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FOREWORD

The papers contained in this proceeding originate from the "2015 International Conference on Green Development in Tropical Regions". Keynote speakers and authors of selected oral and poster presentations were invited to submit a manuscript for publication. Manuscripts were reviewed by the editors, and members of the editorial boards, and papers of a suitable scientific standard feature in this publication. The Steering Commitee appreciates the contributions of all editors and reviewers in improving the quality of this proceeding.

In particular, I wish to express my warmest appreciation to the following people:

Our distinguished keynote speaker, Prof. Dr. H. Susilo Bambang Yudhoyono as President of Assembly and Chair of Council Global Green Growth Institute and the 6th President of Republic Indonesia.

Our plenary speakers Prof. Ian Patrick (University of NewEngland, Australia), Prof. Jamal Othman (University of Kebangsaan Malaysia, Malaysia), Dr.Endah Murningtyas (PERHEPI Pusat, Indonesia), Prof. Bustanul Arifin (Lampung University, Indonesia), Prof. Nestor Baguinon (University of the Philippines Los Banos, the Philippines), Dr. Nguyen Van Kien (An Giang University, Vietnam), Dr. Lareef Zubair (Columbia University) and Prof. Rudi Febriamansyah (Andalas University).

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Padang, July 2016
Chairman,
Prof. Rudi Febriamansyah, PhD
Director of Graduate Program
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EFFECT OF HYDROCOOLING ON THE SHELF LIFE AND QUALITY OF CELERY (*APIUM GRAVEOLENS*, L.) DURING STORAGE

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Abstract: Fresh fruits and vegetables is a sub-sector of agricultural that gets attentions of the world community, including Indonesia in the last decade. This is not free from public awareness of the benefits for health owing to their nutritional values. However, they are very perishable and deteriorated easily after harvest. Therefore, the appropriate ways of handling and technologies for maintaining freshness of the products are necessary to minimize loss of the yield and to extend the trading area. Celery is a perishable product and deteriorated easily after harvest. The purpose of this study was to investigate the quality of celery by using hydrocooling method in order to reduce quality loss during storage. Celery was packaged in polyethylene film and put into the water at temperature 10°C and 27°C (room temperature). Another samples were also stored without packaging and hydrocooling as control. The weight loss, water content, chlorophyll, water activity and gas concentration change inside package were evaluated during storage. The results show that the weight of celery increased on the product stored with hydrocooling method, while for control product, the weight of product decreased during period of storage. the water content and water activity of celery was higher on the product stored at 10°C compared with room temperature and control. For celery hydrocooled at 10°C suppressed the degradation of chlorophyll compared with hydrocooling at room temperature and control. The gas concentration inside packaging changed drastically on the celery hydrocooled at room temperature and control, while on the celery hydrocooled at 10°C gas concentration changed gradually. Based on our observation, the quality parameter of celery could observed until day 21 on the celery hydrocooling at 10°C. It indicates that hydrocooling of celery at temperature 10°C could extend the shef-life of product compared with room temperature.

Keywords: celery, hydrocooling, quality, shelf life

INTRODUCTION

Celery (Apium graveolens L.) is a vegetable growing in the highlands with cold temperature. It also can be cultivated in the lowlands, but their products are not as good as celery cultivated in the highlands (Indrasari, 2009). In general, celeries are used as a spice in food. The development of science, owning celery uses as a medicine so that celery has been processed into herbal medicine in the practically consumed. Celery is harvested by using the traditional method at bright sunlight. However, many celery are withered after harvesting due to lack of post-harvest handling and distance of market. The losses will be increase if the postharvest handling is not exactly. In agribusiness, the fruitfulness is determined by postharvest handling. Therefore, the application of technology maintains the quantity and quality of celery much longer.

There are several methods for storing celery in order to preserve the quality and extend the shelf life of celery such as storage at room temperature and low temperature (Indrasari, 2009). However, storage celery at room temperature cannot prolong the storage period of celery, because at room temperatures, the respiration and transpiration process occurred very quickly. On other hand, storage at low temperatures prolongs the shelf life of celery. However, a very large water loss by storage at low temperature caused celery becomes dry.

Based on the mentioned above, it was required the technology that prolong the shelf life of celery. Hydrocooling was technology that can be used for extending the shelf life of celery. In this method, celery was packaged using plastic material with low of permeability and the din in the water at room temperature and low temperature (10°C). On other hand the usual treatment for storage celery was conducted as control. The quality parameters of celery such as weigh loss, water content, chlorophyll, water activity, physical index, and gas concentrations inside packaging were investigated.

