JRIFST

www.journals.rifst.ac.ir
Journal of Research and Innovation
in Food Science and Technology

Research Institute of Food Science and Technology

Volume 9, Issue 2, Summer 2020, Pages 203-220
Document Type: Extended Abstract
DOI: 10.22101/jrifst.2020.209697.1127

Extended Abstract

The Effects of *Oliveria decumbens* Essential Oil and Chitosan on Physicochemical, Microbial and Sensory Characteristics of Grated Carrots in Polypropylene Packaging under Modified Atmosphere during Storage

Atoosa Mogharabi[1], Nafiseh Zamindar [2*], Elham Khosravi[3], Zahra Ghorbani[1]

1- M.Sc. Graduated, Department of Food Science and Technology, Isfahan (Khorasgan) Branch, Islamic Azad University, Isfahan, Iran
2- Associate Professor, Department of Food Science and Technology, Isfahan (Khorasgan) Branch, Islamic Azad University, Isfahan, Iran
* Corresponding author (n.zamindar@khuisf.ac.ir)
3- Instructor, Department of Food Science and Technology, Isfahan (Khorasgan) Branch, Islamic Azad University, Isfahan, Iran

Received: 2019.12.18; **Accepted**: 2020.06.20

Abstract

Reduction of food waste is the top priority for the food industry. The purpose of this study was to evaluate the effect of *oliveria decumbens* essential oils (EOs) and chitosan on physicochemical and microbial characteristics of grated carrots during storage. Grated carrots (control and coated) weighed and packed in polypropylene packages under the modified atmosphere and stored at 4 °C for 12 days. Color, acid ascorbic and TSS, acidity, pH, CO_2 (in 3 replications) and the total counts, mold, yeast (in 2 replications) were determined in a factorial experiment using a completely randomized design. The treatments included: control, 1.5% chitosan, 150 µL *oliveria decumbens* (EOs), 250 µL *oliveria decumbens*, 1.5% chitosan and 150 µL *oliveria decumbens* (EOs), 1.5% chitosan and 250 µL *oliveria decumbens* (EOs). Experiments were performed on days 1, 3, 6, 9 and 12. The results showed the level of acidity, carotenoid and acid ascorbic, the amount of L* and sensory (color, quality, flavor, odor) scores reduced during the time. By contrast, the level of pH, weight loss, the amount of a*, b*, CO_2 and TSS increased. The level of total counts increased (P<0.05) but no evidence of yeast and mold growth was observed. Therefore, *oliveria decumbens* essential oil and chitosan had a significant effect on improving the properties of grated carrots under modified atmosphere during cold storage.

Keywords: Chitosan, Modified atmosphere, *Oliveria decumbens* essential oil, Polypropylene

Introduction

Carrots are widely used in ready to eat salads; however, due to the damage to the texture of the product and the growth of microbes, its shelf life is reduced (Simões, Tudela, Allende, Puschmann, & Gil, 2009). To increase the shelf life of freshly cut products, it is recommended to use coatings on the surface of these products. Chitosan is a non-toxic polysaccharide coating with antimicrobial and biodegradable characteristics. Chitosan coating caused delay in the weight change of mango cuttings and inhibited microorganism growth (Chien, Sheu, & Yang, 2007).

The emergence of chemical-resistant strains necessitates efforts to find new antimicrobial

agents. *Oliveria* from the *Apiaceae* family is among the native plants of Iran. The aerial parts of this plant have a significant amount of essential oils. The *oliveria* essential oils (EOs) have shown a broad-spectrum antimicrobial activity against all studied organisms, and this effect is comparable to that of commercial antibiotics (Amin, Sourmaghi, Zahedi, Khanavi, & Samadi, 2005).

Packaging with modified atmosphere is one of the best ways to increase the shelf life of fruits and vegetables. The effect of two gas combination (nitrogen: 90%, oxygen: 5%, carbon dioxide: 5% and oxygen: 95%, carbon dioxide: 5%) on the physicochemical properties of grated carrots was investigated and results showed that the first gas composition lead to better carrot quality retention (Alasalvar, Al-Farsi, Quantick, Shahidi, & Wiktorowicz, 2005).

In this study the effect of *oliveria* EOs and chitosan was investigated on the physicochemical and microbial characteristics of grated carrots in polypropylene packages with modified atmosphere during storage.

Materials and methods

Essential oil of *oliveria* plant from Kazerun, Fars province was extracted. Then, the EOs were dehydrated by sodium sulfate. Eventually, it was placed in sealed glass container and stored at 4 °C until using (Mahboubi, Feizabadi, Haghi, & Hosseini, 2008).

