COLOR CHANGES DURING STORAGE OF ORGANIC AND CONVENTIONAL CARROTS

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Abstract

Storage impacts the visual and nutritional characteristics of carrots (*Daucus carota* L.). The visual changes related to color parameters are interrelated to physiochemical changes, especially to those that are responsible for color, i.e. carotenoids. With a proper environment, the long-term storage of carrot is possible with the preservation of valuable nutrients.
In this study, four typical household storage environments are applied for carrot samples originating from organic and conventional production. The results indicated, that among temperature, packaging type, and cultivation type, packaging has the highest impact on the investigated color parameters of carrot homogenates, and, indirectly on carotenoids content.

Introduction

Carrot (*Daucus carota* L.) is consumed worldwide in significant amounts (Keser et al., 2020) and is a rich source of carotenoids, which is responsible for the orange color of the root. Carotenoids are highly unsaturated pigments with strong antioxidant capacity which can reduce the occurrence of cardiovascular diseases (Xia et al., 2020). Throughout storage, carrot loses the majority of its water content, thus its firmness decreases, and microorganisms appear on its surface. These processes lead to changes in surface color which can ruin the attractiveness of the product. The color change can indicate underlying disadvantageous physiochemical processes causing decreased nutritional values (Pither, 2003). Therefore, color is a significant quality indicator for fresh and processed carrots (Simon, 1985) and its observation provide useful information about the ideal storage technology for consumers.

Experimental

For the experiment, bulk and packaged carrots originating from organic and conventional production were purchased from supermarkets. All items were pre-washed. Four-four identical groups of 15 carrots were created from both organic and conventional samples in the laboratory of the Department of Agroecology and Organic Agriculture, Hungarian University of Agriculture and Life Sciences on 16 March 2022. For modeling typical household storage practices, two temperatures (4°C, 12°C) for both bulk and sealable plastic bag storage were employed. The temperature × packaging × cultivation type combinations resulted in eight distinct storage technologies (Table 1). The duration of the storage experiment was set to four weeks.

Temperature	4°C				12°C			
Storage type	Bulk		Packaged		Bulk		Packaged	
Storage type code	CB4	OB4	CP4	OP4	CB12	OB12	CP12	OP12

Table 1. Details and codes of employed storage technologies for carrot samples. C in codes refers to conventional, while O refers to organic cultivation origin.

On a weekly basis, three-three carrots were chosen from each storage groups and separated for instrumental measurements. End parts were removed, and after homogenization with a lboratory blender, homogenate color was measured in triplicate with a handheld Konica Minolta CR-410 colorimeter (Konica Minolta, Japan). CIELab values (L*, a*, b*) were retrieved, which were used for chroma (C*) and hue (h°) values calculation.

Results and discussion

The L* value change of most carrot samples shows a somewhat similar pattern regardless of any factor (Figure 1). After a radical decrease in the first week a gradual increase is experienced. It is visible, that the cutivation system did not influence the change, while the packaging impacted the L* value changes to the highest extent. Bulk storaged carrots showed higher L* value decreases in comparison with packaged ones.

