

Quality Changes In Fresh-Cut Leeks

Özlem TUNCAY¹

Esen KUŞAKSIZ²

Özet

Sınırlı İşlenmiş Pırasalarda Kalite Değişimleri

Son yıllarda Dünya’da sınırlı işlenmiş meyve ve sebzelere olan ilgi giderek artmaktadır. Sınırlı işleme Türkiye için yeni bir kavram olup, marul, lahana, havuç ve pırasa gibi az sayıda ürün sınırlı işlenmektedir. Bu çalışmanın amacı sınırlı işlenmiş pırasalarda depolama sıcaklığı, farklı sayıda delikleri olan polietilen torbalar ve iki farklı işleme şeklinin kalite üzerine etkisini incelemektir. Depolama sıcaklığı ağırlık kaybı ve iç uzaması dışındaki kalite özellikleri üzerinde etkili olmamıştır. Delik sayısı ağırlık kaybı ve rengi etkilemiş, delik sayısı arttıkça kalite düşmüştür. Dilimlenmiş pırasalar yarıya bölünmüş olanlara göre daha fazla ağırlık kaybettilerse de, her iki grupta kalitelerini depolama süresince korumuşlardır.

Anahtar sözcükler: Pırasa, sınırlı işlenmiş, depolama, paketlenme, kalite.

Introduction

Recently, there is an increasing interest in ‘minimally processed’ or ‘lightly’ or ‘fresh-cut’ fresh fruits and vegetables. In Europe, market for fresh-cut products grew explosively in early 1990s (1). Especially the types and quantity of the fresh-cut products increased dramatically (8). Initially, the food service industry was the main user of the fresh-cut products, but use has expanded to restaurants, supermarkets and warehouses. They are also getting popular for household uses, because they are convenient, ready to use and have a fresh like quality. The main advantage of fresh-cut products for restaurants, catering, etc. is lowering expenses and labor, and improving hygiene.

Minimal processing typically involves peeling, slicing, dicing or shredding prior to packaging and storage. All of these steps have an effect on nutrients, shelf-life and quality of the prepared produce.

¹ Yard. Doç. Dr., Ege Üniversitesi, Ziraat Fakültesi, Bahçe Bitkileri Bölümü, Bornova-İZMİR, email: tuncay@ziraat.ege.edu.tr

² Yard. Doç. Dr., Celal Bayar Üniversitesi, Alaşehir Meslek Yüksekokulu, Alaşehir-MANİSA

Fresh-cut fruits and vegetables are more perishable than whole fruit and vegetables because of processing. The shelf-life of vegetable products might change between 2 to 3 weeks. To prolong the shelf-life of fresh-cut products the optimum temperature and relative humidity need to be maintained during the whole chain from harvest to consumption (7). Packaging of vegetables retards weight loss, deterioration and enhances maintenance of nutrients. Fresh-cut products can keep their quality better at low temperatures. The best temperature is 0°C for most of the products, but since it is expensive, the most commonly used temperatures are 5°C and 10°C.

Leeks are produced and consumed all over Turkey during the winter season. According to year 2001 statistics, the total production is 300 000 ton (2). Minimal processing is a rather new concept in food processing industry in Turkey. There are few products, which are fresh-cut, including lettuces, cabbages, carrots and leeks. Leeks are only washed, trimmed, halved and packaged in polyethylene bags. The storage temperature varies in food outlets between 3°C and 7°C. The aim of this study was to determine the effects of different storage temperatures, polyethylene bags and preparation methods on the quality of fresh-cut leeks.

Material and Methods

Leek stalks (*Allium porrum* L.) cv. Inegöl, which were produced under usual practices, obtained from farmers in Turgutlu, Turkey and brought to the laboratory immediately after harvest. In the laboratory they were trimmed (leaf tips and roots cut) and washed with tap water before use. Leeks were prepared in two different ways before storage; (1) leeks were trimmed and had the roots cut off, but the compressed stem was not removed, leaves were cut just above the first separation point, than halved; (2) trimmed leeks had all the roots and 5 mm of stem plate removed, leaves were cut as the first preparation and leeks were cut into 2.5 cm long pieces. The preparations were based on commercial practices for halved leek stalks and usual cooking size for 2.5 cm long leeks.

