Postharvest Biology and Technology 95 (2014) 81–87

Contents lists available at ScienceDirect

Postharvest Biology and Technology

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

Extending the shelf life of fresh-cut eggplant with a soy protein–cysteine based edible coating and modified atmosphere packaging

Christian Ghidelli[a], Milagros Mateos[b], Cristina Rojas-Argudo[a], María B. Pérez-Gago[a,c,*]

[a] *Centro de Tecnología Poscosecha, Instituto Valenciano de Investigaciones Agrarias (IVIA), 46113 Moncada, Valencia, Spain*
[b] *PASAPTA, Universidad CEU-Cardenal Herrera, 46113 Moncada, Valencia, Spain*
[c] *IVIA – Fundación AGROALIMED, 46113 Moncada, Valencia, Spain*

ARTICLE INFO

Article history:
Received 9 December 2013
Accepted 18 April 2014

Keywords:
Minimally processed eggplants
Enzymatic browning
Soy protein edible coating
Cysteine
Superatmospheric oxygen packaging

ABSTRACT

The effect of a soy protein-based edible coating with antioxidant activity, and conventional and superatmospheric modified atmosphere (MA) packaging, on the quality of fresh-cut 'Telma' eggplants, was evaluated during storage. In a first experiment, eggplant pieces were dipped in either a coating composed of soy protein isolate (SPI) and 0.5% cysteine (Cys), or water as an uncoated control. Samples were packed in trays under atmospheric conditions to reach a passive MA (MA-P) or two gas mixtures (MA-A: 15 kPa CO_2 + 5 kPa O_2; MA-B: 80 kPa O_2) and were stored at 5 °C. Atmospheric conditions were used as the control conditions (Control). The coated samples packed under MA-B and Control conditions resulted in the highest whiteness index (WI) values during storage, whereas MA-A did not improve the shelf-life of minimally processed eggplants and had the lowest WI values. The MA-B and atmospheric control conditions helped to maintain firmness, whereas the coating helped to maintain the weight loss under MA-A and MA-B. The maximum commercial shelf-life was reached on day 6 for the coated samples packed under atmospheric conditions. In a second experiment, the commercial shelf-life of fresh-cut eggplants was extended to 8 and 9 storage days by increasing the Cys content in the edible coating from 0.5 to 1% under MA-B and Control storage conditions, respectively.

© 2014 Elsevier B.V. All rights reserved.

1. Introduction

Consumers demand fresh, healthy produce which must also be convenient and easy to prepare. This has led to increased consumption of minimally processed fruit and vegetables. Recently, eggplants (*Solanum melongena*), which are largely consumed as fresh and whole products, are attracting more interest as a minimally processed vegetable. However, wounding, slicing or chopping induces quality deterioration, which results in water loss, softening, microbial contamination, increased respiration and enzyme activity. Among these factors, the main limiting factor that reduces the shelf-life of fresh-cut eggplants is oxidation of phenolic compounds by polyphenol oxidase (PPO) (Barbagallo et al., 2012a).

The main approach to control enzymatic browning and to extend the shelf-life of fresh-cut products is the combination of chemical and physical methods, such as using antioxidant agents and modified atmosphere (MA) packaging. In fresh-cut 'Birgah' eggplants, Barbagallo et al. (2012b) reported a significant reduction in PPO related activity by applying 0.5% or 1% L-ascorbic (−21%), benzoic (−15%), citric (−27%), ferulic (−43%), and L-glutamic (−32%) acids. These effects, as browning index, demonstrated the efficacy of the anti-browning treatments to extend the shelf-life of minimally processed eggplants. In very recent work, we studied the effect of a wide range of antioxidants to inhibit the enzymatic browning of eggplant fresh-cut tissue. Overall, the best result for reducing enzymatic browning was obtained with 1% cysteine (Cys), which extended the commercial shelf-life of this produce to 9 storage days at 5 °C (Ghidelli et al., 2013a). However at this concentration, off-flavors might be developed, as reported for thiol-containing compounds such as Cys (Garcia and Barrett, 2002).

