Influence of ozone pre-treatment on the quality of frozen red bell peppers (*Capsicum annuum* L.)

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Introduction

In the last years, an increased attention has been given to the quality and safety of foods, not only from a consumers' perspective but as well from governmental entities. Freezing is a proven efficient food preservation process. For maximum quality retention, some treatments may precede freezing. In the case of vegetables, one of the most common methods applied, before freezing and storage under frozen conditions, is blanching. Blanching may reduce considerably the microbial load of the food and also inactivate enzymes responsible for quality degradation, thus resulting in products with extended shelf life. However, this convenient thermal process in terms of food quality and safety, from an industrial point of view may be extremely energy consuming. Some sensory food attributes may also suffer the negative influence of the thermal impact at cellular tissues level. More recently, alternative non-thermal technologies have been emerging in the food processing domain. Due to the strong oxidising characteristics and powerful non-chemical disinfectant properties, ozone has been applied in the food industry, both in equipment or as wastewater sanitizer. In 2001, the Food and Drug Administration (FDA) approved the use of ozone as an antimicrobial agent for the treatment, storage, and processing of foods in gas and aqueous phases in direct contact with foods (Suslow, 1999). Proposed mechanisms of ozone action at cellular level involve oxidation of amino acids of enzymes, peptides and proteins to shorter peptides, and oxidation of polyunsaturated fatty acids to peroxides (Victorin, 1992). In such way, ozone treatments may increase the shelf life of vegetables (Rice *et al*., 1982) and be used as an alternative to traditional thermal treatments.

The objective of this work was to study the influence of ozone in aqueous solution, used as a pre-treatment to freezing and frozen storage, on quality parameters (i.e. colour, pH and texture) of red bell peppers. Results were compared with those obtained when a traditional blanching process was used.

Material and Methods

Red bell peppers (*Capsicum annuum* L.), acquired in a local market, were cut in small portions (4x10cm) and separated randomly in four groups, as follows:

- *group I* – freezing at -30 ºC for 30 minutes (blast and fluidized bed freezer; FT36, Armfield, UK). Storage at -7 and -30 ºC in freezing chambers for 72 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*);
- *group IV* – blanching treatment at 100 ºC for 2 minutes, followed by a procedure similar to group I.

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 in water and its content indirectly measured by potential difference (SZ 265, B&C Electronics Inc., USA). Samples of fresh-cut bell peppers, after treatment and at different storage periods were analysed in terms of colour, pH and texture.

The colour was measured using the Hunter (*L*, *a* and *b*) scale, with a colourimeter (CR-300, Minolta, USA) at both internal and external surfaces (10 replicates), and in homogenised samples (3 replicates). The *T*otal *C*olour *D*ifference [$TCD \equiv \sqrt{(a-a_0)^2 + (b-b_0)^2 + (L-L_0)^2}$, *being index 0 indicative of initial reference values of fresh product*] was the parameter considered for evaluation of colour as quality factor.

Measurements of pH (GLP 22, Crison, Spain) were done after homogenisation and filtration of the samples (3 replicates).

Texture parameters (hardness, springiness, cohesivity and gomosity) 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 each treatment were compared by analysis of variance (two-way ANOVA, Analysis Tool Package, Excel 2000, Microsoft®, USA).

Results and Discussion

Results showed that pH of bell peppers was not affected either by the pre-treatments applied or the freezing and frozen storage temperature and time (averaging 4.93± 0.01).

Blanched samples presented considerable higher values of total colour difference, in relation to fresh bell peppers. The colour of samples treated with ozone remained constant during the frozen storage, and no considerable differences were detected among samples stored at -7 and -30 ºC.

Texture was significantly affected ($p<0.05$) by the blanching process. Hardness and gomosity decreased considerably, when compared to those treated with ozone in aqueous solution. Besides the expected negative influence of the freezing and frozen storage processes on hardness of vegetables, frozen bell peppers treated with ozone showed higher values of hardness, as well as for gomosity, when compared to the blanched ones. This was verified along all the storage period considered.

Conclusions

Red bell peppers pre-treated with ozone presented higher quality retention, in terms of texture and colour, when compared to the blanching process. This was also observed during storage under frozen conditions at -7 and -30 ºC.

Further studies related with the influence of ozone on microbial activity are in progress. All results obtained in this work will allow studying the potentiality of ozone pre-treatments in developing safer processed foods with higher quality attributes.

References

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