

## EFFECT OF PACKAGING ON CHEMICAL COMPOSITION AND STORABILITY OF FRESH-CUT ICEBERG LETTUCE

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### Abstract

The aim of this study was to evaluate the influence of the method of packing and storage conditions on sensory properties and chemical composition of the fresh-cut iceberg lettuce. There was investigated iceberg lettuce of cultivar 'Elena'. Chemical investigations of lettuce and their products were carried out according to the methods applied at the Biochemistry and Technology laboratory. Fresh-cut iceberg lettuce stored at the temperature of  $+1\pm 1$  and  $+6\pm 1$  °C in package in air ambience was distinguished for the best taste properties. Fresh-cut iceberg lettuce stored at the temperature of  $+1\pm 1$  °C in vacuum package had the biggest amount of dry soluble solids. When products are stored at the temperatures of  $+6\pm 1$  and  $+9\pm 1$  °C, the bigger amount of dry soluble solids are left in the packages without vacuum. Fresh-cut iceberg lettuce stored at the temperature of  $+1\pm 1$  °C in vacuum package and package without vacuum has bigger amounts of ascorbic acid. When products are stored at the higher temperatures, more ascorbic acid is found in fresh-cut lettuce stored in packages without vacuum. Bigger chlorophyll amounts remained in cut lettuce, stored at the temperatures of  $+1\pm 1$  and  $+6\pm 1$  °C in vacuum packing.

**Key words:** chemical properties, fresh-cut lettuce, packaging.

### Introduction

Iceberg lettuce (*Lactuca sativa* L. var. *capitata*) – one of the lettuces, which are grown in Europe and North America for a long time. Their popularity is determined by low cost and long period of storage. This lettuce is distinguished for dietetic properties. Their leaves accumulate considerable amount of folic acid, A and B group vitamins, calcium, iron and ascorbic acid (20–50 mg 100 g<sup>-1</sup>). Because of good storage and taste properties iceberg lettuce is in great demand among users. Minimally prepared lettuce mixes are especially popular.

The quality of made up products depends on the method of their preparation, packing material and storage conditions. It was observed that even 20% more of ascorbic acid remains in the products, which are stored at the low temperature (Barry-Ryan, O'Beirne, 1999). Loss of marketable appearance and quality of products is most often observed due to the browning of cut lettuce. Water, which is used in the production and has much nitrogen and calcium, and suitably balanced composition of modified air slow down oxidation processes of ascorbic acid and polyphenolic substances in cut lettuce. Their quality and time of usage increase. Water temperature, when preparing lettuce, also considerably influences production quality (Martin-Diana *et al.*, 2005; Beltran *et al.*, 2005).

In order to slow down oxidation processes of ascorbic acid and to improve sensory properties of products, it is suggested to irradiate packs with  $\gamma$ -rays, applying 0.5–1 kGy doses (Xuetong *et al.*, 2003).

Packing materials also influence sensory properties of products, because lettuce respiration intensity and product colour changes depend on the composition of the used materials (Del Nobile *et al.*, 2006).

It was observed that cut lettuce, which were stored in vacuum packing and before that were soaked in 1% ascorbic acid solution, distinguished themselves with attractively intensive colour (Pospilšil, Kovacev-Granic, Kuček, 2003).

Lithuanian Institute of Horticulture together with joint stock company “Salpronė” started quality evaluation investigations of iceberg lettuce products, made according to the minimal preparation method.

The aim of this study was to evaluate the influence of the method of packing and storage conditions on sensory properties and chemical composition of the fresh-cut iceberg lettuce.