The effect of low O_2 and high CO_2 MA packaging to control enzymatic browning has been reported for several fresh-cut fruit and vegetables (Rojas-Graü et al., 2009). The basic principle for using low O_2 and high CO_2 in fresh-cut products is that MAs are theoretically expected to control the physiological and quality changes in the product by reducing the respiration rate, ethylene production, browning, weight loss, etc. (Toivonen and DeDell, 2002). However,

---

[*] Corresponding author at: IVIA – Fundación AGROALIMED, 46113 Moncada, Valencia, Spain. Tel.: +34 963424000; fax: +34 963424001.
E-mail address: perez_mbe@gva.es (M.B. Pérez-Gago).

http://dx.doi.org/10.1016/j.postharvbio.2014.04.007
0925-5214/© 2014 Elsevier B.V. All rights reserved.

the response to different atmospheres depends largely on the commodity. In fresh-cut eggplants, Catalano et al. (2007) reported that, although MA improved quality preservation during storage at 4 °C, an increase in CO_2 and a decrease in the O_2 concentration inside the package stimulated the PPO activity of the product.

Some studies have proposed the use of elevated O_2 concentrations as an alternative to low O_2 atmospheres to maintain the quality and to extend the storage life of some fresh-cut fruit and vegetables. The main benefits of superatmospheric O_2 are related with preventing microbiological spoilage and anaerobic fermentation, as observed in fresh-cut melon, cabbage, and baby spinach leaves (Allende et al., 2004; Oms-Oliu et al., 2008a; Lee et al., 2011). Moreover, high oxygen atmospheres have been found to be particularly effective at inhibiting enzymatic discoloration and at maintaining the firmness of fresh-cut products, such as iceberg lettuces, mushrooms, potatoes and melons (Amanatidou et al., 2000; Day, 2001; Jacxsens et al., 2001; Limbo and Piergiovanni, 2006; Oms-Oliu et al., 2008a). Nevertheless, the effect of superatmospheric O_2 treatment depends on certain factors such as commodity type, temperature, storage duration, etc. (Kader and Ben-Yehoshua, 2000). Thus storage under high oxygen MAP is not recommended for fresh-cut mango and pears as it induces enzymatic browning (Poubol and Izumi, 2005; Oms-Oliu et al., 2008b,c).

A recent approach to prolong the shelf-life of fresh-cut fruit and vegetables is the use of edible coatings either alone or combined with MA packaging. Edible coatings can provide a semipermeable barrier to gases and water vapor, reducing respiration, enzymatic browning and water loss (Pérez-Gago et al., 2005), and their protective function can also be enhanced with the addition of ingredients such as antioxidants. The basic ingredients of edible coatings are proteins, polysaccharides, and lipids. Among the proteins, soy protein isolate (SPI) coatings containing Cys have been seen to help control enzymatic browning of fresh-cut eggplants to a greater extent than Cys alone, and extend the shelf-life up to 9 storage days depending on the Cys content (Ghidelli et al., 2010). Other work has demonstrated the effect of SPI-based coatings to preserve the freshness of apple slices (Kinzel, 1992), to control browning in potato slices, and to reduce moisture loss in carrots and apple slices (Shon and Haque, 2007). Therefore, the present work aimed to study the effect of a soy protein-based edible coating containing two concentrations of Cys (0.5 and 1%, w/v) in combination with conventional and superatmospheric MA packaging to control the enzymatic browning of fresh-cut eggplants.

2. Materials and methods

2.1. Materials

Beeswax (BW) (Brillocera, S.A., Valencia, Spain) was selected as the lipid phase of the soy protein isolate (SPI) emulsion film. The SPI (SUPRO 760 IP) was supplied by Solae (Ieper, Belgium). Food-grade glycerol was purchased from Panreac Quimica, S.A. (Barcelona, Spain). Cysteine (Cys) was acquired from Sigma-Aldrich (Barcelona, Spain).

2.2. Preparation of the coating formulation

Two experiments were conducted to study the effect of a SPI-based edible coating and MAs packaging on the shelf-life of 'Telma' fresh-cut eggplant. The Cys content of the SPI-based coating was 0.5% and 1% (wet basis, wb) in the first and the second experiment, respectively.

