Quality changes of minimally processed fresh and microwave cooking of faba bean seeds

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Resumen

Numerosos estudios han demostrado que el consumo regular de hortalizas se asocia con propiedades beneficiosas para la salud. Al mismo tiempo, hoy en día, existe por parte de los consumidores un interés hacia alimentos funcionales, saludables y listos para comer. Actualmente se están desarrollando nuevas formas de presentar la semilla de haba como alimento fresco mínimamente procesado, así como su cocción en microondas, tratando de fomentar su consumo, debido a sus ventajas como parte de una dieta nutritiva y saludable. La desinfección de las semillas frescas inmaduras se realiza por lo general con hipoclorito sódico. En este estudio se analizó el efecto de dos tratamientos alernativos: luz UV-C, como agente físico de desinfección, y un recubrimiento comestible (Naturcover P), como agente antipardeante natural. Se estudiaron distintos parámetros como calidad sensorial (calidad global, sabor, aroma, apariencia visual, textura, pardeamiento, deshidratación y pérdida de brillo) y la evolución de la vitamina C en habas crudas y cocidas. Estos análisis se realizaron para el producto mínimamente procesados durante su almacenamiento a 5°C por 10 días, y para este mismo producto inmediatamente después de su cocción con microondas. La calidad sensorial se mantuvo por encima del límite de aceptabilidad para las semillas frescas y cocinadas sometidas a tratamiento con la luz UV-C y el recubrimiento comestible Naturcover P, hasta el final del almacenamiento de 10 días. En cambio, las habas tratadas con hipoclorito de sodio mantuvieron su aceptación sensorial hasta el día 7, tanto en producto fresco como cocinado. Además, la vitamina C disminuyó durante el almacenamiento, independientemente del tipo de tratamiento, tanto en el producto fresco como cocinado, siendo mucho menor el contenido de vitamina C en el caso de las habas cocinadas en el microondas. Sin embargo, son necesarios más estudios para analizar sus efectos sobre otros parámetros de calidad.

Palabras clave: *Vicia faba*; UV-C; recubrimiento comestible; calidad sensorial; vitamina C.

Abstract

Several studies have shown that regular consumption of vegetables is associated with beneficial properties for human health. At the same time, there is an increased interest by consumers on functional, healthy and ready to eat foods. Currently, new ways of presenting faba beans as a minimally fresh processed food as well as cooked in microwave are developed, trying to encourage consumption, given its advantages as part of a nutritious and healthy diet. Disinfection prior to packaging is usually done by using

sodium hypochlorite. In this study the effect of two alternative treatments were analyzed: UV-C light, as a physical agent of disinfection, and coating with an edible cover (Naturcover P), as a natural antibrowning agent. Sensory attributes (overall quality, taste, aroma, visual appearance, texture, browning, dehydration, and darkening) and evolution of the content of vitamin C were studied on uncooked and cooked faba beans. These analyzes were performed for minimally processed product during storage at 5°C for 10 days as well as the same product immediately after microwave cooking. Sensory attributes were above the limit of acceptability for fresh and microwaved beans, subjected to UV-C light and antibrowning edible coating treatments until the end of storage (day 10). However, beans treated with sodium hypochlorite maintained their sensory acceptance until day 7, for both fresh and microwaved samples. The content of vitamin C decreased during storage regardless of the type of treatment, for both fresh and cooked product, being much lower in the case of microwaved beans. However, more research is needed to study the effect of these treatments on other quality parameters.

Keywords: *Vicia faba*; UV-C; edible cover; sensory quality; vitamin C.

Introduction

Legumes are an important source of protein, carbohydrates, vitamins and minerals. They provide important amino acids of plant origin for people around the world and should be consumed as part of a healthy diet to reduce obesity and protect again diseases like diabetes, heart disease and cancer (Traranathan and Mahadevamma, 2003; Trinidad et al., 2010). The current pace of life, with little time to prepare balanced meals, has increased the demand for natural, fresh, healthy and ready to eat plant products, as it is the case of minimally fresh processed (MFP) fruits and vegetables (Artés-Hernández et al., 2009). Thus, the supply of MFP products has increased significantly in industrialized countries.

