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SHORT COMMUNICATION

Changes in Ethylene Production and Flesh Firmness of Melting, Nonmelting and Stony Hard Peaches after Harvest

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Summary

We examined changes in ethylene production and flesh firmness after the harvest of three peach [*Prunus persica* (L.) Batsch] cultivars: a melting cultivar 'Hakuho', a nonmelting cultivar 'Early Gold' and a stony hard cultivar 'Yumyeong'. The melting and nonmelting cultivars showed increases in ethylene production and drops in flesh firmness, although their degrees differed, whereas the stony hard cultivar produced little or no ethylene and remained firm during storage. Hence, the latter apparently has different ripening characteristics from the former two cultivars. Stony hard is a mutant in ethylene production and, thus, may be used as a genetic source for improving keeping quality of dessert peaches.

Key Words: ethylene, peach, stony hard, texture.

Introduction

Peaches [*Prunus persica* (L.) Batsch] are broadly classified by their flesh texture into melting and nonmelting groups. The former groups soften on trees or soon after harvest, whereas the latter are characterized by a slow softening rate and without notable decrease in flesh firmness even when overripe (Connors, 1922, 1928). Genetically, the melting and nonmelting characters are controlled by a single allele; the former is dominant over the latter (Bailey and French, 1949). Most dessert peaches, which are eaten fresh, belong to the melting group, whereas the nonmelting cultivars are more suitable for canning and processing. Occasionally cross breeding among melting cultivars produces peaches that hardly soften on trees or after harvest (Yoshida, 1976). Yoshida (1976) called this trait stony hard; he reported that the flesh hardly softened after harvest but melted like melting cultivars when heated. Therefore, the stony hard peaches do not belong to either melting or nonmelting group, but their physiological characteristics are little understood.

This study examined the ripening characteristics with respect to ethylene production and flesh firmness after harvest of melting, nonmelting, and stony hard cultivars.

Materials and Methods

Tests were conducted in 1999 on 'Hakuho', 'Early Gold' and 'Yumyeong' that were growing at the National Institute of Fruit Tree Science. 'Hakuho' is a melting cultivar, and 'Early Gold' a nonmelting cultivar. 'Yumyeong', a cultivar bred in Korea by crossing 'Yamatowase' and 'Nunomewase' (Kim et al., 1978), was introduced into Japan in 1985. 'Yumyeong' was judged to be stony hard-types because it fails soften but otherwise has excellent keeping quality both on the tree and after harvest.

The optimum time of harvesting was determined based on the size and ground color of the fruit skin. 'Early Gold', 'Hakuho' and 'Yumyeong' were harvested 95, 102, and 137 days after full bloom (AFB), respectively. The ripe fruits were stored at 25 ℃ and their firmness and ethylene production monitored daily on 5 fruits of each cultivar from harvest for eight days. After removing the skin along the equatorial diameter of a fruit, the firmness was determined by a fruit pressure tester (Italtest, FT011) with plunger of 8 mm in diameter. The ethylene production was determined by incubating one fruit in a sealed dessicator (1.5 liter) for 2 hr at 25 ℃. A 1.0-ml sample of the gas was withdrawn with a syringe and injected into a gas chromotagraph (Shimadzu GC-9A) equipped with a flame ionization detector. Helium was used as carrier gas, and activated alumina as column packing. The column and injector temperatures were 80 ℃ and 100 ℃, respectively.

Results and Discussion

Data on ethylene production and flesh firmness (Fig. 1) revealed that in 'Hakuho' ethylene production increased steeply from 1.4 to 17.9 nl · gFW^{-1} · hr^{-1} while firmness dropped from 4.3 to 0.8 kg during the first day after harvest. Two days later, the ethylene production was 34.3 nl · gFW^{-1} · hr^{-1}, while firmness was 0.4 kg on