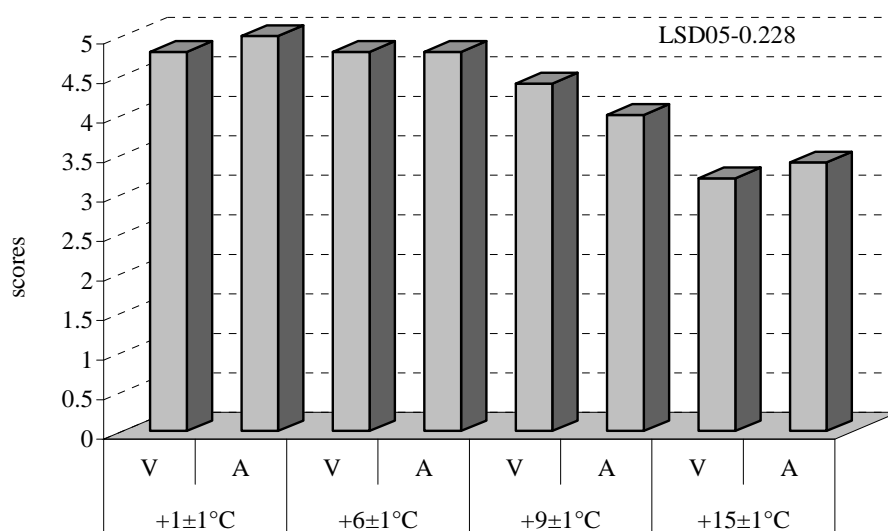
## Materials and Methods

Investigations were carried out at the Lithuanian Institute of Horticulture, Biochemistry and Technology Laboratory. Iceberg lettuce were prepared and packed in the enterprise of vegetable processing joint stock company “Salpronė”. The object of the research was iceberg lettuce of cultivar ‘Elena’. Lettuce-heads were cut in belts (6 mm in width and 80–100 mm in length) and packed into packages of two types 200 g in each. Packages were made out of barrier PA/PE 80 mik and TOPLEX HB PE 45 film in two ways – using vacuum and without it, in the air.

Investigations of the sensory properties and chemical composition of the prepared products were carried out on the sixth day of storage. Chemical investigations of lettuce and their products were carried out according to the methods applied at the Biochemistry and Technology laboratory. Ascorbic acid was measured by titration with 2, 6-dichlorophenolindophenol sodium chloride solution (Ермаков ., 1987); dry soluble solids – by digital refractometer ATAGO; amounts of chlorophylls a and b–spectrophotometrically according to Vernon (Гавриленко, Ладыгина, Хандобина, 1975). Investigations were carried out in three replications. Sensory properties significance was denoted by a confidence level of 5%. Statistical processing of chemical composition results was made with the help of MS EXCEL.

## Results and Discussion

In the department of vegetable processing in joint stock company “Salpronė” the heads of lettuce cultivar ‘Elena’ were cut in belts. Before packing, there were carried out investigations of the cut lettuce chemical composition. There were established 3.6% of dry soluble solids, 64.0 mg 100 g<sup>-1</sup> of ascorbic acid and 0.03 mg g<sup>-1</sup> of chlorophylls in fresh-cut lettuce of cv. ‘Elena’ (Fig. 2, 3). Cut lettuce was packed into film of different types in two ways – with vacuum and without it, in air.



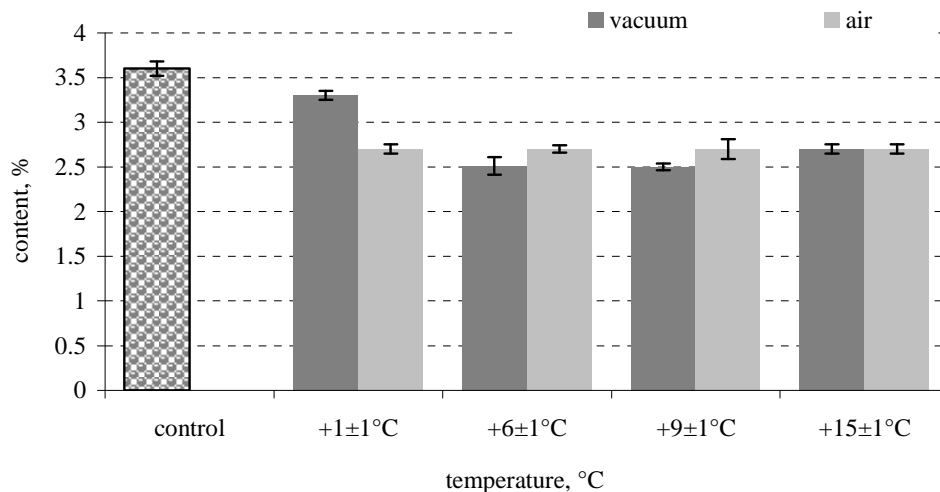
**Figure 1. Sensory (total: external attractiveness, smell) evaluation of fresh-cut iceberg lettuce (V– vacuum, A – air), scores**