Despite all the favorable characteristics explained above, the fresh faba beans still represent a staple food in the diet of consumers. One of the main reasons is that legumes require long time of preparation and cooking; therefore, the development of new forms of presentation of the beans and all vegetables in general, represents a market of great interest (Vioque et al., 2012).

For MFP preparation, disinfections is a very important step. Normally, it is carried out by using sodium hypochlorite. However, due to some health concerns due to chlorine disinfection by products, new healthier alternatives are under study Consequently, the aim of this research was to evaluate the effects of two alternatives: UV-C light, as a physical disinfection agent and an edible coating (Naturcover P), as a natural antibrowning agent on the preservation of overall quality and vitamin C content in fresh faba bean seeds stored for 10 days at 5°C. Washing with sodium hypochlorite (SH) (100 ppm, pH 6.5) was used as control.

Material and methods

Plant material. Faba beans (var. Palenca) were collected from an open field crop and cold transported 30 km to the laboratory. Upon arrival they were kept in darkness at 1°C. The next day, the plant material was peeled in a cold chamber (8°C) and immature seeds were immersed in water (4ºC). After that, they were sanitized by immersion in sodium hypochlorite (HS), (100 ppm, pH 6.5) or, alternatively, in Naturcover P (10% in cold water), or sterilized with UV-C (3 KJ m^{-2}).

Packing. Seeds (about 125 g) were packaged in polypropylene bags (15x15 cm, 35 μ thick) in order to achieve a passive modified atmosphere. Bags were previously

sterilized with UV-C light (8 kJ m^{-2}) for avoiding any kind of microbial contamination due to the packaging.

The bags were heat sealed and stored at 5°C and 90-95% RH. Eight replicates per treatment and day of analysis were used. The determinations were performed at different sampling days (0, 3, 7 and 10).

Sensory evaluation. A panel of seven people (aged 24–50) trained in sensory quality analyses performed the evaluation. Before running the experiments, a consensus was reached among the panelists on those attributes that best described sensory changes. Sensory quality was evaluated on the processing day and after 3, 7 and 10 days of shelf life at 5°C. A 9-point hedonic scale was scored for visual symptoms of dehydration, browning and loss of lightness (9=none; 5=limit of usability; 1=extreme). Visual appearance, flavor, aroma, texture, color and overall quality were evaluated using a nine-point scale (1=extremely bad; 5=limit of usability; 9=excellent).

Vitamin C. The vitamin C was measured according to the method of Zapata and Dufour (1992) with slight modifications. Derivaticed samples (20 µL) were injected onto a Gemini NX (250 mm×4.6 mm, 5 µm) C18 column (Phenomenex, Torrance CA, USA), using an HPLC (Series 1100 Agilent Technologies, Waldbronn, Germany) equipped with a G1322A degasser, G1311A quaternary pump, G1313A autosampler, G1316A column heater and G1315B photodiode array detector. The HPLC system was controlled by the software Chem Station Agilent, v.08.03. Both, AA and DHA were quantified using commercial standards (Sigma, St Louis, MO, USA). Total vitamin C was calculated as the sum of AA and DHA and expressed as mg kg−1 fw. All samples were tested in triplicate.

Results and Discussion

Sensory evaluation. Effects of the different disinfection treatments on sensory quality of immature seeds are shown in Figure 1. Mean scores for all sensory attributes at day 0 indicated an optimal quality, with no differences between treatments. Indicators of deterioration, such as browning, dehydration or lost of lightness, were undetectable after washing. During storage, sensory quality declined slightly. Sensorial attributes were above the limit of acceptability for fresh and microwaved beans, subjected to treatment with UV-C light and antibrowning edible coating Naturcover P until the last day of storage. However, beans treated with sodium hypochlorite maintained their sensory acceptance only until day 7, both in fresh and microwaved product.