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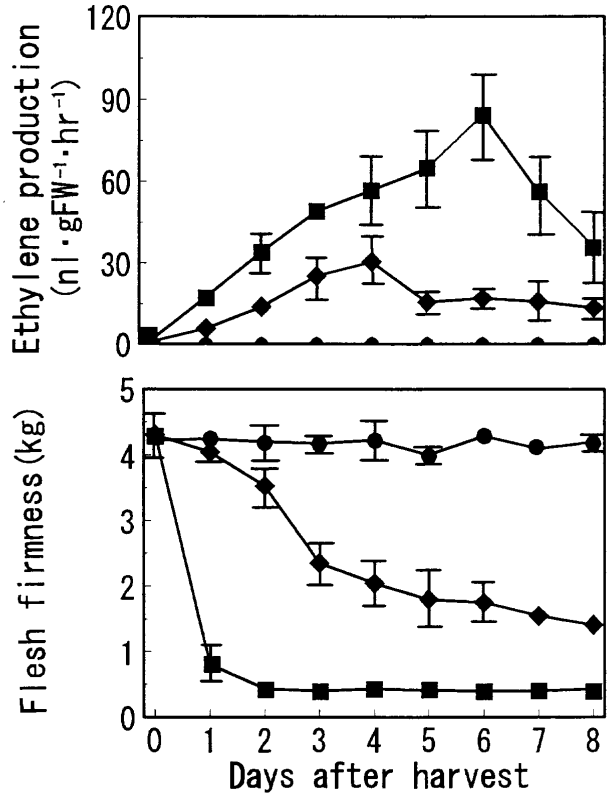

Fig. 1. Changes in ethylene production and flesh firmness in peach fruit stored at 25 ℃. Vertical bars represent SE (n=5).
■ : Hakuho (melting), ◆ :Early Gold (nonmelting), ● :Yumyeong (stony hard).

completely soft fruits. Ethylene production continued to increase thereafter and reached a peak of 84.5 nl・gFW^{-1}・hr^{-1} six days after harvest.

In 'Early Gold', ethylene production was 1.0 nl・gFW^{-1}・hr^{-1} while flesh firmness was 4.3 kg on the day of harvest. Ethylene production continued to increase until the fourth day after harvest, attaining a peak of 30.5 nl・gFW^{-1}・hr^{-1}. Fruits softened gradually during storage becoming 1.4 kg eight days after harvest.

Flesh firmness of 'Yumyeong' which was 4.2 kg on the day of harvest, did not decrease during storage even eight days after harvest. No ethylene was detected during the eight days of postharvest storage.

The difference in softening between melting and nonmelting cultivars is attributed to the presence of both endo- and exo-polygalacturonase (PG) in melting cultivars whereas nonmelting cultivars have only exo-polygalacturonase (Pressey and Avants, 1978). Ethylene is a plant hormone that controls ripening of fruits. In recombinant or mutant tomatoes which produce no ethylene, PG activities are suppressed (Bryant and Cuming, 1999). Our results indicate that (1) the difference in softening between the melting and nonmelting cultivars is also attributable to the difference in the activity of these softening enzymes that ethylene induces, and (2) softening of the stony hard cultivar is suppressed because ethylene production is inhibited.

Dessert peaches with their melting texture soften rapidly while ripening and, therefore, are easily bruised. Improving eating and keeping qualities are important goals in dessert peach breeding. Because inhibition of ethylene production by gene recombination is a novel method for improving the keeping quality (Grierson, 1998), stony hard cultivars may be useful as a gene source. Thus, we plan to study the inhibition mechanisms of ethylene production, responses to exogenous ethylene, and hereditary traits of peaches.

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溶質，不溶質および硬肉モモ品種の収穫後における果肉硬度とエチレン生成量の変化

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摘　要

モモの溶質品種'白鳳'，不溶質品種'アーリーゴールド'，および硬肉品種'有明'を供試し，収穫後における果肉硬度とエチレン生成量の推移を調査した．溶質品種と不溶質品種では程度の違いはあるものの，果肉硬度の低下とエチレン生成量の増加が認められるのに対して，硬肉品種では果肉硬度の低下とエチレン生成が認められず，溶質および不溶質品種とは明確に異なる成熟特性を示すことが明らかになった．このように硬肉品種はエチレン生成に関する変異体であり，生食用モモ品種の日持ち性向上育種を進める上で有用な形質と考えられる．