It was established lettuce, stored at the temperature of +1±1 and +6±1 °C, had good sensory properties (external attractiveness, smell); they were evaluated in 4.7–5.0 points (Fig. 1). Cut lettuce, stored at the temperature of +1±1 and +6±1 °C in packing without vacuum distinguished themselves with the best aroma and taste, though storing products at the temperature of +6±1 °C, there were observed “dew” drops in the packing. Marketable appearance of the cut iceberg lettuce stored at the temperature of +1±1 and +6±1 °C in

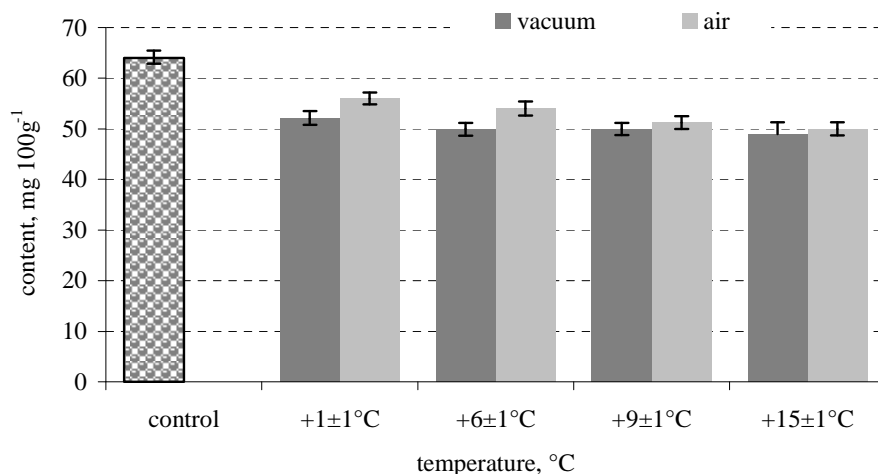
vacuum packing was evaluated in 5 points, but their taste and aroma were worse than those of lettuce stored in packing without vacuum.

It was established lettuce, stored at the temperature of  $+1\pm 1$  and  $+6\pm 1$  °C, had good sensory properties (external attractiveness, smell); they were evaluated in 4.7–5.0 points (Fig. 1). Cut lettuce, stored at the temperature of  $+1\pm 1$  and  $+6\pm 1$  °C in packing air ambience distinguished themselves with the best aroma and taste, though storing products at the temperature of  $+6\pm 1$  °C, there were observed “dew” drops in the packing. Marketable appearance of the cut iceberg lettuce stored at the temperature of  $+1\pm 1$  and  $+6\pm 1$  °C in vacuum packing was evaluated in 5 points, but their taste and aroma were worse than those of lettuce stored in packing without vacuum.

During storage the amount of dry soluble solids in made up products decreased. The biggest amount of dry soluble solids (3.3%) was in cut lettuce stored at the temperature of  $+1\pm 1$  °C in vacuum packing. When temperature of storage in packing without vacuum was  $+6\pm 1$  and  $+9\pm 1$  °C, in iceberg lettuce there was established more dry soluble solids than in vacuum packing. When products were stored at the temperature of  $+15\pm 1$  °C, the amount of dry soluble solids in lettuce in vacuum packing and in packing without vacuum essentially didn't differ (Fig. 2).