Vitamin C. The initial total vitamin C content was 1443, 1627 and 1561 mg kg^{-1}fw for fresh and 607, 469 and 476 mg kg^{-1}fw for cooked faba beans treated with sodium hypochlorite, UV-C and Naturcover P, respectively. The content of vitamin C decreased during storage, regardless of the type of treatment, for both fresh and cooked produce. In Figure 2, it can be observed the effect of treatment with microwave on the content of vitamin C where heating caused an important loss. At day 0, there was a reduction of about 58%, 71% and 70% on the content of vitamin C in cooked beans when compared to fresh beans treated with sodium hypochlorite, UV-C and Naturcover, respectively. These results are in agreement with those reported by Zhang et al. (2004), who described a dramatic reduction in vitamin C content on microwaved broccoli. Delchier et al. (2012) also reported a degradation of vitamin C content in green beans and spinach after a baking treatment at high temperatures.

Conclusions

The use of UV-C as disinfectant agent and Naturcover P as an antibrowning agent showed to be as effective as sodium hypochlorite and in some cases better.

The application of the edible coating in fact avoided the typical browning of seeds until the end of storage.

The three different treatments applied had no significant influence on the content of vitamin C. In fact, the behavior of these treatments during storage were recorded as being approximately the same for the three treatments.

On the other hand, differences between fresh and microwaving were obtained, showing differences on nutritional quality. The microwaved beans had a greater decrease in vitamin C because this is a very thermolabile nutrient.

The development of a product based on faba bean seed, both fresh and cooked, initially yielded good results. Further research is needed to study the presence of anti-nutritional factors and to optimize processing techniques in order to reduce quality losses during storage.

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References

Artés, F., Gómez, P., Aguayo, E., Escalona, V. & Artés-Hernández, F. 2009. Sustainable sanitation techniques for keeping quality and safety of fresh-cut plant commodities. Postharv Biol Technol 51: 287–296.

Delchier, N., Reich, M. & Renard, C. 2012. Impact of cooking methods on folates, ascorbic acid and lutein in green beans (*Phaseolus vulgaris*) and spinach (*Spinacea oleracea*). Food Sci Technol 49: 197–201.

Tharanathan, R.N. & Mahadevamma, S. 2003. Grain legumes, A boon to human nutrition. Trends Food Sci Technol 14: 507–518.

Trinidad, P., Mallillin, A.C., Loyola A.S., Sagum, R.S. & Encabo, R.R. 2010. The potential health benefits of legumes as a good source of dietary fibre. British J Nutrition 103: 569–574.

Vioque, J., Alaiz, M. & Guirón-Calle, J. 2012. Nutritional and functional properties of Vicia faba protein isolates and related fractions. Food Chemistry 132: 67–72.

Zapata, S. & Dufour, J.P. 1992. Ascorbic, dehydroascorbic and isoascorbic and simultaneous determinations by reverse phase ion interaction HPLC. J Food Sci 57: 506–511.

Zhang, D. and Hamauzu, Y. 2004. Phenolics, ascorbic acid, carotenoids & antioxidant activity of broccoli and their changes during conventional and microwave cooking. Food Chemistry 88: 503–509.