MATERIALS AND METHOD

Plant materials and storage conditions

Celeries were freshly harvested from a farm in West Sumatera Province, Indonesia. It uniform in size and free from blemishes was chosen for experiment. About 30 g celeries were packed in polyethylene plastic (14 × 27 cm), wrapping and then dip into the water at temperature 10°C and room temperature. One lot of celery without packaging and hyrocooling treatment was also prepared as a control of experiment.

Weight loss

Weight loss was determined for each celery where it was weighed immediately after arrival at the laboratory and then after removal from refrigerated storage. Weight loss of each celery in the was calculated using the following formula:

$$WL(\%) = \left(1 - \frac{AW}{BW}\right) \times 100 \quad (1)$$

Where, WL is weight loss (%), BW and AW are celery weight (kg) before and after storage, respectively.

Water content

Aluminium cup that has been dried in a clean oven at ± 105-110°C for 1 hour were cooled in a desiccator for 15 minutes and weighed. 2 g sample was inserted into the cup and then roasted at a temperature of 105-110°C for 3 hours. The samples were cooled in a desiccator and weighed. Drying was repeated until it reacheed a constant weight. The water content was calculated using the formula:

$$WC\ (\%) = \frac{W1+W2-W3}{W2} \times 100 \quad (2)$$

Where, WC is water content (%), W1 is weight of cup (g), W2 is weight of sample (g), W3 is weight of cup plus sample (g).

Chlorophyll

The samples taken from the skin and fruit flesh parts of fresh pickling cucumber were subjected to extraction with acetone (90%); the absorbance values were monitored in spectrophotometer (Shimadzu VV-120-01) at 652 nm wave- length against distilled water in the filtrate of these extracts, and total chlorophyll was calculated.

$$\text{Chlorophyll}\left(\frac{mg}{L}\right) = 20.2\ A_{645.0\ mm} + 8.02_{663.0\ nm} \quad (3)$$

$$\text{Chlorophyll}\left(\frac{mg}{L}\right) = (1000/35.5)\ A_{625\ nm} \quad (4)$$

Water activity

Water activity of the samples was measured using aw meter calibrated with NaCl salt with a humidity of 75%. The sample is introduced into the container in aw meter and sealed. Aw value readings made at the time the numbers have not changed. This was demonstrated by writing or indicators on aw meter.

Gas concentration inside packaging
O_2 and CO_2 concentration in MAP were determined by using gas alanyzer every day during storage.

Statistical analysis
Statistical significance was determined by submitting the means values to analysis of variance and was subsequently compared using Tukey test at the 5% probability level that performed by SPSS software.

RESULTS AND DISCUSSION

Figure 1 shows the weight loss of celery stored with hydrocooling treatment at temperatures 10°C and room temperature, and also without hydrocooling treatment as control. The weight loss of celery reduced quickly on celery without hydrocooling treatment, while for celery storage with hydroccoling treatment, the weight of celery was increased. However, for celery storage with hydrocooling at room temperature could be stored until day 3, while for hydrocooling at 10°C could be stored until day 21. Rapid reduces of weight loss caused the product unmarketably. Hawa (2005) reported that the loss of water in fruits and vegetables caused loss of weight of product during storage. The amount of water loss from the products is depended on the temperature and relative humidity. The higher the temperature storage increased transpiration of fruit wither resulting wilting and softening.

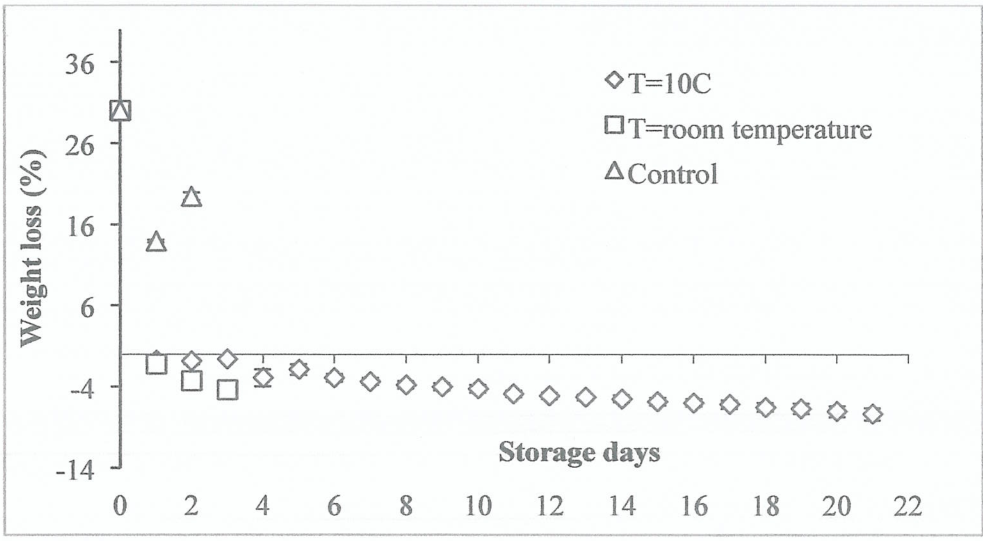

Figure 1. The weight loss on celery hydrocooling treatment at temperatures 10°C and room temperature, and also without hydrocooling treatment as control.