Subsequently, prepared leeks (four or five leeks in each bag) were placed in polyethylene bags, which were; (1) without perforation; (2) with four punctures (314 mm² total perforation area); (3) with eight punctures (628 mm² total perforation area). Afterwards, all the bags were heat-sealed and half of the bags were stored at 1°C and the other half was stored at 5°C for two weeks. Quality was evaluated prior to

storage, then at the end of first week and finally, at the end of the storage period.

Quality Evaluation Methods

For visual quality, color changes both in white and green stem parts measured with a tristimulus colorimeter (Model CR-300 with 8 mm aperture, Minolta, Japan) as CIE L* a* b* and hue°, which is used to express the hue of the color (6), was calculated from a* and b* values with the following formula. The colorimeter was calibrated using the manufacturer's standard white tile.

$$\text{Hue}^{\circ} = \tan^{-1} \times (b / a)$$

Growth or extension of the white inner leaf bases ('telescoping'), which can cause a rapid loss in the overall market quality in leeks and green onions, was measured in halved leek stalks as the length from the cut surface of the white leaf base to the end of the most extended portion.

Bags were weighed prior to storage and at sampling dates. Then the percentage of weight loss calculated.

Elasticity of the stalks was measured with a Fruit Hardness Tester (Nippon Optical Works, Japan) with a hemisphere type tip at 1 cm from compressed stem.

For the analysis of total soluble solids (TSS) chopped leeks were blended in a Waring Blender, and TSS was measured with a refractometer (Atago, Japan) in filtered juice.

The dry matter content (expressed as the percentage of fresh weight) was determined by drying chopped leek samples in an oven at 65°C until a constant weight was obtained.

Experiment was conducted as a randomized complete block with a split-split plot arrangement with three replicates of four to five leek stalks per treatment. The main plots were sampling dates (0, 7, 14 days); subplots storage conditions (1°C and 5°C), and sub-subplots combination of preparation methods (halved, 2.5 cm long) and polyethylene bag types (0, 4 and 8 punctures).

Data were subjected to analysis of variance (ANOVA), using SPSS software (SPSS Inc., U.S.A.). Means were compared using Fisher's protected least significant difference (LSD) test at $P \leq 0.05$.

Results

Halved and sliced leeks were stored in different polyethylene bags and at different storage temperatures up to 14 days. There was

either no visual defects or very slight water loss at the end of the storage period. In general, all the leeks were saleable. Weight loss (fig. 1) was affected by sampling time, storage temperature, perforation area and preparation method. Weight loss was increased with the increasing perforation area (% 0.190, 0.282 and 0.469) and during storage (% 0.0, 0.337 and 0.543). Also, sliced leeks (% 0.320) lost more weight than the halved ones (% 0.267). Weight loss was higher in leeks stored at 1°C (% 0.315) than 5°C (% 0.272).

Total soluble solids percentages (fig. 2) were only affected by sampling period, and decreased during the storage (% 6.850, 6.428, 6.292). The other treatments did not have any statistically significant effect on TSS. Dry matter content (fig. 3) followed a similar pattern.

Lightness and Hue° values (fig. 4 and 5), which represent the discoloration in the green parts of leaves, were affected both by sampling period and perforation area. Leaf discoloration was most severe in leeks at the end of the storage (lightness; 57.48, 58.32, 59.30 and Hue°; 122.21, 121.28, 120.25) and in the most perforated bags (lightness; 57.77, 57.61, 59.72 and Hue°; 121.65, 121.23, 120.86).

