Journal of Cleaner Production 257 (2020) 120364

Contents lists available at ScienceDirect

Journal of Cleaner Production

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

Short communication

Efficacy of hot water treatment as sanitizer for minimally processed table grape

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ARTICLE INFO

Article history:
Received 22 October 2019
Received in revised form
8 January 2020
Accepted 31 January 2020
Available online 1 February 2020

Handling Editor: Yutao Wang

Keywords:
Ready to eat
Quality
Yeast
Mold

ABSTRACT

Ready to eat fruit are greatly appreciated by consumers for convenience and freshness. However, postharvest degradation of these products limits the marketability and the quality. In order to delay this undesirable aspect, the influence of mild heat treatment on the postharvest quality ready to eat table grape was investigated. The sample grapes were dipped in a water bath at 50 °C for 10 min, minimally processed (stemless or with cap stem), packed and stored at 5 °C for 8 d. Fruit treated with room temperature water were used as control. Texture, titratable acidity, and soluble solids content (TSSC) were investigated. Microbial analysis was made to evaluate the efficacy of the treatment. Texture and quality parameters were not significantly ($P > 0.05$) affected by either heat treatment or stem removal. The heat treatments inhibited the microbial growth during storage. The results confirmed that water treatment at 50 °C/10 min is an optimal combination that can be applied to ready to eat grapes as an effective treatment to reduce postharvest microbial growth throughout the supply chain.

1. Introduction

Demand for minimally processed grapes is increasing due to their easy consumption. However, table grapes deteriorate rapidly due to berry quality loss and pathogen growth, which make it difficult to preserve without post-harvest treatments. The use of SO_2 provide a good long term storage, but the residues in berries peels can be threatening to the quality and safety of the products (Wang et al., 2017) and to human health (Lou et al., 2017). For these reasons, there is a growing interest to discover innovative approaches that prevent postharvest quality losses using cleaner technology (Chiabrando et al., 2019; Valero et al., 2006). Physical treatments, like heat (hot water and hot air treatments), hypobaric and hyperbaric pressure, microwave, ultraviolet radiation and radio frequency are promising control means to delay the postharvest fruit quality decay or to reduce the pathogens growth. This work assessed the reliability of the treatment with hot water, as a valid alternative to the use of sulfur dioxide, to guarantee the possibility of marketing Italian grapes in countries where the use of SO_2 is strictly limited. Therefore, the overall objective of this study was to propose and validate a hot water treatment on grapes for quality maintenance and to limit the microbial growth. Moreover was evaluated the better preparation technique for ready to eat grapes (pulling stems out entirely, or leaving 1- to 2-mm stems on the fruits).

2. Materials and methods

Table grapes (*Vitis vinifera* L., cv Crimson Seedless) were harvested from a commercial farm located in Lagnasco (CN - Italy). Half of the sampled grapes were treated with hot water by dipping the grapes in a water bath at 50 °C for 10 min. The other half was treated with water at room temperature and used as control. Then the grapes were prepared according to the following 2 methods: (1) the grape stems were manually removed (stemless); (2) the cap stem were cut short with sanitized scissors so that the grapes retained 1–2 mm of cap stem. A total of 60 trays (15 hot water/stemless, 15 hot water cap stem, 15 control/stemless, 15 control/cap stem) with 30 units of grapes per tray was prepared, packaged in a PET tray, sealed with microperfored film (permeability of 2300 cc/m^2/d) and were stored at 5 ± 1 °C for 21 d. Quality evaluation (texture with a puncture test, soluble solid content and titratable acidity) were performed periodically (each 7 days) and microbiological analyses (yeast and mold evaluation, Vanderzant and Splittstoesser, 1992) were performed before the treatment and at the end of storage period.

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https://doi.org/10.1016/j.jclepro.2020.120364
0959-6526/

Table 1
Microbial counts (decimal logarithm of colony forming units (log CFU/g)) in table grape samples.

		day 0		day 21	
		yeasts (CFU g^{-1})	molds (CFU g^{-1})	yeasts (CFU g^{-1})	molds (CFU g^{-1})
treated	cap stems	2	2	1.60 b	1.00 b
	stemless	2	2	1.00 c	1.00 b
control	cap stems	2	2	2.74 a	3.00 a
	stemless	2	2	2.90 a	2.32 ab

3. Results

SSC level at harvest were 15.9 °Brix and increased gradually along with the storage. At the end of the storage, SSC level of control berries (17.15 °Brix) was higher than those of hot water treated ones, although statistically insignificant. Moreover, no significant differences ($P > 0.05$) was found for titratable acidity values and fruit texture, both parameters were not significantly ($P > 0.05$) affected by either heat treatment or stem removal.

According to the microbiological criteria for Foods, (IFST, 1999), a maximum level of yeast and molds count of 6 log CFU g−1 is considered suitable at any point of supply chain. The microbial counts in ready to eat grapes at day 0 was 2 CFU g-1 both for yeasts and molds. At the end of storage all the treated samples showed lower values compared to control. For yeasts, the lower values were detected in hot water treated stemless grapes, the higher values were showed in both control samples (cap stem and stemless, that showed an average of 2.74 and 2.90 log CFU g-1 respectively). Only in this case, the stem removal had an important effect. In molds, both treated grapes showed lower values (1 log CFU g-1), compared to the control stemless with 2.32 log CFU g-1 and to the control cap steam that showed the highest values of 3 log CFU g-1 (Table 1).

4. Conclusion

The effect of hot water treatment and two processing methods of ready to eat table grape were tested during shelf-life. Results demonstrated that the heat treatment was sufficient to stop the development of yeasts and molds during storage, regardless of the technique used for the preparation of ready to eat table grape. These results suggest that a hot water treatment of 50 °C/10 min can be an effective, inexpensive and environmentally safe method to improve the microbial quality of ready to eat grapes and allowing a shelf-life period of 21 days without the use of chemical treatments.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

CRediT authorship contribution statement

V. Chiabrando: Formal analysis, Writing - original draft. **G. Giacalone:** Writing - original draft.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jclepro.2020.120364.

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