Figure 2 shows the water content of celery stored with hydrocooling treatment at temperatures 10°C and room temperature, and also without hydrocooling treatment as control. Significant decreased in water content was shown on control celery. Water content was decreased gradually on celery stored with hydrocooling at room temperature which celery could be stored until day 3. On other hand, water content was steady on celery stored with hydrocooling at 10°C which celery could be kept until day 21.

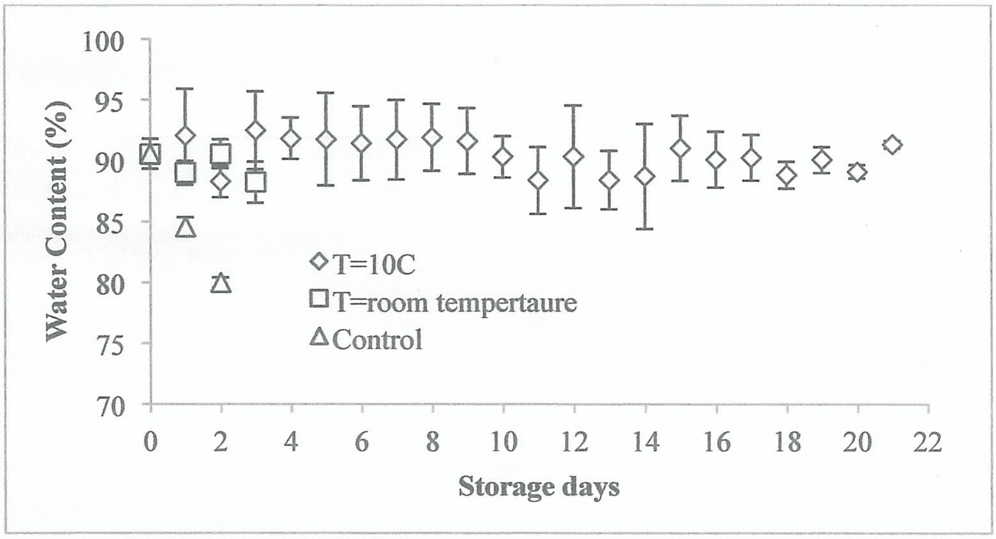

Figure 2. The water content on celery hydrocooling treatment at temperatures 10°C and room temperature, and also without hydrocooling treatment as control.

Differences in water content of each treatment were caused by the difference in storage temperature. Hydrocooling at temperature 10° C reduced the rate of transpiration on celery compared with hydrocooling at room temperature. According to Robinson et al. (1975), plant loses the water as much as 10% from its original weight due to evaporation which it is the critical limit. Thorne (1972) reported that critical limits lower than 8% due to water loss as much as 7% alone was caused space between cells in plants widened so that the cells with cells that others have started to separate. For example, onions and cabbage water loss by 10% already withered and quality to be so low that the price was very cheap, may not even be sold. It turned out to lettuce critical limits much lower, at only 3% because the lettuce leaves quickly wither if the water content decreases slightly.

