Title Expression profiles of the *MdACS3* gene suggest a function as an accelerator of apple (*Malus* × *domestica*) fruit ripening

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Abstract

Ethylene plays an important role in apple fruit development and its biosynthesis is catalyzed by the two enzymes ACS (1-aminocyclopropane-1-carboxylate synthase) and ACO (1-aminocyclopropane-1-carboxylic acid oxidase). Within the apple ACS gene family, at least two members, *MdACS1* and *MdACS3,* are expressed in apple fruit tissues. While *MdACS1* expresses only at late ripening stages corresponding to a sudden increase of ethylene production, a typical feature of system-II ethylene biosynthesis, the expression of *MdACS3* can be detected as early as 6 weeks before physiological maturity. The objective of this study was to characterize the cultivar-specific dynamics of *MdACS3* expression at both preharvest and postharvest stages, its relationship with *MdACS1* activation, and its roles in apple fruit ripening and quality. Based on the transcript profiles during 8-week on-tree maturation and ripening, two *MdACS3* expression patterns could be clustered among 12 apple cultivars. Most of the cultivars in pattern 1 showed high level expression with a steadily increasing trend, and most of those in pattern 2 exhibited low level expression with a transient peak at or before physiological maturity. These two expression patterns appeared to correlate with fruit ripening season and fruit firmness change during ripening. Unlike *MdACS1*, the expression of *MdACS3* was stimulated by 1-MCP treatment, indicating a negative feedback regulation mechanism.