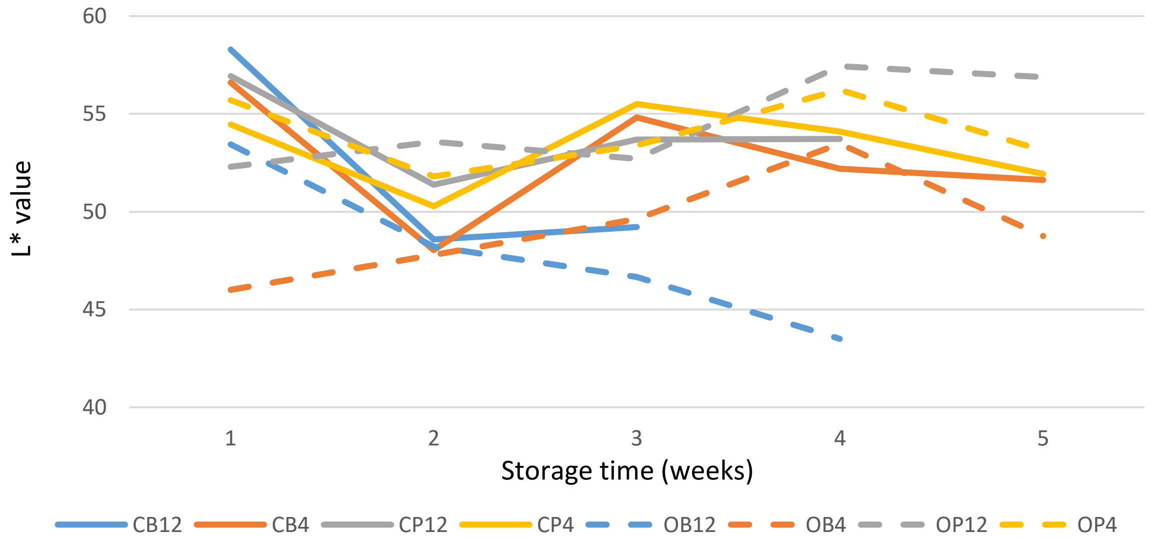

Figure 1. L* value changes of carrot samples during storage.

A slight decrease is shown by the a* values of the samples after one week storage, which is followed by a rise for the second and other weeks. Organic bulk samples show a lower a* value at the beginning of the experiment; OB12 or OB4 give the lowest values over the whole storage time in comparison with other samples. Regardless of starting values, bulk stored samples overperform those stored in plastic bags in terms of a* values throughout the storage time. With the exception of OB samples, CB, CP, and OP samples show similar trends regardless of temperature differences over storage. Organic and conventional samples do not divide.

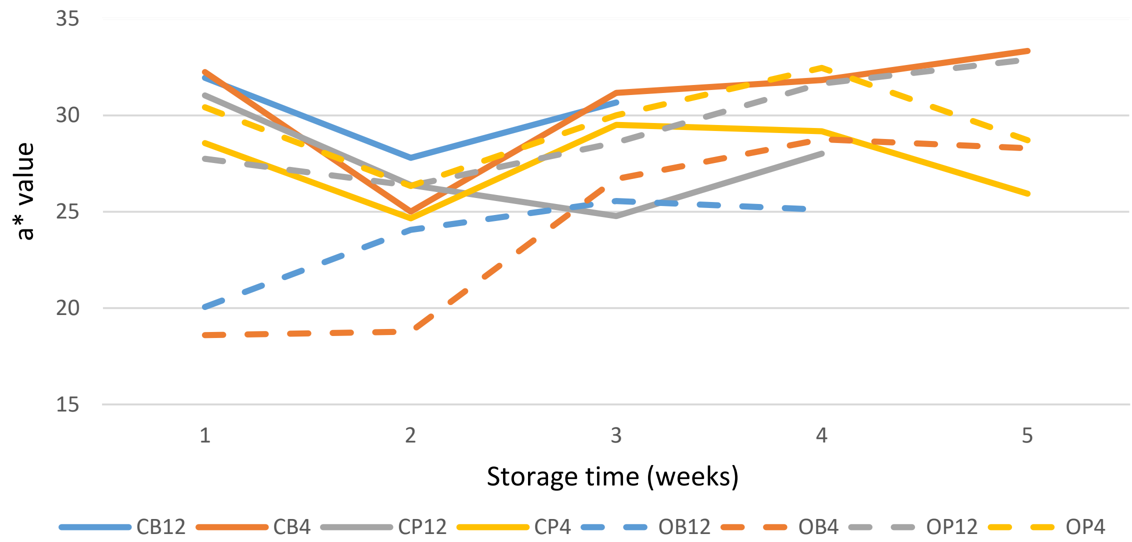

Figure 2. a* value changes of carrot samples during storage.

The Chroma value changes reflects the L* and a* value changes of carrot samples. OB samples together with CP samples show the lowest results. In case of bulk stored samples, cultivation system had an impact, possibly because of the low initial values of organic samples. Storage on higher temperatures seems to result in lower C* values regardless of cultivation type and packaging.