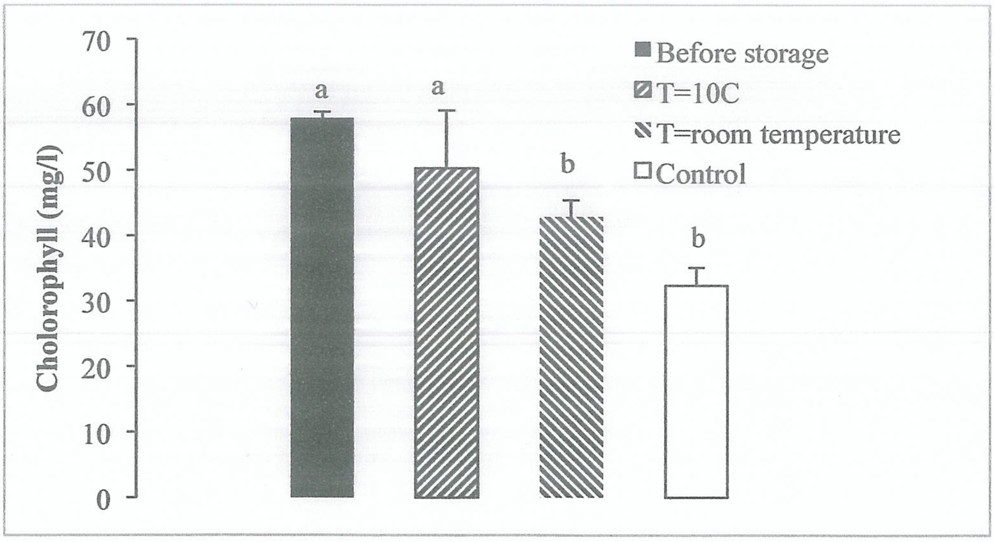

Figure 3. The chlorophyll content of celery at the end of storage on celery hydrocooling at temperatures 10°C and room temperature, and also without hydrocooling treatment as control.

Figure 3 shows the chlorophyll of celery at the end of storage with hydrocooling at temperatures 10°C and room temperature, and also without hydrocooling treatment as control. Significant deference in chlorophyll content were shown on celery hydrocolling at room temperature and control compared with celery before storage. It means that the chlorophyll content of celery decreased during period storage. However, significant different did not show between celery before storage and hydrocooling at 10°C. It means that by hydrocooling at 10°C suppressed degradation of chlorophyll during period of storage. The difference in cholorophyll content in celery was affected by temperature of water. Storage at low temperature suppressed the degradation of chlorophyll compared with storage at room temperature.

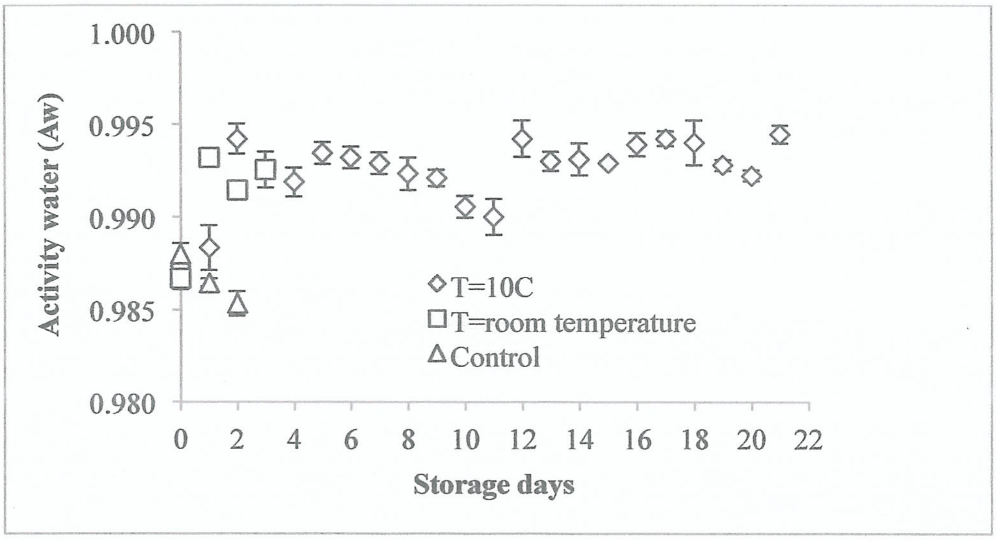

Figure 4. Activity water on celery hydrocooling at temperatures 10°C and room temperature, and also without hydrocooling treatment as control.

Figure 4 shows the water activity of celery stored with hydrocooling treatment at temperatures 10°C and room temperature, and also without hydrocooling treatment as control. Significant decreased in water activity was shown on control celery. Water activity was increased rapidly at first day of storage on celery stored with hydrocooling at room temperature then relative steady until 3 day of storage. On other hand, water activity was increased rapidly at first day of storage on celery hydrocooling at 10°C then relative steadies until day 21.

