

Abstract:

According to their ripening characteristics, fruits can be classified as climacteric or non-climacteric. Climacteric fruits are characterized by increases in ethylene production and respiration rates at the onset of ripening, whereas non-climacteric fruits do not exhibit these characteristics. The ethylene levels in cultivated Japanese pear fruit were shown to vary from 0.1 to 300 μ l C₂H₄/kg. f.w./hr. during ripening. The shelf life of Japanese pear fruit is determined by its level of ethylene production.

Genes involved in the ethylene biosynthetic pathway were isolated to elucidate the cause of the differences in ethylene production between cultivars. Three ACC synthase genes (PPACS1, PPACS2, PPACS3) and one ACC oxidase gene (PPAOX1) were isolated. PPACS1 was shown to be specifically expressed in the cultivars with a high ethylene production level ($\geq 10\mu$ l/kg f.w./hr) and PPACS2 was shown to be specifically expressed in the cultivars with moderate ethylene production levels (0.5 μ l/kg f.w./hr~10 μ l/kg f.w./hr) during fruit ripening.

Using genes encoding for ethylene biosynthetic enzymes as probes, RFLP analysis was conducted. RFLP markers tightly linked to the locus conferring the ethylene evolution rate of ripening fruit in Japanese pear were identified, using RFLP analysis with two ACC synthase genes (PPACS1 and PPACS2). RFLPs were designated as A (2.8kb of PPACS1), linked to high levels of ethylene ($\geq 10\mu$ l/kg f.w./hr) and B (0.8kb of PPACS2), linked to moderate levels of ethylene (0.5 μ l/kg f.w./hr~10 μ l/kg f.w./hr), when the total DNA was digested by HindIII. Four RFLP types (AB, Ab, aB, ab) were identified based on RFLPs using this gene diagnosis. The maximum ethylene level during fruit ripening in Japanese pear was proposed to be regulated mainly by the expression of these two ACC synthase genes and the action of A to mask that of B due to its much higher level of expression. This RFLP analysis was applicable to Chinese pear cultivars. This RFLP with two ACC synthase genes is very useful for breeding strategies to improve storage ability in Japanese pear.