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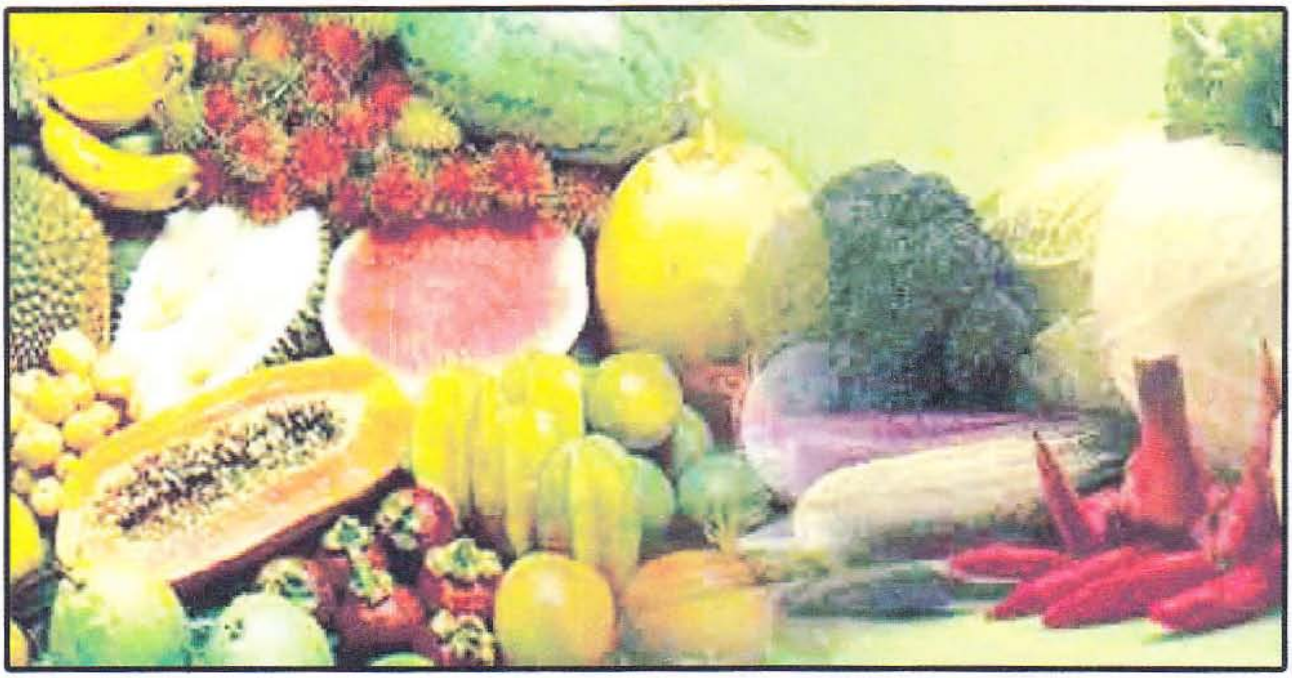
MANUAL BOOK

International Seminar on Horticulture to Support Food Security 2010

Bandar Lampung, 22-23 June 2010
INDONESIA



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PROCEEDING
International Seminar
on Horticulture to Support Food Security 2010

June 22-23, 2010
Bandar Lampung, INDONESIA

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PREFACE

Growing populations across the world, economic growth and changes in dietary patterns have caused both the production and consumption of horticultural produce, mainly fruit and vegetables, increasingly important. Horticulture, which includes the production of fruits, vegetables, flowers, spices, medicinal and aromatic plants and plantation crops, has a vital role in farm income enhancement, poverty alleviation, food security, as well as sustainable agriculture. However, this sector severely suffers from postharvest losses. Some estimates suggest that about 30–40% of fruit and vegetables are lost or abandoned after being harvested. Huge postharvest losses result in diminished returns for producers, and reduced food availability.

It is very clear that postharvest management determines food quality and safety, competitiveness in the market, and the profits earned by producers. However, the postharvest management of fruit and vegetables in most developing countries is very poor.

