Use of 1-MCP to Extend Postharvest Life of Hardykiwi Fruit and Anticancer Effect of the Fruit Extract

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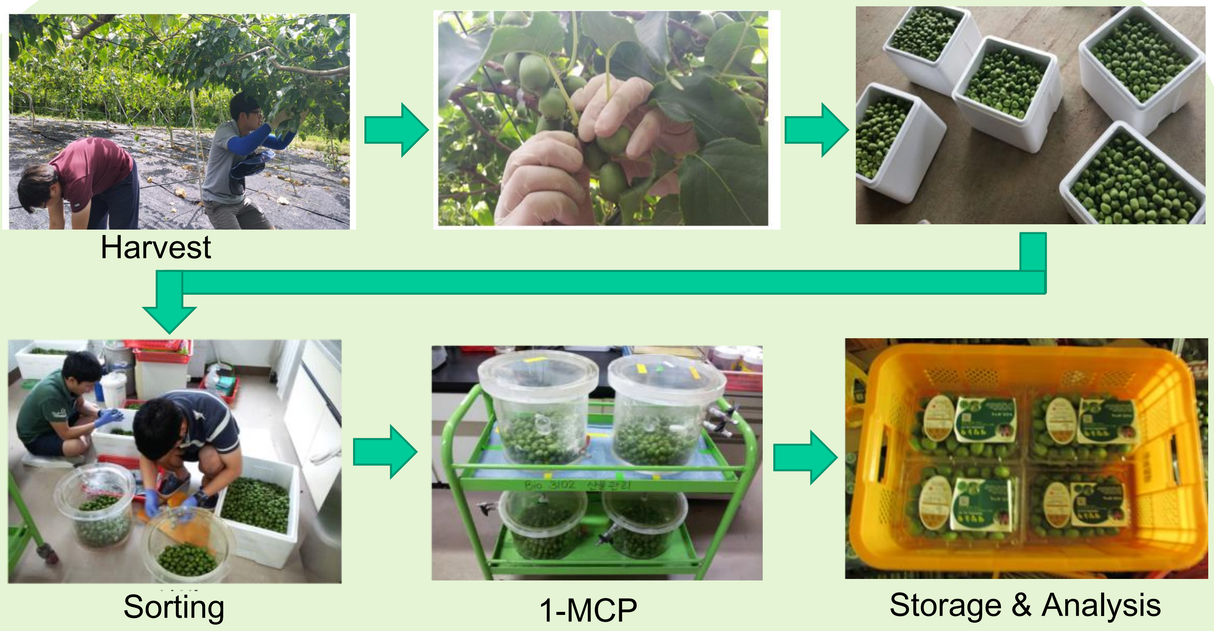
Abstract

The hardy kiwifruit (*Actinidia arguta* cv 'Cheongsan'), which was bred in Korea in 2005, has recently become popular in the market as demands for new tastes and healthy food increase. However, fruit distribution to the market is limited by rapid fruit ripening after harvest. To delay fruit ripening, hardy kiwifruits were treated with 20 mL/L 1-MCP for 16 h at 10 °C and subsequently stored at 1 ± 0.5 °C. Physicochemical changes and expressions of fruit ripening-related genes (*AcACO*, *AcACS*, and *AcLOX*) were analyzed. The anticancer properties of the fruit extracts were tested against five types of human cancer cells. The hardy kiwifruits without 1-MCP treatment showed increases in both respiration and ethylene production rates during fruit storage at 1 ± 0.5 °C. The 1-MCP treatment remarkably inhibited fruit ripening by reducing respiration and ethylene production rates. Transcript levels of *AcACO*, *AcACS*, and *AcLOX* were down-regulated by the 1-MCP treatment. Fruits with the 1-MCP treatment could be stored for up to five weeks by maintaining higher fruit firmness, ascorbic acid levels, and total phenolic contents compared to the control, which lost marketability completely due to over-ripening. The hardy kiwifruit extracts showed proliferative inhibitory effects to Hep3B and HeLa cells but not to HT29, HepG2, and LoVo cells.

