



# THE INFLUENCE OF STORAGE TEMPERATURE AND DURATION ON CHILLING INJURIES IN CUCUMBER FRUITS

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## INTRODUCTION

Cucumber fruits belong to chilling sensitive vegetables, therefore recommended storage temperature is about 12°C. However, there is common practice to store vegetables in lower temperatures in retail or in transport.

The objective of the study was to determine changes in cucumber fruits during storage at different temperature regimes, which could be found in retail practice.

Quality traits studied related to visual quality, chilling injuries visual symptoms, electrolyte leakage as the indice of chilling injuries of cell structures, as well as antioxidant activity of the fruit flesh.

## MATERIAL AND METHODS

The fruits of cucumber cv. 'Colonel F<sub>1</sub>' were obtained from greenhouse production in the Department. The fruits were harvested at optimal harvest maturity.

### Storage period was:

1 week, 1 week + 2 days of simulated retail conditions (16°C), 2 weeks, 2 weeks + 2 days of simulated retail conditions (16°C).

### Storage conditions were:

temperature of 4°C (subcritical), 12°C (overcritical), 16°C (simulated retail conditions). Relative humidity (RH) during the storage was 90%.

### There were determined:

- colour of the fruits in CIE L\*a\*b\* system (10° D65 observer) at wave lengths of 400–700 nm (with HunterLab spectrophotometer),
- electrolyte leakage (conductivity of cell juice leakage measured in water),
- antioxidant activity (with DPPH and FRAP methods),
- total phenolics (with HPLC),
- chilling injuries and visual quality rated in scale ranged from 1 to 9. Fruits rated at level of 1-4 units were unmarketable.

Observations and analyses of the fruits were carried out directly after harvest and after storage periods. The evaluation was performed on the same fruits before and after storage. Electrolyte leakage was measured with the modified method of Mao et al. (2007). The leakage was expressed by percent of the whole leakage.

## CONCLUSIONS

Storage of the fruits at the temperature of 4°C resulted in small increase of L\* parameter value (lightness), and also small, but significant increase of b\* value (yellowness).

The value of a\* parameter (greenness) did not show significant changes. However, the same parameters for cucumbers stored at the temperature of 12°C showed more significant changes, for L\* and b\*, especially (increase).

For cucumbers stored at temperature of 4°C significant electrolyte leakage increase was observed, compared to cucumbers stored at 12°C. This indicates initiation of injuries of cell structures.

The leakage increased especially after additional storage of the fruits at simulated retail conditions. In the case of cucumber fruits stored at temperature of 12°C the values for electrolyte leakage did not show significant changes.

The development of chilling injuries was confirmed by visual evaluation of the quality of the fruits. The visual quality showed significant degradation resulted from storage, both for the fruits stored at 4°C and 12°C.

## RESULTS

Measured parameters of cucumber fruits stored at the temperature of 4°C

| Storage duration | L*      | a*     | b*     | electrolyte leakage (% of total) | chilling injuries (scale 1-9) | visual quality (scale 1-9) |
|------------------|---------|--------|--------|----------------------------------|-------------------------------|----------------------------|
| 0 weeks          | 35.60a  | -8.15a | 15.86a | 4.19a                            | 1.0a                          | 9.0d                       |
| 1 week           | 34.67a  | -8.03a | 15.42a | 9.71b                            | 2.0b                          | 6.5c                       |
| 1 week + 2 days  | 36.57ab | -8.86c | 18.22c | 20.19d                           | 3.5d                          | 5.5b                       |
| 2 weeks          | 37.22b  | -8.16a | 17.26b | 14.40c                           | 3.0c                          | 5.2ab                      |
| 2 weeks + 2 days | 37.36b  | -8.39b | 19.33d | 23.42e                           | 3.9d                          | 4.8a                       |

Values marked with different letters differ significantly at p=0.05 according to Tukey's HSD test

Measured parameters of cucumber fruits stored at the temperature of 12°C

| Storage duration | L*     | a*     | b*     | electrolyte leakage (% of total) | chilling injuries (scale 1-9) | visual quality (scale 1-9) |
|------------------|--------|--------|--------|----------------------------------|-------------------------------|----------------------------|
| 0 weeks          | 35.60a | -8.15a | 15.86a | 4.19a                            | 1.0a                          | 9.0c                       |
| 1 week           | 39.80b | -9.57b | 21.45b | 6.49b                            | 2.0b                          | 7.9b                       |
| 1 week + 2 days  | 41.01c | -9.99c | 23.56c | 6.90b                            | 2.1b                          | 6.6a                       |
| 2 weeks          | 41.98c | -9.78c | 25.28d | 6.42b                            | 2.1b                          | 6.0a                       |
| 2 weeks + 2 days | 44.18c | -9.79c | 28.63e | 4.90a                            | 1.7b                          | 6.0a                       |

Measured parameters of cucumber fruits stored at the temperature of 4°C

| Storage duration | Total phenolic compounds % d.m. | Antioxidant activity DPPH (mg TE/ g f.w.) | Antioxidant activity FRAP (mg TE/ g f.w.) |
|------------------|---------------------------------|---|---|
| 0 weeks          | 0.35a                           | 11.23d                                    | 2.59c                                     |
| 1 week           | 0.42b                           | 8.10c                                     | 1.83b                                     |
| 1 week + 2 days  | 0.45b                           | 4.77a                                     | 1.51ab                                    |
| 2 weeks          | 0.56c                           | 6.64b                                     | 1.15a                                     |
| 2 weeks + 2 days | 0.62d                           | 4.69a                                     | 1.26a                                     |

Measured parameters of cucumber fruits stored at the temperature of 12°C

| Storage duration | Total phenolic compounds % d.m. | Antioxidant activity DPPH (mg TE/ g f.w.) | Antioxidant activity FRAP (mg TE/ g f.w.) |
|------------------|---------------------------------|---|---|
| 0 weeks          | 0.35a                           | 11.23c                                    | 2.59ab                                    |
| 1 week           | 0.38a                           | 7.75b                                     | 2.92b                                     |
| 1 week + 2 days  | 0.51b                           | 6.97a                                     | 1.91a                                     |
| 2 weeks          | 0.50b                           | 7.85b                                     | 2.09a                                     |
| 2 weeks + 2 days | 0.49b                           | 7.88b                                     | 2.59ab                                    |



cold storage facility



Fruits stored for 2 weeks at 12°C



Fruits stored for 2 weeks at 4°C