The major constraints include inefficient handling and transportation; poor technologies for storage, processing, and packaging; and poor infrastructure.

In order to overcome the incidence of the huge postharvest losses in the region and new challenges faced under trade liberalization and globalization, serious efforts are needed to reduce postharvest losses of horticultural produce, and to support food security.

Therefore, the University of Lampung in collaboration with the Government of Lampung Province as well as the University of Kentucky USA has organized this seminar with the objectives: 1) to discuss recent developments in postharvest handling, processing and marketing of horticultural produce, 2) to identify issues and constrains to reduce postharvest losses, 3) to define strategies and measures to reduce such losses in order to support food security, 4) to discuss marketing and food security issues, and challenges in the postharvest management of horticultural produce, issues and obstacles to improve the marketing and safety of postharvest handling and processing of horticultural produce.

It is our hope that serious consideration will be given to the recommendations of International Seminar on Horticulture to Support Food Security in shaping the future development of the production, postharvest handling, processing and marketing of horticultural produce.

June 22, 2010

Organizing Committee
International Seminar for Horticulture to Support Food Security 2010
Bandar Lampung - Indonesia

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EARLY DETECTION OF CHILLING INJURY SYMPTOMS IN HORTICULTURAL PRODUCTS

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ABSTRACT

Chilling injury symptoms in horticultural products were examined through the dynamic state of water by proton NMR analysis. Cucumber fruits, a chilling sensitive horticultural product, were used as a sample. After harvesting, samples were stored in polyethylene bags at temperature of 5°C and 25°C for 9 days. T_1 relaxation time, weight loss, pH, ion leakage and the occurrence of pitting were measured during the period of storage. For samples stored at 25°C, T_1 changed slightly for the first 3 days from 1.25 to 1.29s and increased from 4 days at the range of 1.35 to 1.38s. In contrast to this, at storage temperature of 5°C, T_1 increased extremely from 1.24 to 1.59s from storage time of 2 to 4 days and after that decreased to 1.38s at 9 days. The change in T_1 indicates the change in water movement in cell due to the physical change in membrane permeability. This phenomenon was supported by the change in weight loss, pH and ion leakage. The weight loss of samples for 25 and 5°C was almost the same; therefore, it is considered that the pitting for samples stored at 5°C was due to the impact of low temperature. The increasing tendency of pH was observed for samples stored at 5°C with the value at 9 days was higher than that at 25°C. The increase in pH could be thought as the change in acid content which indicates the occurrence of chilling injury. The rate of ion leakage for samples stored at 5 °C was higher than that at 25°C. This shows that impact of chilling has changed the membrane permeability. It is concluded that longer T_1 relaxation time in chilling temperature indicates the change in the dynamic state of water which is related to the increase in membrane permeability. The dynamic state of water which is showed through the change in T_1 could be applied to detect the early symptom of chilling injury before the external symptoms such as pitting can be detected.

Keywords: T_1 relaxation time, proton NMR, ion leakage, membrane permeability

INTRODUCTION

Low temperature is commonly storage method to extend the post harvest life of fresh horticultural products. However, for some products, stored under low temperature (above °C) are liable to reduce their marketability considerably because of chilling injury (Fukushima *et al.*, 1977). Chilling injury is primarily a disorder of crops of tropical and subtropical origin. The critical temperature for chilling injury varies with the commodity, but it generally occurs when produce is stored at temperatures below 10 – 13 °C. The injury symptoms may develop as characterized by abnormal ripening, surface pitting, discoloration, water-soaking, etc., if the period of exposure to chilling temperature becomes longer (Saltveit, 2002).