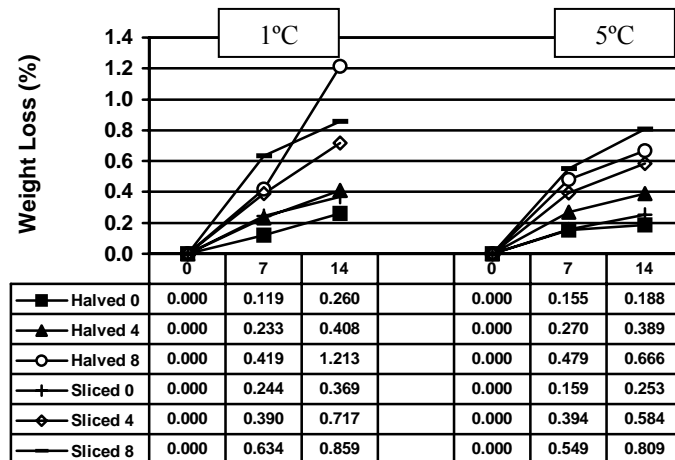


Figure 1. Weight loss (%) changes in leeks stored at 1°C and 5°C. (LSD_{0.05} Sampling time= 0.043; LSD_{0.05} Storage temp.=0.042; LSD_{0.05} Prep. Method=0.051; LSD_{0.05} Perforation area=0.063).

Inner leaf extension ('telescoping') was observed only in halved leeks. The effects of sampling period and storage temperature on inner leaf extension were statistically significant at $p \leq 0.01$. Leeks stored at 1°C had less extended inner leaves (4.13 mm) than those stored at 5°C (10.04 mm). The degree of inner leaf extension increased

during the storage (0.0, 8.11, 13.14 mm). Although it did not have any statistically significant effect on telescoping, there was a positive correlation with the increasing perforation area (fig. 6).

There was no statistically significant effect of treatments on elasticity, lightness and hue^o values of the white stem base (data are not shown).

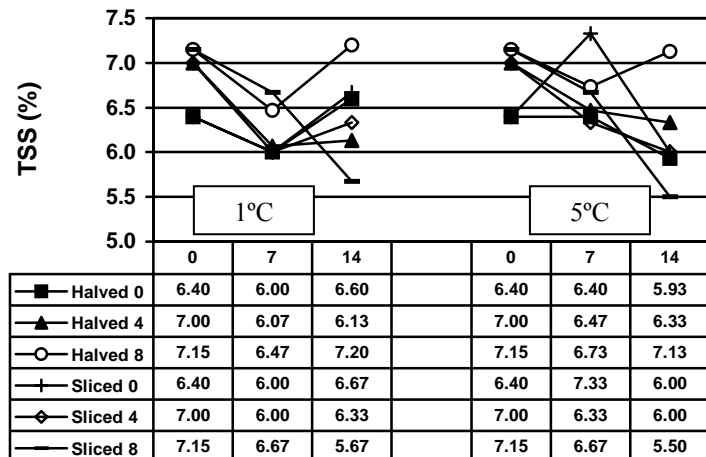


Figure 2. Total soluble solids (%) changes in leeks stored at 1°C and 5°C. (LSD_{0.05} Sampling time = 0.231).

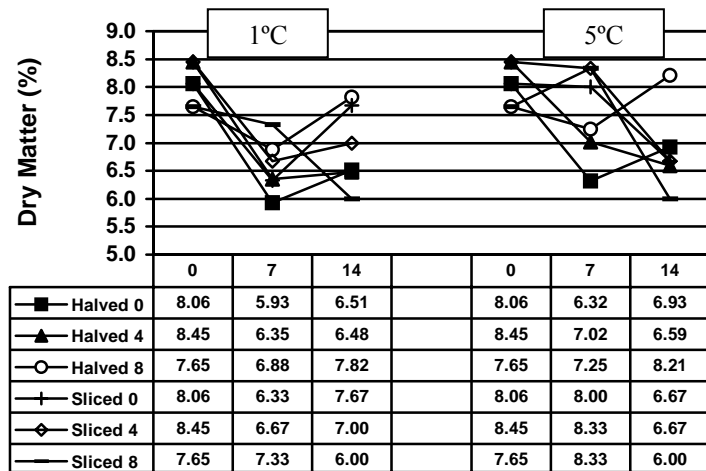


Figure 3. Dry matter (%) changes in leeks stored at 1°C and 5°C. (LSD_{0.05} Sampling time = 0.541).