Carrots (*Wilmoren* cultivar) were disinfected with sodium hypochlorite solution (100 mg/L) for 1 min. An industrial crusher crushed the carrots. After separating the surface water by centrifugation, the grated carrots were coated by treatment solutions.

The chitosan was dissolved in a 1% volumetric-acetic acid solution to a concentration of 1.5% using a magnetic stirrer. The resulting chitosan solution was filtered using vacuum filter paper No. 3 under vacuum to remove impurities. Then the pH of the solution was increased to 5 with NaOH solution (1N) and finally 2 mL of tween 80 was added to 1 L of the prepared solution. For the control treatment (non-coated sample), according to Chien *et al*. (2007), 1 L of 1% acetic acid was used, the pH of which was adjusted and 2 mL of tween 80 was added. Then the *Oliveria* EOs were added to the chitosan solution at the specified concentrations and distributed evenly for 1.5 min at a rate of 700 rpm using a mixer (Chien *et al*., 2007). The resulting solution was deaerated at 25 °C. The grated carrots were immersed in the solution for 2 min and placed in the drain to remove the extra solution and the carrots were allowed to dry by air (Hashemi, Razavi, & Musavi, 2009):

T_1: control sample (without coating)
T_2: 1.5% chitosan
T_3: 150 μL *olivieria* EOs
T_4: 250 μL *olivieria* EOs
T_5: 1.5% chitosan and 150 μL of *olivieria* EOs
T_6: 1.5% chitosan and 250 μL of *olivieria* EOs

After weighing (250 g), the grated carrots (control and coated) were placed in 10 g polypropylene packages (0.5 mm thick) of suitable food grade in dimensions of 20×20 cm and injected in the packing machine with 5% modified oxygen atmosphere, 5% carbon dioxide and 90% nitrogen. After thermal sealing, the packages were stored in the refrigerator for 12 days at 4±1 °C. The tests were performed on days 1, 3, 6, 9, and 12 (Ayhan, Esturk, & TAŞ, 2008).

Evaluation of chemical, microbial and sensory characteristics

The pH was measured by a digital pH meter. The acidity was measured based on the method described by the AOAC (1990) and Rocha, Ferreira, Silva, Almeida, & Morais (2007).

The percentage of weight loss in each treatment was reported using pre- and post-storage weight (Becaro *et al*., 2016). The carotenoid concentration was calculated based on the method described by Rocha et al. (2007) in terms of μg per L. A refractometer was used to determine the total soluble solids (°Brix) (AOAC, 1990).

The content of ascorbic acid (mg per 100 g of sample) was calculated based on the method described by Falahi, Ghiasvand, Ebrahimzadeh, & Khalkhali Rad (2013). The L*, a*, b* and WI (white index) indicators of grated carrots were evaluated using the Hunter lab system (Rocha *et al*., 2007). A 5-point hedonic test was used to assess sensory values (aromatic, color, and overall acceptability) (Rahman, Jin, & Oh, 2011). The internal gas concentration was evaluated by Ullsten & Hedenqvist (2003) method using gas analyzer. Plate count agar medium was used for total counting of microorganisms and yeast glucose chloramphenicol agar medium was used as cultivation medium for molds and yeasts according to the method described by Becaro *et al*. (2016).

Data analysis

This study was conducted in a completely randomized design with factorial form to investigate the effect of independent variables of coating (6 levels) and time (5 levels) on the physicochemical properties of grated carrots (3 replications) and total counting and mold and yeast (2 replications). Mean comparison was performed using LSD test at 5% probability level and SPSS software was used to analyze statistical data.

Results and discussion

The results showed that acidity, carotenoids and ascorbic acid, L* and sensory values (color, acceptability, and aroma) decreased during storage time while pH, weight loss, values of a*, b*, carbon dioxide gas and total soluble solids and microbial total count had reverse trend (P<0.05). No evidence of yeast and mold growth was observed until day 12. Overall, the *Oliveria* EOs and chitosan were effective in improving the properties of grated carrots under the modified atmosphere during storage.

T_6 containing 1.5% chitosan and 250 μL *Oliveria* EOs had the highest levels of acidity, carotenoids and ascorbic acid and the lowest levels of pH, weight loss percentage, total soluble solids, color indexes L*, b*, a*, and microbial total count (P<0.05). Samples containing chitosan and essential oil, as well as hybrid samples, lacked significant differences in sensory evaluation (color, taste, aroma, and acceptability), but these samples had a significant difference with the control sample (P<0.05).