If the horticultural products are stored below the critical temperature for short periods, the product may repair the damage. If exposure is prolonged, irreversible damage occurs and visible symptoms often result. Injury occurs sooner and is more severe, the lower the temperature is below the threshold temperature. Detection of chilling injury is often difficult, as products often look sound when removed from the chilling temperature, but symptoms may occur when the products is placed at higher temperatures. Symptoms which appear at higher temperatures may appear almost immediately, or may take several days to develop; symptoms also may not be visible externally. The change in membrane permeability as a response to chilling temperature has been pointed out as a possible causes of chilling injury (Lyons, 1973). The membrane permeability regulates the water movement in cell and the dynamic state of water can be used to detect a chilling-induced permeability change of membrane (Naruke *et al.*, 2003). The dynamic state of water in cell structure during chilling treatment can be examined through the change in water proton NMR T_1 relaxation time (Iwaya-Inoue *et al.*, 1996). T_1 relaxation time reflects structurally related differences in the relaxation properties of the proton 1H nuclei of water and indicates mobility of water molecules (Watanabe and Iwaya-Inoue, 1996).

From those points of view, early detection of symptoms of chilling injury will be important in order to understand when chilling-induced change occurs. In this study, chilling injury index of horticultural product was investigated through the dynamic state of water by proton NMR analysis. T_1 relaxation time and diffusion coefficient were set as an index of the dynamic state of water. Cucumber fruits were used as a sample of horticultural products.

MATERIALS AND METHODS

Material and storage condition

Cucumber fruits (*Cucumis sativus*, L) cv. Alfa Fushinari and Flesco 100 were used as a sample. One day after harvesting, cucumber fruits were transported to the laboratory at ambient temperature. Sample of fruits were then placed at storage chamber at set temperature condition in polyethylene bags. The temperature was set at 5°C (chilled) and 25°C as a control (room temperature). The fruits were then put into polyethylene bags (340 x 240 x 0.08 mm) which each bag contains 4 fruits. Ten bags were stored at temperature of 5°C (chilled) and another 10 bags at 25°C (ambient temperature) for 9 d. The polyethylene bags were ventilated once a day to prevent anaerobic condition.

Sample preparation and measurement

For measurement of T_1 relaxation time, samples of sarcocarp with dimensions of 5x5x20mm were dissected from the middle of the longitudinal axis of cucumber fruits. After the dissection, the sample was put in a NMR tube and placed in the NMR spectrometer (25MHz, 0.58T, JNM-MU25, JEOL). From the same middle part of cucumber fruits, sample of sarcocarp with 4mm of diameter and 10mm of length was dissected using cork borer for ion leakage measurement. The samples were soaked in deionized water (40ml) which the initial value of its electric conductivity was known. The change in electric conductivity in the solution with time was then measured by EC meter (D-24, HORIBA) at 20°C. After 8 h, the sample was homogenized for 2 min. to leak all ions out from the sample and the total electric conductivity was measured. Data of ion leakage was expressed as a percent of the total conductivity of the solution. The remaining part of cucumber fruits was then squashed to extract the solution. pH of solution was measured by pH meter (D-24 HORIBA) at 20°C. T_1 relaxation time, weight loss, pH, ion leakage and the occurrence of pitting were examined during period of storage. For each measurement, 4 fruits were used.

RESULTS AND DISCUSSIONS

Pitting and other quality evaluation

Pitting was observed for fruits stored at 5°C at days 6. For fruits stored at 25°C, a white color at the middle of the longitudinal axis cut of cucumber fruits was observed for all samples (5 days), this might be caused by the dehydration of fruits due to the deterioration process during storage. The weight loss after 9 days for the fruits stored at 25 and 5°C was 2.5% and 1.5%, respectively (Figure 1). The weight loss for both conditions was almost the same; therefore, it thought that the pitting for fruits at 5°C was because of the impact of low temperature. Water loss, i.e. weight loss, has a close relationship to membrane water permeability.

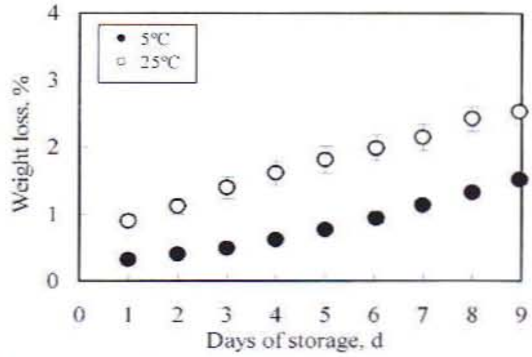

Figure. 1. Weight loss of cucumber fruits stored at 5°C and 25 °C

Change in pH

The change in pH during storage at both condition of 5 and 25°C was slightly (Figure 2). The increasing tendency of pH was observed for fruits stored at 5°C with the value at storage time of 9 days were higher than that at 25°C. The increase in pH could be thought as the change in acid content which indicate the occurrence of chilling injury.