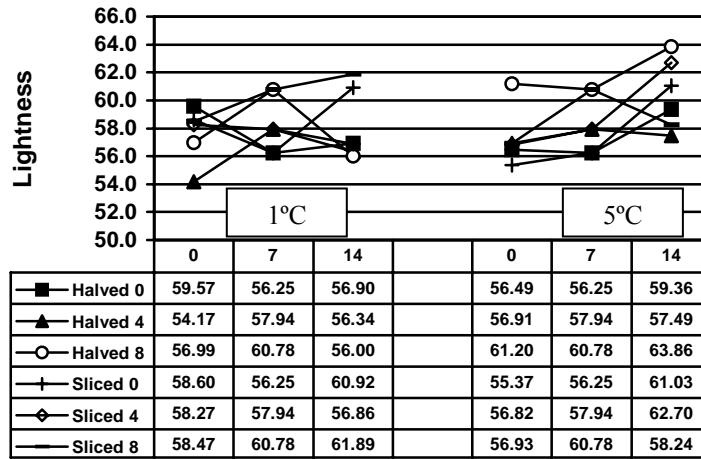


Figure 4. Changes in leaf color (lightness) in leeks stored at 1°C and 5°C. 0 and 100 indicates black and white, respectively. (LSD_{0.05} Sampling time = 1.299; LSD_{0.05} Perforation area = 1.370).

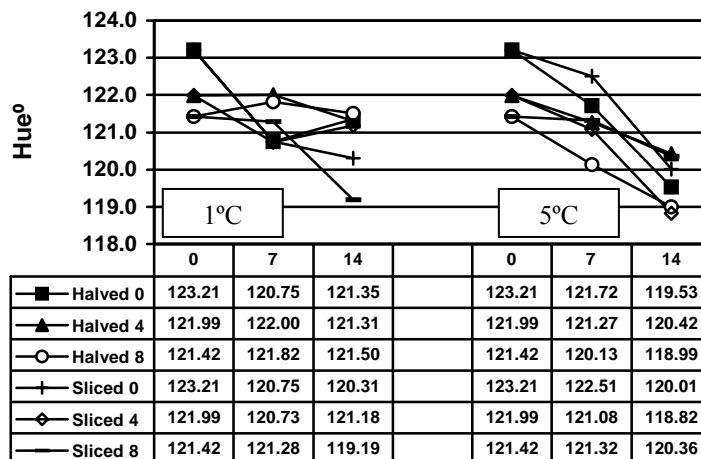


Figure 5. Changes in leaf color (Hue°) in leeks stored at 1°C and 5°C. 90° and 180° indicates yellow and green, respectively. (LSD_{0.05} Sampling time = 0.413; LSD_{0.05} Perforation area = 0.535).

Discussion

The overall quality of the fresh-cut leeks declined during the storage, but after 14 days of storage all of the leeks were still marketable. Weight loss and telescoping increased during storage, while the colour of the green outer leaves turned into a more yellowish green. Dry matter content and TSS decreased.

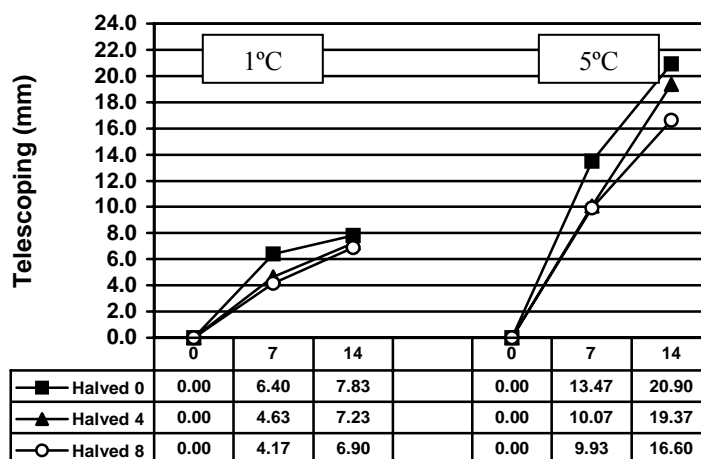


Figure 6. Inner leaf extension ('Telescoping') changes in leeks stored at 1°C and 5°C. (LSD_{0.05} Sampling time = 0.171; LSD_{0.05} Storage temp. = 0.304).

