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Effect of refrigerated storage conditions on leafy vegetables

Abstract

Considering the increasing of shelf life of leafy vegetables, the most important factor to keep the quality is the rapid cooling. The lettuce packaging under refrigeration and specific relative humidity just after harvest provides decreased breathing by water loss, which affects addition to weight, appearance, flavor and texture. This study aimed to investigate the effect of temperature and relative humidity in the appearance global of refrigerated curly lettuce and stored in PET crystal surrounded by PVC packaging for 14days. The samples were stored in incubator chamber (B.O.D.), simulating domestic refrigeration conditions at 4°C and a relative humidity of 74%. The package acted as a barrier, slowing food degradation caused by microorganisms and physicochemical changes resulting from the metabolism and external factors. For the sensory analysis we used a hedonic scale unstructured nine points.

Keywords: temperature, relative humidity, lettuce, appearance global

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Abbreviations: B.O.D, incubator chamber; PET, polyethylene terephthalate; PVC, polyvinyl chloride

Introduction

Aiming to healthier foods and practical for daily use, with high quality nutritional and sensory, the demand for minimally processed products has increased.[1] Minimally processed foods are marketed products ready for consumption, sanitized, in suitable containers in order to preserve its fresh state.[2]

As studies of Takayanagui et al.[3] microbiological contamination that can occur in these products are mainly due to inadequate handling and distribution. For this reason, the consumption of raw foods is often infectious disease transmission vehicles.

According to Pinto and Morais,[4] after harvest, indicate that the leafy vegetables are subject to continuous biological changes as respiration, transpiration and ethylene production may be desirable or undesirable. To prevent any loss of product, they are applied methods for the preservation of food.

According to Shewfelt[5] the rapid cooling, for most products, is the most important factor to maintain the required quality and increase shelf life.

As studies of Pinto and Morais[4] studies the use of the cold is the element that is most active in retarding of undesirable changes and the factors that usually influence on conservation are temperature, relative humidity and the composition of the current atmosphere. The temperature reduction immediately after collection provides a decrease in water loss by respiration (respiratory rate), ethylene production and microbial growth are the main causes of degradation of the food.

Carvalho[6] reports that the water loss affects the appearance, flavor, texture and the mass of plant food. However, the temperature condition for cooling varies according to each product, being acceptable for lettuce and spinach with hydro-cooling process by dipping or spraying with cold chlorinated water.[4]

Freitas and Figueiredo[7] point out that the relative humidity (RH) is another parameter that also should be controlled, because low relative humidity can cause loss of water from foods with water activity (Aw) high, losing consequently characteristics in terms of quality. However, the authors state that if a very high relative humidity is applied, this will encourage the multiplication of microorganisms, because the water is absorbed into the food surface. The lower temperature used in the food preservation method, slower will the chemical reactions, enzyme activity and microbial growth, which directly affect the overall appearance of the food.

The vegetable storage with low relative humidity can lead to weight loss, wilting and yellowing.[8] Due to the large surface area of transpiration of leafy vegetables to be larger than its volume; they must be stored at a high humidity, bigger than 95%.

Hardenburg et al.[9] in studies with lettuce, concluded that the freezing temperature is -0.2°C and a minimum temperature of cooling is from 0°C with relative humidity between 98% and 100%, which cause a longer shelf life. Thus, the good appearance of this vegetable is maintained for more days than at higher temperatures.

Studies in the last 20years indicate that storage temperatures recommended for foods vary from 2 to 7 ° C.[9–13] In the same way the relative humidity (RH) of the storage environment, ranging from 80% to 95%.[14,15]

Thus, this study aimed to investigate the effect of temperature and relative humidity in the appearance global of lettuce leaves chilled in domestic conditions.

Materials and methods

Sample

The crisp lettuce (*Lactuca sativa L.*) was acquired directly from hydroponics system, in the morning, and was transported in coolers for the Food Processing Laboratory (LAPRA) Department of Chemical Engineering in Blumenau Regional University of Blumenau (FURB).

