Title The role of ethylene in kiwifruit ripening and senescence

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Abstract

Purpose of review: Kiwifruit cv. 'Hayward' is considered a fruit with typical climacteric behaviour. Healthy fruit display climacteric behaviour at ambient temperature (~20°C) and non-climacteric behaviour at temperatures ≤10°C. However, it is extremely sensitive to ethylene action even at low temperatures. The behaviour of kiwifruit in relation to ethylene sensitivity and ethylene production is of great importance for long-term storage. This paper discusses the most recent findings concerning the role of ethylene in kiwifruit ripening and senescence.

Main findings: Kiwifruit senses propylene at temperatures ranging from 15 to 34°C by advancing the onset of ripening and respiration, while the ethylene burst occurs late in the ripening process. The main reason for late ethylene production is the tardy increase of 1-aminocyclopropane-1-carboxylate synthase (ACCS) activity. The lag period for ethylene production decreases as temperature increases. Propylene-treated kiwifruit show reduced ethylene production at 38°C and almost none at 40°C. 1-Aminocyclopropane-1-carboxylate oxidase (ACCO) is the first enzyme to be affected at high temperatures, followed by ACCS. Below a critical temperature range (11-14.5°C), kiwifruit lacks the ability to produce ethylene even when treated with propylene. The main reasons for the inhibition of ethylene production at 10°C are primarily due to the suppression of the propylene-induced ACCS gene expression and low ACCO activity. However, wounded or *Botrytis*-infected fruits produce ethylene at low temperatures. A period of about 12 days at low temperature induces autocatalysis of ethylene upon re-warming of kiwifruit, while around 19 days are required when fruit is held continuously at ambient temperatures. Low temperatures slow ripening, while high temperatures block or cause abnormal ripening. Controlled atmosphere (CA) storage in 2% O_2 + 5% CO_2 and ultra low oxygen (ULO) storage with 1% O_2 + 1% CO_2 increases storage life compared with conventional storage (CS). Prolonged storage for 60 days at 0°C induces ACCS activity but not that of ACCO. Upon re-warming, only fruit stored under CS and CA produced ethylene. ULO-treated fruit lost the ability to produce ethylene, mostly due to reduced ACCO activity.

Directions for future research: The atypical behaviour of kiwifruit in relation to ethylene sensitivity and ethylene production at different temperatures and atmosphere

compositions makes this fruit a good system for studying the ethylene biosynthetic pathway, and its regulation and action on fruit ripening and senescence. Although some efforts have been made to clarify this behaviour at the physiological level, the means by which the genes of the enzymes of ethylene biosynthesis pathway are regulated in kiwifruit need further research.