Low temperatures are important in the shelf-life of fresh-cut products and 0°C is usually the best temperature to maintain the quality (7), but since it is expensive, in practice the temperature changes between 5°C to 10°C (7). Hruschka (5) and Hong *et al.* (4) reported that green onions could be stored at 0°C about 3 to 4 weeks. Hong *et al.* (4) also reported that at 5°C modified atmospheres were needed to extend the shelf-life. The decline in visual quality was more severe after 14 days. In our experiment, storage temperature did not affect the TSS and dry matter content and colour of fresh-cut leeks statistically. Although, the storage temperature affected weight loss, the effect was probably due to the sudden increase in weight loss of leeks that were halved and stored in the bags with eight punctures. Other than those, all of the leeks followed a similar pattern in both storage temperatures. Telescoping was better controlled in 1°C than 5°C.

Both halved and sliced leeks maintained their quality during the storage. As expected, sliced leeks lost more weight than halved ones. Although, usually browning occurs when tissues are disrupted, there was no browning in both halved and sliced leeks; which is in agreement with the results of Blanchard *et al.* (3). Telescoping was not observed in sliced leeks.

Perforation area on the bags did not affect any quality attribute with the exception of weight loss and colour. Obviously, increased perforation area increased the weight loss. The colour of the outer green leaves was kept better in bags without puncture, and 4 punctures.

The leeks in bags with 8 punctures were more yellow (figures 4 and 5). These can be due to the increased respiration rate in bags with larger perforation areas.

Conclusion

Both 1° and 5°C were enough to maintain the quality of sliced leeks, but halved leeks were stored better at 1°C, because at 5°C telescoping could not be controlled. Preparation method did not caused any serious problem to the shelf-life of leeks, therefore it is possible to market leeks prepared for direct use in the kitchen, namely sliced. There was not any mould damage, and weight loss was the lowest in non-perforated bags, and quality was better maintained.

Summary

Recently, there is an increasing interest on 'lightly' or 'minimally processed' or 'fresh-cut' fresh fruits and vegetables in all over World. In Turkey minimal processing is a rather new concept, and there are few minimally processed products, such as lettuces, cabbages, carrots and leeks. The aim of this study was to determine optimum storage temperature and perforation area of polyethylene bags, and compare two different types of preparation methods, in terms of quality of fresh-cut leeks. The storage temperature did not affect most of the quality attributes, except weight loss and telescoping. Perforation area affected weight loss and colour, and quality declined with the increased perforation area. Although sliced leeks lost more weight, both sliced and halved leeks maintained their quality during storage.

Keywords: Leeks, fresh-cut, storage, packaging, quality

References

1. Ahvenainen. R., 1996. New approaches in improving the shelf life of minimally processed fruit and vegetables. *Trends in food Science and Technology*, 7:179-187.
2. Anonymous, 2001. *Tarımsal Yapı ve Üretim*. DİE Yayınları.
3. Blanchard, M., Castaigne, F., Willemot, C., Makhlof, J., 1996. Modified atmosphere of freshly prepared diced yellow onion. *Postharvest Biology and Technology*, 9: 173-185.
4. Hong, G., Peiser, G., Cantwell, M.I., 2000. Use of controlled atmospheres and heat treatment to maintain quality of intact and minimally processed green onions. *Postharvest Biology and Technology*, 20: 53-61.
5. Hruschka, H.W., 1974. Storage and shelf life of packaged green onions. U.S. Dept. Agric. Marketing Res. Report No. 1015, p.21.
6. Thai, C.N., Shewfelt, R.L. and Garner, J.C., 1990. Tomato colour changes under constant and variable storage temperatures: Empirical models. *Trans. Am. Soc. Agric. Eng.*, 33:607-614.
7. Verlinden, B.E. and B.M. Nicolai, 2000. Fresh-cut fruits and vegetables. *Acta Horticulturae* 518:223-232.
8. Watada, A.E., N.P. Ko, D.A. Minott, 1996. Factors affecting the quality of fresh-cut horticultural products. *Postharvest Biology and Technology*, 9: 115-125.