Conclusions

The study showed that adding the *Oliveria* essential oil and chitosan to grated carrots in packages containing modified atmosphere during storage was effective in reducing respiration, water loss, microbial load and increased shelf life. T_6 containing 1.5% chitosan and 250 microliter *Oliveria* essential oil showed the best chemical, microbial and sensory characteristics. The results indicated that by packing under modified atmosphere and coating by chitosan and *Oliveria* essential oil, a new product of grated carrots can be provided to the Iranian consumer market in such a way that it maintains its durability and quality characteristics during storage.

References

Alasalvar, C., Al-Farsi, M., Quantick, P. C., Shahidi, F., & Wiktorowicz, R. (2005). Effect of chill storage and modified atmosphere packaging (MAP) on antioxidant activity, anthocyanins, carotenoids, phenolics and sensory quality of ready-to-eat shredded orange and purple carrots. *Food Chemistry, 89*(1), 69-76. doi:https://doi.org/10.1016/j.foodchem.2004.02.013

Amin, G., Sourmaghi, M. H. S., Zahedi, M., Khanavi, M., & Samadi, N. (2005). Essential oil composition and antimicrobial activity of Oliveria decumbens. *Fitoterapia, 76*(7), 704-707. doi:https://doi.org/10.1016/j.fitote.2005.06.009

AOAC. (1990). Association of Official Analytical Chemists. Chemical compositions, nutritional properties and volatile compounds of guddaim (Grewia Tenax. Forssk) Fiori Fruits.

Ayhan, Z., Esturk, O., & TAŞ, E. (2008). Effect of modified atmosphere packaging on the quality and shelf life of minimally processed carrots. *Turkish Journal of Agriculture, 32*, 57-62.

Becaro, A., Puti, F., Panosso, A., Gern, J., Brandão, H., Correa, D., & Ferreira, M. (2016). Postharvest quality of fresh-cut carrots packaged in plastic films containing silver nanoparticles. *Food and Bioprocess Technology, 4*, 637-649. doi:https://doi.org/10.1007/s11947-015-1656-z

Chien, P.-J., Sheu, F., & Yang, F.-H. (2007). Effects of edible chitosan coating on quality and shelf life of sliced mango fruit. *Journal of Food Engineering, 78*(1), 225-229. doi:https://doi.org/10.1016/j.jfoodeng.2005.09.022

Falahi, E., Ghiasvand, A., Ebrahimzadeh, F., & Khalkhali Rad, A. H. (2013). The determination of vitamin C, organic acids, phenolic compounds concentration of Red and Golden delicious apple grown in Lorestan province. *scientific magazine yafte, 15*(2), 5-14. (in Persian)

Hashemi, M. H., Razavi, H., & Musavi, M. A. (2009). Studies on physical, mechanical, antibacterial and microstructural properties of chitosan edible films containing thyme and cinnamon essential oils. *Food Processing and Preservation, 2*, 47-68. (in Persian).

Mahboubi, M., Feizabadi, M. M., Haghi, G., & Hosseini, H. (2008). Antimicrobial activity and chemical composition of essential oil from Oliveria decumbens Vent. *Iranian Journal of Medicinal and Aromatic Plants Research, 24*(1), 56-65. (in Persian)

Rahman, S. M. E., Jin, Y.-G., & Oh, D.-H. (2011). Combination treatment of alkaline electrolyzed water and citric acid with mild heat to ensure microbial safety, shelf-life and sensory quality of shredded carrots. *Food Microbiology, 28*(3), 484-491. doi:https://doi.org/10.1016/j.fm.2010.10.006

Rocha, A. M. C. N., Ferreira, J. F. F. C., Silva, Â. M. M., Almeida, G. N., & Morais, A. M. M. B. (2007). Quality of grated carrot (var. Nantes) packed under vacuum. *Journal of the Science of Food and Agriculture, 87*(3), 447-451. doi:https://doi.org/10.1002/jsfa.2723

Simões, A. D. N., Tudela, J. A., Allende, A., Puschmann, R., & Gil, M. I. (2009). Edible coatings containing chitosan and moderate modified atmospheres maintain quality and enhance phytochemicals of carrot sticks. *Postharvest Biology and Technology, 51*(3), 364-370. doi:https://doi.org/10.1016/j.postharvbio.2008.08.012

Ullsten, N. H., & Hedenqvist, M. S. (2003). A new test method based on head space analysis to determine permeability to oxygen and carbon dioxide of flexible packaging. *Polymer Testing, 22*(3), 291-295. doi:https://doi.org/10.1016/S0142-9418(02)00101-0