To prepare the coatings, aqueous solutions of 5% (w/v) SPI were prepared and denatured for 30 min in a water bath at 90 °C. Glycerol was added as plasticizer at a SPI:glycerol ratio of 2:1, and this ratio was kept constant. BW was added to the hot SPI–glycerol mixture at a concentration of 20% (dry basis, db). Samples were homogenized with a high-shear probe mixer (PolyTron, Model PT 2100, Kinematica AG Inc., Lucerne, Switzerland) for 4 min at 30,000 rpm. After homogenization, emulsions were placed in an ice bath to prevent further protein denaturation and to crystallize the lipid particles. Finally, Cys was incorporated into the emulsion coating by magnetic agitation at the desired concentration. Both formulations were prepared with a total solids content of 7.5% (w/v).

Table 1
Soy protein-based coating and modified atmosphere (MA) packaging conditions.

	Experiment 1	Experiment 2
Cys (%, w/v, wet basis)[a]	0.5	1.0
MAs packaging conditions[b]	MA-A (15 kPa CO_2 + 5 kPa O_2)	–
	MA-B (80 kPa O_2)	MA-B
	MA-P (21 kPa O_2 + 0.03 kPa CO_2)	–
	Control (atmospheric conditions during storage)	Control

[a] Cysteine (Cys) content in the soy protein isolate (SPI)-Beeswax (BW) edible coating. BW content = 20% (dry basis); SPI: glycerol ratio of 2:1; total solid content = 7.5% (w/v).

[b] Initial gas mixtures in trays (balance N_2). Film: 35 μm P-Plus polypropylene film (35 PA 200).

2.3. Preparation of eggplants

Eggplants (*S. melongena* L., cv. Telma) were purchased in a local market (Valencia, Spain) and were stored at 5 °C for 24 h until they were processed. After washing with chlorinate water (150 ppm), eggplants were peeled and cut into rectangular pieces (approximately 5 cm × 3.5 cm × 1.5 cm) using a sharp stainless-steel knife. A maximum of 15 eggplants were processed at the same time to minimize their exposure to oxygen. The whole process was carried out in a temperature-controlled room at 10 ± 1 °C under suitable hygienic conditions.

2.4. Application of edible coating and modified atmosphere packaging

Eggplant pieces were dipped into the coating or in water (uncoated-control) for 3 min at 5 °C. After draining and drying under cold conditions, four pieces (75 ± 5 g) were placed in polypropylene trays (17.4 cm × 12.9 cm × 3.6 cm, 470 ml, Ilpra Systems, Barcelona, Spain). Trays were heat-sealed with a 35 μm P-Plus polypropylene film (35 PA 200) with an O_2 transmission rate of $1100\,cm^3\,m^{-2}\,day^{-1}$, a CO_2 transmission rate of $30{,}000\,cm^3\,m^{-2}\,day^{-1}$ at 25 °C and 0% RH, and with a moisture vapor transmission rate of $0.9\,g\,m^{-2}\,day^{-1}$ (Amcor Flexibles, Barcelona, Spain). In the first experiment, MA conditions were obtained by flushing the trays with two gas mixtures (MA-A: 15 kPa CO_2 + 5 kPa O_2; MA-B: 80 kPa O_2) or by conventional storage under atmospheric conditions with the same film to reach a passive MA (MA-P). For the control, the film was perforated with a needle (four perforations, 1 mm in diameter) to ensure that the gas composition within the package remained near the ambient oxygen concentration (Control). In the second experiment, the assayed atmospheres were the MA-B and Control conditions. Table 1 shows the treatments for both experiments. Thermosealing was done in an ULMA-Smart 300 packing machine (Oñati, Spain). All the samples were stored at 5 °C for quality evaluation during 8 and 9 days for the first and the second experiment, respectively.

2.5. Headspace gas analysis

The gas composition in the package headspace during storage was determined in a gas chromatograph (GC valve ThermoFinnigan,

Download English Version:

https://daneshyari.com/en/article/4518178

Download Persian Version:

https://daneshyari.com/article/4518178

Daneshyari.com