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EFFECT OF 1-METHYLCYCLOPROPENE AND OZONE ON THE QUALITY OF BROCCOLI

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Fresh broccoli florets (*Brassica oleracea* L. Italica group) were treated with or without 1 $\mu L \cdot L^{-1}$ methylcyclopropene (1-MCP) for 14h, and then stored at 10 °C with 0, 200, or 700 $nL \cdot L^{-1}$ ozone. Samples were evaluated after 1, 2, 5, 8, or 12 days of storage. Treatments with 1-MCP delayed the yellowing of florets, and at day 5 the hue angle of 1-MCP treated florets was 116 compared with 102 for the controls. Respiration rate of florets was reduced by 1-MCP for the first 5 days and ethylene production was stimulated during the first 2 days following treatment. The 1-MCP treatment maintained higher chlorophyll fluorescence expressed as Fv/Fm during 12 days of storage. Also, 1-MCP inhibited dimethyl trisulfide production, which contributes to off-odor development in broccoli florets. Compared with the controls, florets stored in 200 nL*L-1 ozone had less mold growth, but no differences were observed in color, respiration, ethylene production, or chlorophyll fluorescence. Florets stored in 700 $nL \cdot L^{-1}$ ozone were greener at day 12 than florets held in air or 200 $nL \cdot L^{-1}$ ozone, but interestingly, chlorophyll fluorescence decreased significantly. At day 12, Fv/Fm was only 30% of its initial value. Storage in 700 $nL \cdot L^{-1}$ ozone stimulated respiration and ethylene production of florets after 1 day of storage, and caused stem browning of florets. A synergistic effect of 700 $nL \cdot L^{-1}$ ozone and 1-MCP on respiration and ethylene production was found. The 1-MCP, 200 $nL \cdot L^{-1}$ ozone, and 200 $nL \cdot L^{-1}$ ozone plus 1-MCP treatments were considered to be suitable to maintain the quality and extend the shelf-life of broccoli florets stored at 10 °C.

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OZONE AND 1-METHYLCYCLOPROPENE TREATMENTS AFFECT QUALITY AND THE STORAGE LIFE OF FRESH CARROTS

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Fresh carrots (*Daucus carota* L.) were treated with or without 1.0 $\mu L \cdot L^{-1}$ 1-methylcyclopropene (1-MCP) for 16 hours before storage or after 3 months of storage at 0 °C, and then exposed to 0, 300, or 1000 $nL \cdot L^{-1}$ ozone at 10 °C for 0, 1, 2, or 4 days. The carrots were stored at 0 °C for up to 6 months. Decay and mold incidence, electrolyte leakage, surface discoloration, and 6-Methoxymellein (6-MM) content in the peel tissue of carrots were evaluated. While no decay of the roots was observed, the incidence of saprophytic mold on the crowns was reduced during the first 2 months of storage, following the 300 $nL \cdot L^{-1}$ ozone treatments of 1, 2, or 4 days. A similar effect was found on the carrots treated after 3 months. The 1000 $nL \cdot L^{-1}$ ozone treatments for 2 or 4 days caused severe tissue injury resulting in the highest mold incidence of 65% after 6 months of storage. The 1000 $nL \cdot L^{-1}$ ozone also induced a greater rate of electrolyte leakage in the peel and caused surface discoloration. The discoloration index, using a scale of 0 (absent) to 3 (severe), was 1.55 compared to 0.3 for those treated with 300 $nL \cdot L^{-1}$ ozone. Bitterness, which results from the accumulation of 6-MM, was affected by the concentration of ozone and the treatment time. Treatments of 300 and 1000 $nL \cdot L^{-1}$ ozone for 4 days induced 6-MM production in carrot peels reaching concentrations as high as 180 and 365 $\mu g \cdot g^{-1}$, respectively. Treatment with 1-MCP effectively prevented bitterness induced by the ozone treatments. 6-MM remained below 150 $\mu g \cdot g^{-1}$ in carrots treated with 1-MCP and 1000 $nL \cdot L^{-1}$ ozone for 4 days.

