Effects of 1-methylcyclopropene (1-MCP) on shelf life and quality of Cavendish bananas

Farid Moradinezhad

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School of Agriculture, Food and Wine

Faculty of Sciences

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Summary

Banana quality and shelf life are variable and often insufficient to meet the needs of marketers and consumers. Hence, postharvest treatment by 1-methylcyclopropene (1-MCP) may be variable. This study examined how the efficacy of 1-MCP varies throughout the year; the effect of concentration, duration and timing of ethylene application; the effect of hand position on the bunch; the timing of 1-MCP application in relation to ripening and harvest time; and the effect of ripening storage temperatures and chilling storage. Additionally, impact of 1-MCP treatment on ethylene synthesis was studied. All studies used Cavendish cv. Williams bananas grown on a single property in Innisfail, north Queensland, harvested at 75 to 80% maturity (when they were hard and green) and then transported at 14 °C to Adelaide.

When examining the effect of 24 h application of different concentrations of 1-MCP (0 to 10000 nL L^{-1}) prior to storage at 22 °C to partially ripened bananas throughout the year, 1-MCP at a concentration of 300 nL L^{-1} increased shelf life significantly in fruit harvested in different months across the year except March where 3000 nL L^{-1} was required. Fruit harvested in May was significantly more responsive with a greater than two-fold increase in shelf life. Firmness of 1-MCP treated fruit was up to 19% greater than the control across the year. Lower levels of weight loss and discolouration were observed in 1-

MCP-treated fruit regardless of harvest time while 1-MCP had no effect on total soluble solids (TSS).

Early-climacteric 1-MCP treatment significantly increased shelf life to a greater extent in fruit from the top of the bunch compared with fruit from the bottom of the bunch. While 1-MCP was effective on fruit from the top of the bunch regardless of the time of year fruit was harvested, it was only effective on fruit harvested from the bottom of the bunch in October and April.

Concentration and the duration of ethylene exposure had impact on efficacy of 1-MCP. 1-MCP was most effective at increasing shelf life and firmness when fruit were treated with 100 $\mu L\ L^{-1}$ ethylene for the first day and 2 $\mu L\ L^{-1}$ for the second day. Winter-harvested bananas that were exposed to 100 $\mu L\ L^{-1}$ ethylene for 50 h had a longer shelf life compared to bananas treated for 40 h. 1-MCP was only more effective in summer-harvested fruit when they were exposed to ethylene for 40 h with an increase in firmness. 1-MCP did not affect weight loss or discolouration when fruit were treated with ethylene at different concentrations or duration.

Simultaneous application of 1-MCP (30 $nL\ L^{-1}$) with ethylene (100 $\mu L\ L^{-1}$) in the second day and reapplication of 1-MCP (300 $nL\ L^{-1}$) alone in the third day more than doubled banana shelf life. When bananas were treated with 100 $\mu L\ L^{-1}$ ethylene for two days followed by 1-MCP for 24 h and ripened at 16 and 19 °C shelf life was extended significantly but not at 22 or 25 °C. Pre-

ripening chilling temperature (5 °C) also decreased shelf life to a greater extent than when fruit were stored at 15 °C.

Measuring activity of ethylene biosynthesis enzymes during ripening showed that pulp and the peel of bananas respond differently to ethylene and 1-MCP treatment with a greater and quicker impact on peel than the pulp. The findings of this study allow 1-MCP to be used in a more commercially reliable manner.

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