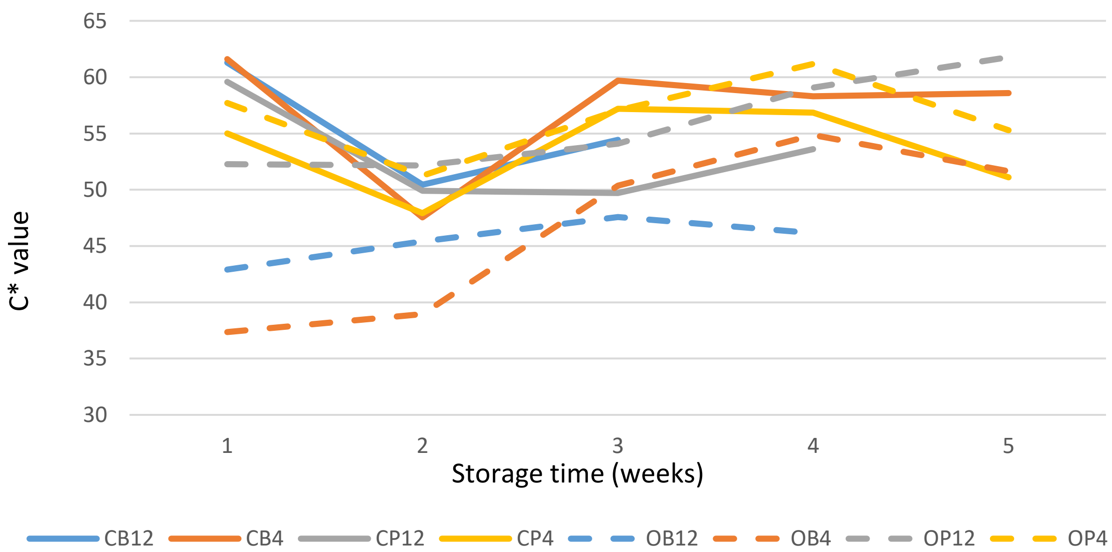

Figure 3. Chroma (C*) value changes of carrot samples during storage.

Higher initial hue values were obtained for OB samples. CB4, CB12, and OB4 samples shows the greatest decreases among storage types. In general, hue values seems to be stagnating over the storage period and no outstanding differences can be experienced. Overall, hue values are not influenced by the variations in temperature, packaging, and cultivation type.

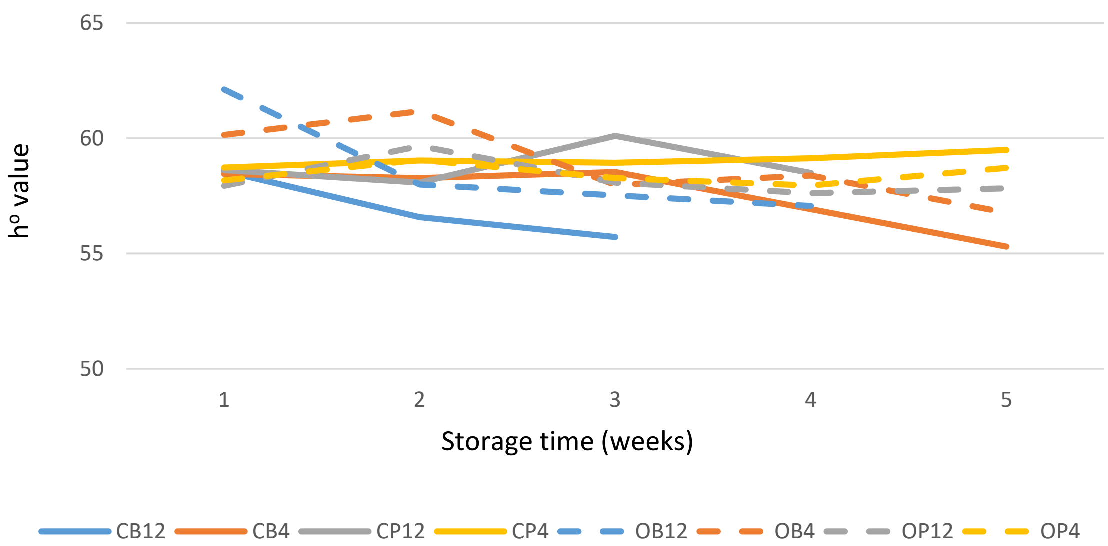

Figure 4. Hue (h^o) value changes of carrot samples during storage.

Conclusion

Among the investigated temperature, packaging and cultivation parameters, packaging seems to have the highest impact on the investigated color parameters (L*, a*, C*, h^o) of carrot samples. The changes in color is interrelated with certain physiochemical processes, therefore further instrumental analyses are required to explore correlations of color and phytonutrient traits.

References

[1] R.J. Pither, Enc Food Sci Nutr, 1111 (2003) 845-851.
[2] P.W. Simon, in: E. Eskin (Ed.), Evaluation of quality of fruits and vegetables, AVI Publishing Co., Westport, CT, 1985, pp. 315-328.
[3] Keser, D., Guclu, G., Kelebek, H., Keskin, M., Soysal, Y., Sekerli, Y. E., Selli, S.. Food Bioprod Proc, 119 (2020) 350–359.
[4] Xia, H., Wang, X., Su, W., Jiang, L., Lin, L., Deng, Q., Liang, D. Postharvest Biol Tech, 164 (2020) 111162.