Conclusion: These results suggest that the application of 1-MCP at harvest effectively delayed the ripening process of the hardy kiwifruits, and the fruit extract had beneficial effects for the prevention of human cancer cell growth.

Material & Methods



- Cultivar: *Actinidia arguta* cv 'Cheongsan'
- Harvest: 83 days after flowering
- 1-MCP treatment: 20 ppb 1-MCP, 8 hours at 10 °C
- Storage: 1±0.5 °C, RH 92~95%, PP box package
- Analysis: Respiration, ethylene production, ethylene biosynthesis gene expression (*AcACO, AcACO, AcLOX*), MTT assay (human cancer cell lines: Hep3B, HeLa, HT29, HepG2, LoVO cells)
- Fruit extracts: 80% MeOH by Soxhlet at 55~65 °C for 16 hours

Table 1. Primer sequences used for RT-PCR and RT-qPCR analyses of *AcACS, AcACO, AcLOX,* and *AcACT* in *Actinidia aruguta* 'Cheongsan'.

Gene	Accession number	Forward primer sequence (5'→3')	Reversed primer sequence (3'→5')
AcACS	AB007449	CAACCTCCTGCTCACGTTCA	GTTGGAGTATATGGCCCCGA
AcACO	JQ062390	TGCTTGTGAGAACTGGGGCTT	GCGCAAGAAGAAGGTGCTTTC
AcLOX	AB300613	CATGCAGTAATCGAGCCATTC	CAGCCGGGAGTGCCTGCTCTG
AcACT	DQ682826	ACCTTGCTGGCCGTGATCTA	AGCTCCAATTGTGATGACCTGA

Results

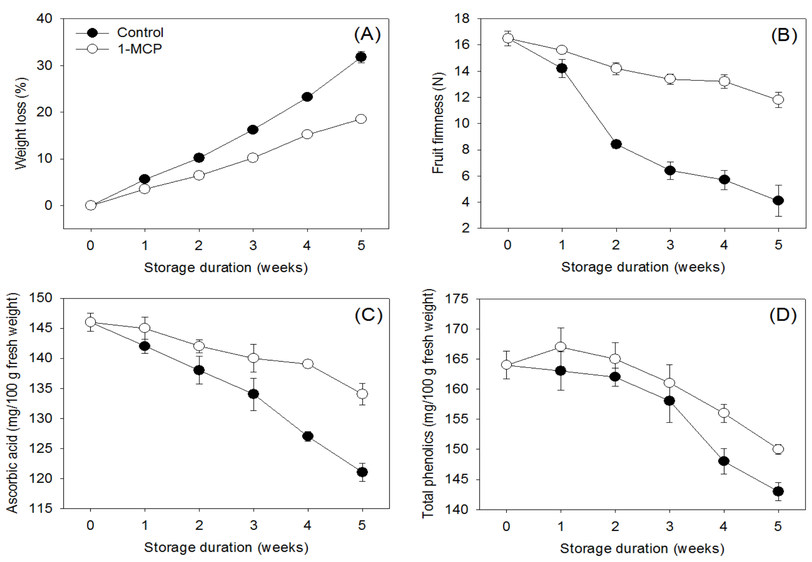


Figure 1. Quality changes of hardy kiwifruits stored at 1 ± 0.5 °C for five weeks. Data were expressed as means ± standard deviations of three replicates.

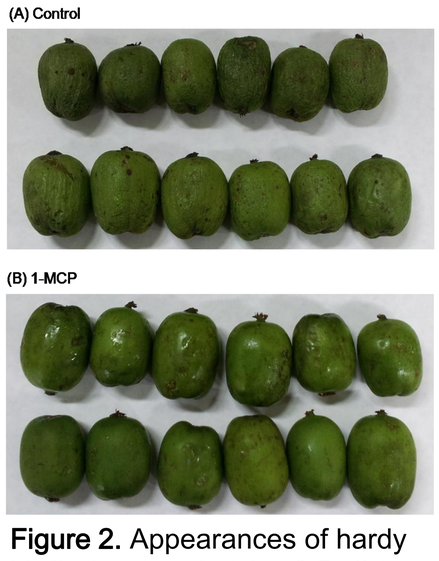


Figure 2. Appearances of hardy kiwifruits stored at 1 ± 0.5 °C for five weeks.

