Processamento de Hortofrutículas Congelados – EMERCON). The authors Alexandre E. M. C., Santos D. M. and Brandão T. R. S. would like to thank Fundação para a Ciência e a Tecnologia (grants SFRH/BD/16042/2004, SFRH/BPD/11580/2002 and SFRH/BPD/9174/2002, respectively).

FCT Fundação para a Ciência e a Tecnologia
MINISTÉRIO DA CIÊNCIA E DO ENSINO SUPERIOR Portugal