Methods

The lettuce leaves underwent a cleaning process and selection in accordance with the similarity in size, color and absence of defects. Then the samples were packed in PET crystal packaging covered by PVC film (policloroeteno), stored in Camera Incubator (B.O.D.), in isothermal system (4°C) and relative humidity average of the cooler of 74%.

Sensory analysis

To monitor the temperature and relative humidity during the 14days of storage was coupled to B.O.D.one sensor, Pro Klimalogg, to monitor the behavior of the temperature and RH in the cooling chamber. During this period, the lettuce samples were evaluated sensorially by 7 trained judges in the sensorial characteristics related to overall appearance (darkening of the midrib and edges, lush appearance and cooked aspect) using hedonic scale unstructured nine points (1 - extremely disgusted 9- extremely good).

The project received a assent of the Ethics Committee of FURB (CAAE 48613415.1.0000.5370).

Results and discussion

According to some researchs, leafy vegetables, like chinese cabbage, were stored at 5°C and 90% relative humidity to prolong its quality, after the 8th day were observed a decreased the scores for the overall impression[16] and the organic arugula remained look good until the 6th day of storage at 6.29°C and relative humidity of 31.68%.[17] To the red chard of the type "baby", packaged in a refrigerator at 5°C, the overall appearance declined from at 8th day storage and spinach type "baby" minimally processed conditioned at 8°C had their kept attributes within stipulated by the author until 8.[18,19]

In their work, Reis et al.[20] makes comparison of three types of packages including fully open, partially closed and fully closed. The author shows that using a totally closed container, the lettuce leaves showed deterioration exemption until the fifth day of analysis.

In this job the lettuce leaves stored in PET crystal packaging with PVC film coating showed excellent results for the overall appearance up to the 7th day of cold storage because the scores awarded remained very close and above 6. After this period, there was a considerable drop notes due to the pronounced appearance of dark spots on the top edge and midrib, accompanied by advanced shriveled appearance. The averages of the scores given over the 14days are shown in Figure 1.

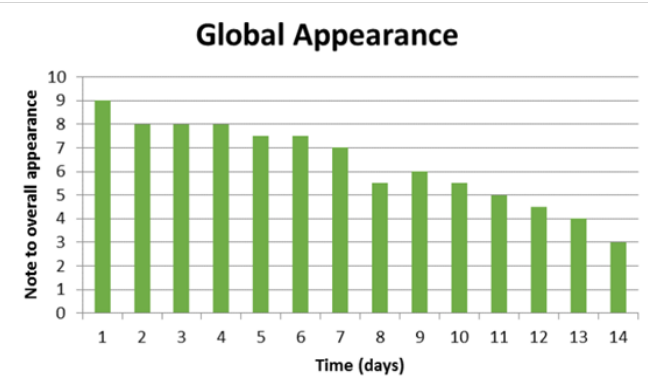

Figure 1 Behavior of the overall appearance of the lettuce leaves during the 14 days of refrigerated storage (4°C) in the sensorial analysis of the samples.

Studies by Sarantópoulos et al.,[21] demonstrated that the packaged lettuce was satisfactory overall appearance untill 7th day of storage at 5.5±1 ºC, after this period showed quality loss due to injuries, edge darkening and slight discoloration, very similar results to those found in this work. Already watercress showed satisfactory results on the overall appearance until the 5th day, because had loss of turgescence in the following days.

Carnelossi et al.,[22] studying the cabbage stored in PET box at 10°C, observed good quality only until the 5th day of storage.

Freire Júnior et al. stored lettuce at hydroponics system at 2°C and the sensory characteristics of overall quality were maintained until the 7th day. In the packaging at 10°C the time was less, keeping the overall appearance only until the 3rd day.

Conclusion

According to the results obtained in this work, it can be seen that the storage of curly lettuce in experimental conditions showed good results, considering that the notes remained satisfactory (up to 6) and very close up to the 7th day of storage. However, from the 8th day, darkening pronounced at the top edge and midrib of the leaf, accompanied by shriveled appearance caused by moisture loss, caused product rejection by the judges. The package intensified the conservative effect of cooling, by acting as a barrier to delay food deterioration caused by microorganisms and physicochemical changes resulting from the metabolism and external factors.

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Conflict of interest

The author declares there is no conflict of interest**.**

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