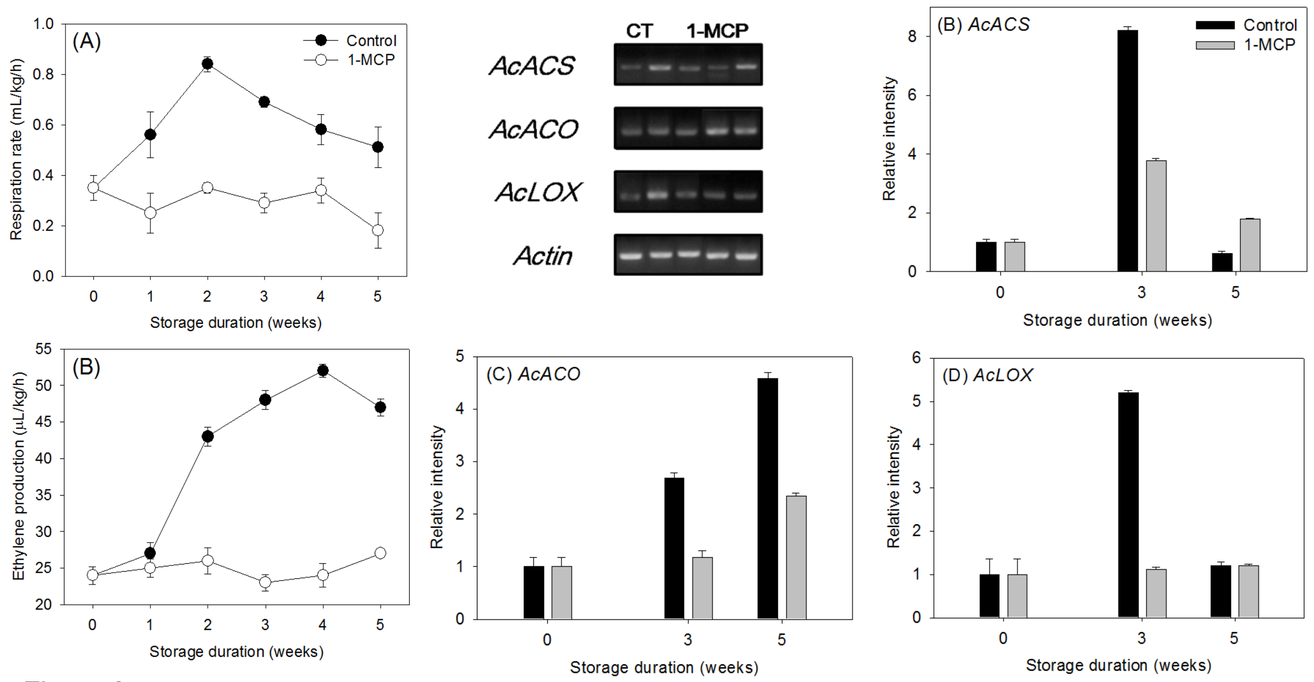
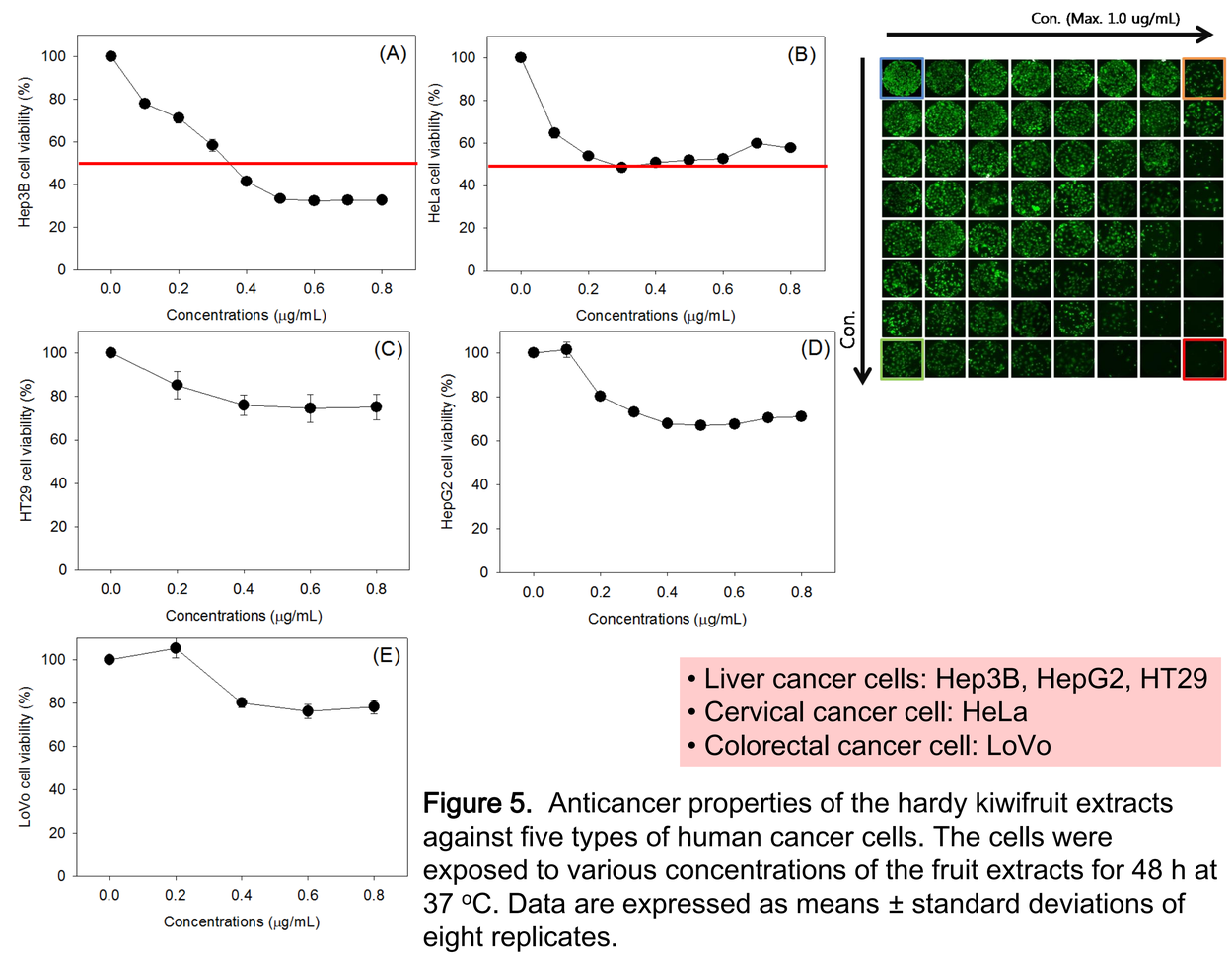


Figure 3. Respiration rate and ethylene production of hardy kiwifruits stored at 1 ± 0.5 °C for five weeks. Data are expressed as means ± standard deviations of three replicates.

Figure 4. RT-PCR and RT-qPCR analyses of ripening-related genes (*AcACS, AcACO*, and *AcLOX*) of hardy kiwifruits stored at 1 ± 0.5 °C for five weeks. Data are expressed as means ± standard deviations of three replicates.



- Liver cancer cells: Hep3B, HepG2, HT29
- Cervical cancer cell: HeLa
- Colorectal cancer cell: LoVo

Figure 5. Anticancer properties of the hardy kiwifruit extracts against five types of human cancer cells. The cells were exposed to various concentrations of the fruit extracts for 48 h at 37 °C. Data are expressed as means ± standard deviations of eight replicates.

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