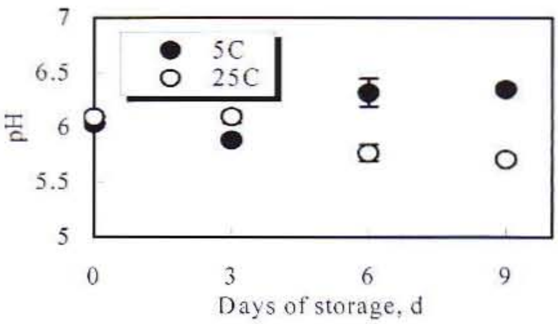

Figure 2. Change in pH

Change in ion leakage

After 20 min, the slope of the change in percentage of ion leakage was not extremely as occur in the first 20 min. However, the rate of ion leakage for fruits stored at 5 °C was higher than that at 25°C. This indicates that impact of chilling changed the membrane permeability. The extremely difference in percentage of ion leakage was observed at storage time of 9 days which show that the percentage of ion leakage reached to 87% at 60 min for 5°C and 39% for 25°C (Figure 3).

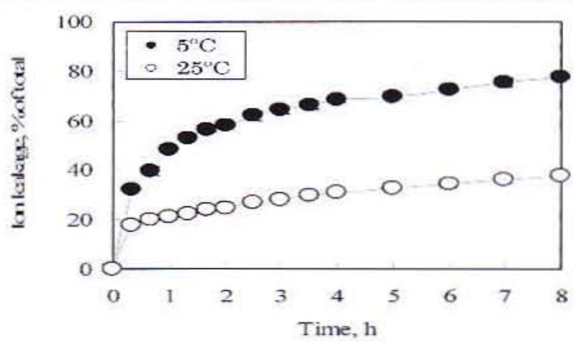

Figure 3. Change in ion leakage

Change in T_1 relaxation time

The change in T_1 relaxation time at condition of 5C indicates the change in water movement in the cell due to the physical change in membrane permeability. Impact of chilling is thought to be a cause of the increase in membrane permeability (Lyons, 1973), in this study was indicated by the extremely increase in the value of T_1 relaxation time. It was shown that the dynamic state of water in cucumber fruits changed into a different state at the chilling temperature. In other word, T_1 relaxation times became longer at the incipient stage of chilling injury during physiological change such as pitting of fruits could not be detected by visual inspection. The variation in T_1 relaxation time was thought to be due to the increase in membrane permeability in relation to chilling temperature (Figure 4).

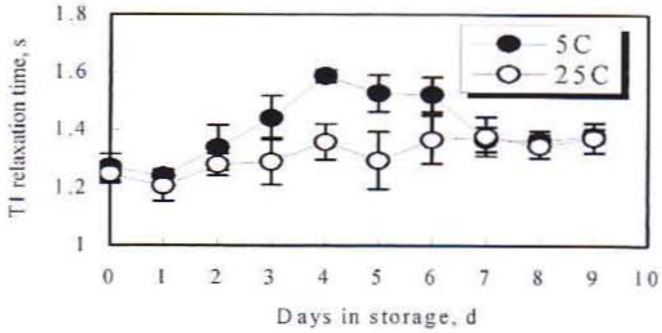

Figure 4. Change in T_1 relaxation time

CONCLUSIONS

Longer T_1 relaxation time in chilling temperature indicates the change in the dynamic state of water which is related to the increase in membrane permeability. This is thought to be the occurrence of chilling injury. Impact of chilling injury can also be detected from the change in pH, ion leakage and weight loss. Finally, the dynamic state of water which showed through the change in T_1 relaxation time could be applied to detect the early symptom of chilling injury.

ACKNOWLEDGEMENTS

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