Tables and Figures

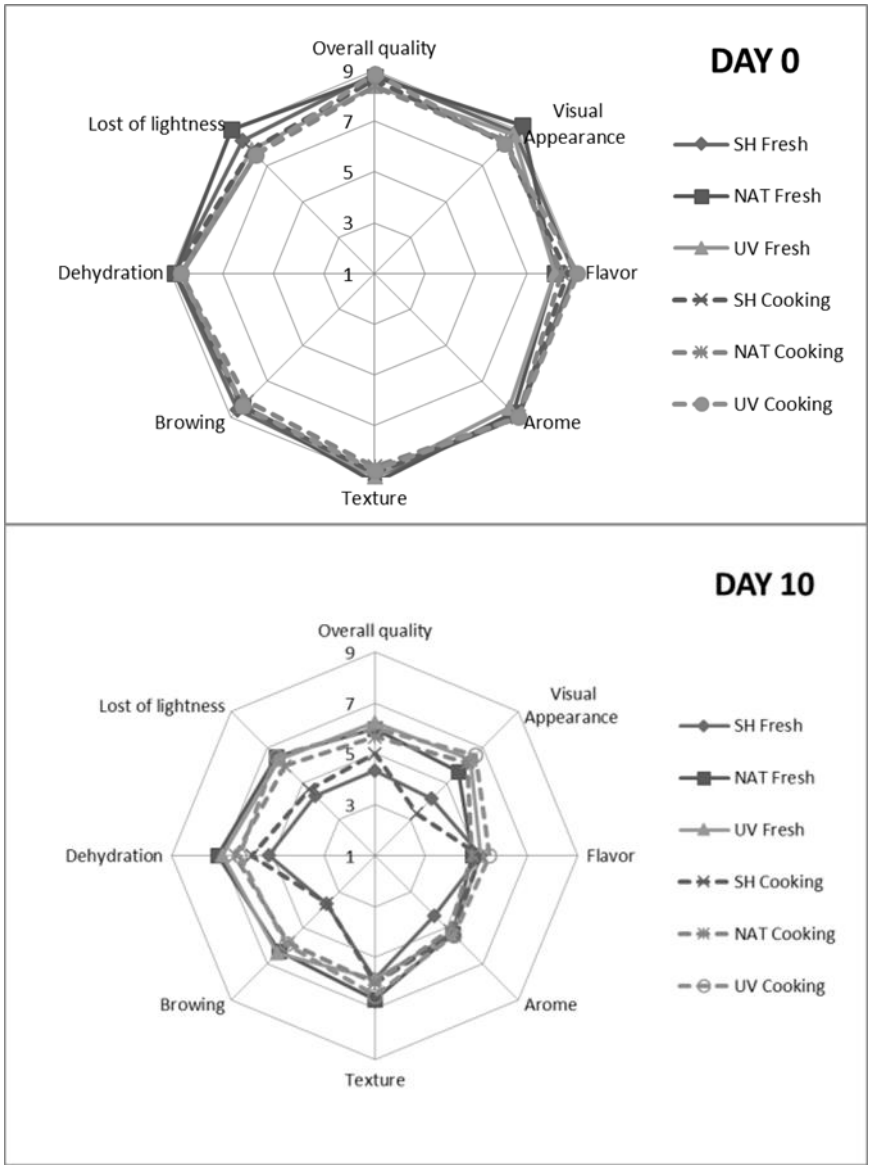

Figure 1. Sensory quality of MAP stored immature faba beans seeds at days 0 and 10, previously treated with chlorine (SH), Naturcover (NAT), UV, as fresh and cooking products.

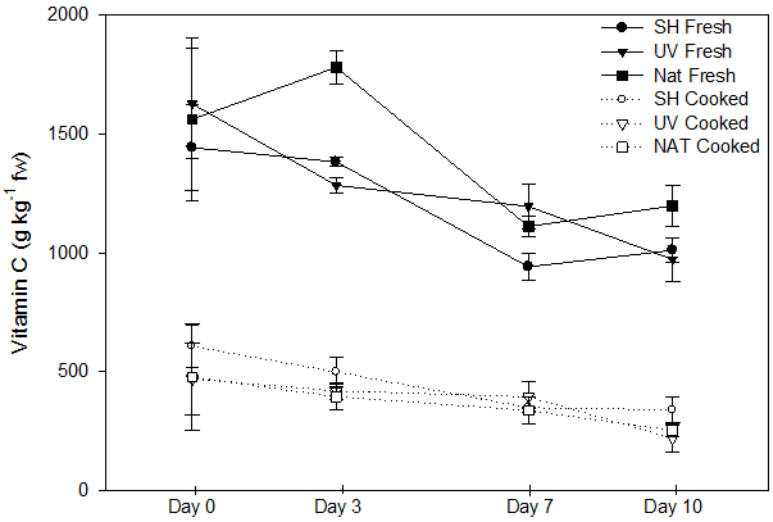

Figure 2. Changes in the content of vitamin C in MAP stored immature faba seeds during storage, previously treated with chlorine (SH), Naturcover (NAT), UV, as fresh and cooking products (bars indicate standard deviation).