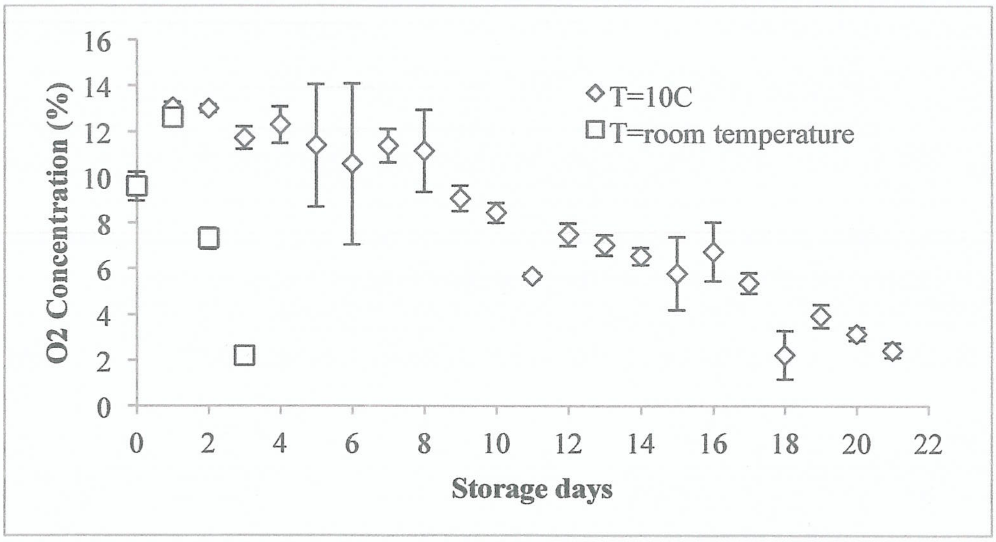

Figure 5. Oxygen concentration inside packaging contained celery hydrocooling at temperatures 10°C and room temperature.

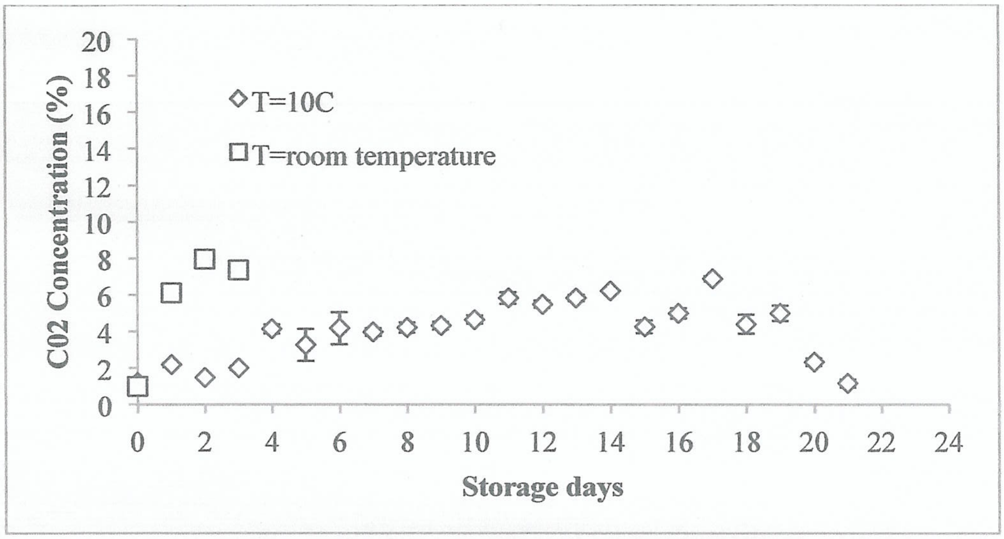

Figure 6. Carbon dioxide concentration inside packaging contained celery hydrocooling at temperatures 10°C and room temperature.

Figure 5 and 6 show the O_2 and CO_2 concentration inside packaging contained celery hydrocooling at temperatures 10°C and room temperature. O_2 concentration increased on the first day of storage, then decreased on subsequent days of storage. But the decline in the concentration of O_2 on celery hydrocooling at room temperature was faster than hydrocooling at temperature of 10 ° C. On other hand, CO_2 concentration increased rapidly on celery hydrocooling at room temperature, while on celery hydrocooling at 10°C, CO2concentration increased gradually. The differences in O_2 and CO_2 concentration on both of treatment was caused by the temperature difference in storage temperature, which storage at temperature of 10 ° C suppressed respiration rate compared with room temperature storage.

CONCLUSIONS

For conclusions, the weight of celery increased on the product stored with hydrocooling method, while for control product, the weight of product decreased during period of storage. the water content and water activity of celery was higher on the product stored at 10°C compared with room temperature and control. For celery hydrocooled at 10°C suppressed the degradation of chlorophyll compared with hydrocooling at room temperature and control. The gas concentration inside packaging changed drastically on the celery hydrocooled at room temperature and control, while on the celery hydrocooled at 10°C gas concentration changed gradually. Based on our observation, the quality parameter of celery could observed until day 21 on the celery hydrocooling at 10°C. It indicates that hydrocooling of celery at temperature 10°C could extend the shef-life of product compared with room temperature.

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