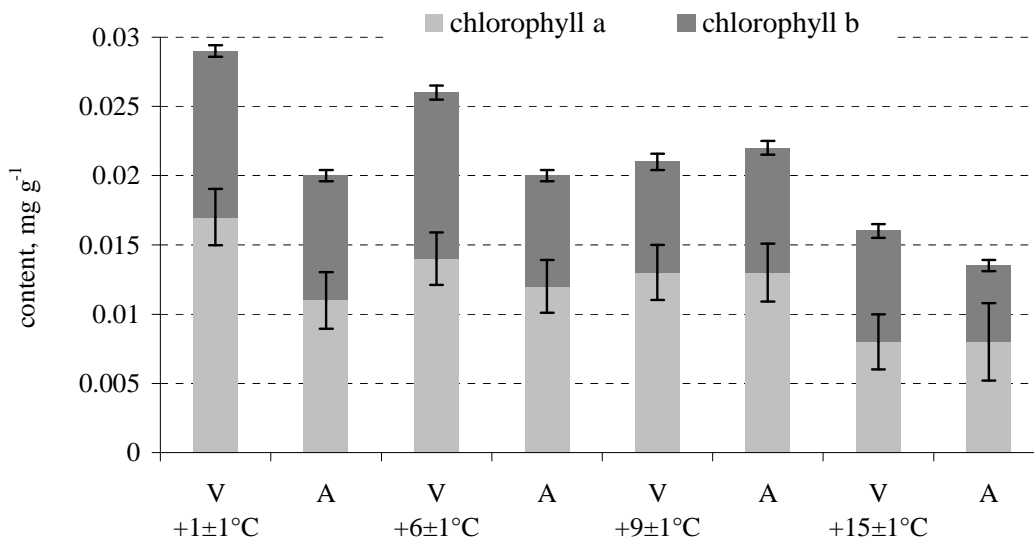


**Figure 2. Dry soluble solids content in fresh-cut iceberg lettuce, %**



**Figure 3. Ascorbic acid content in fresh-cut iceberg lettuce, mg 100 g<sup>-1</sup>**

The amount of ascorbic acid in cut iceberg lettuce decreased from 8.0 mg 100 g<sup>-1</sup> to 15 mg 100 g<sup>-1</sup>, depending on storage conditions and packing method (Fig. 3). The bigger amounts of ascorbic acid were established when lettuce was stored in both packings at the temperature of +1±1 °C. When storing at the higher temperature, the amount of ascorbic acid in cut lettuce decreased from 5.7 to 10.7%, dependently on packing method. The bigger amounts of ascorbic acid remained in lettuce, stored at different temperatures in packing without vacuum.



**Figure 4. Chlorophylls a and b contents of fresh-cut iceberg lettuce (V– vacuum, A – air), mg g<sup>-1</sup>**

Amounts of chlorophylls a and b in cut lettuce essentially decreased during storage. Temperature of storage and packing method influenced pigment concentration in products. Bigger amounts were established in cut lettuce, stored in vacuum packing in vacuum packing at the temperatures of +1±1 and +6±1 °C (Fig. 4). The least amount of chlorophylls a and b remained in products, stored in vacuum packing and packing without vacuum at the temperature of +15±1 °C. When lettuce was stored in air, without vacuum, at the temperatures of +1±1, +6±1 and +9±1 °C, pigment concentration in them decreased, but differences among chlorophyll amounts in products weren't established.

### Conclusions

1. Fresh-cut iceberg lettuce stored at the temperature of +1±1 °C and +6±1 °C in package without vacuum was distinguished for the best taste properties.
2. Fresh-cut iceberg lettuce stored at the temperature of +1±1 °C in vacuum package had the biggest amount of dry soluble solids. When products are stored at the temperatures of +6±1 and +9±1 °C, the bigger amount of dry soluble solids are left in the packages without vacuum.
3. Fresh-cut iceberg lettuce stored at the temperature of +1±1 °C in vacuum package and package without vacuum has bigger amounts of ascorbic acid. When products are stored at the higher temperatures, more ascorbic acid is found in fresh-cut lettuce stored in packages without vacuum.
4. Bigger chlorophyll amounts remained in cut lettuce, stored at the temperatures of +1±1 and +6±1 °C in vacuum packing.

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