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EFFECTS OF MCP AND 1.52 KPA OXYGEN ON APPLE SCALD CONTROL AND ALPHA-FARNESENE BIOSYNTHESIS

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In the past 4 years we have studied the effects of MCP on scald control in "Granny Smith," "Rome," and "Red Delicious" apples, which are susceptible to scald, and in "Gala" and "Braeburn" cultivars, which are scald-resistant. Application of MCP and 1.52 kPa oxygen immediately after harvest inhibited development of the disorder during 180-220 days storage at 1 °C followed by 10-15 days at room temperature in all cultivars. This was accompanied by a strong inhibition of the increase in α-farnesene and conjugated trienols. The effectiveness of MCP in controlling scald in "Granny Smith" apples was attenuated whenever its application was delayed. Furthermore, in "Red Delicious", if the onset of the ethylene climacteric had been initiated at harvest the effectiveness of MCP was greatly diminished. We have cloned the genes of 3- methyl-3-hydroxyl glutaryl-CoA reductase (HMGR1) and the pharnesenyl-pyrophosphate synthase (FPPS) of the mevalonate pathway of *-farnesene synthesis. The expression of either of these genes does not appear to be inhibited by MCP despite the strong inhibition of the rise in a-farnesene content. 1.52 KPa of oxygen strongly enhances the expression of HMGR1. In fact the expression of HMGR1 parallels that of ADH at different O_2 concentrations. Low oxygen does indeed inhibit the accumulation of FPPS transcripts.

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EFFECTS OF MCP AND HYPOXIA ON ETHYLENE EVOLUTION AND EXPRESSION OF GENES INVOLVED IN ETHYLENE BIOSYNTHESIS AND PERCEPTION

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Low uxygen (1.53 KPa) and MCP suppressed onset of the ethylene climacteric in "Gala" and "Granny Smith" apples for 250 days. This was associated with a strong inhibition in accumulation of ACS-synthase (ACS) transcripts, while their effect on the amount of ACC-oxidase (ACO) mRNA was marginal. Neither treatment had any effect on the expression of ETR1, whereas there was a strong inhibition of the increase in the ERS1 type of C_2H_4 receptor that occurred in control fruits. The effectiveness of MCP in retarding the ethylene onset depends on fruit maturity. In 1999 MCP retarded onset of the ethylene climacteric in "Red Delicious" apples for longer than 220 d. However, in 2000 initiation of the ethylene climacteric had already started at harvest, and the retardation by MCP of the rise in ethylene evolution was greatly attenuated. Furthermore, with the rise in ethylene evolution in MCP-treated fruits there was an increase in the transcripts of both ACS and ERS1. Similar results were observed with "Rome Beauty" fruits. Both MCP and 1.52 kPa had no effect on the rate of System 1 ethylene evolution.

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SHIPPING AND ETHYLENE EFFECTS ON FLOWER BUD ABSCISSION IN POTTED HIBISCUS

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Shipping potted flowering hibiscus (*Hibiscus rosa-sinensis*) is a commercial problem due to abscission of flowers and buds. A series of experiments was conducted to evaluate factors affecting bud drop during shipping. Flower buds were divided into six developmental stages with stage 1 being the smallest (<1 cm) and stage 6 an open flower. When 'Pink Versicolor' was shipped for 2, 4 or 6 days at temperatures of 13, 18, or 25 °C, a three-way interaction (P = <0.0001) between shipping, temperature and bud stage was found. The stage 5 and 6 buds went through normal development and senescence under all conditions. However, abscission of undeveloped stage 1 and 2 buds increased with temperature and shipping duration. When plants were exposed to ethylene, stage 5 and 6 buds abscised quickly without undergoing normal development. There was not a difference between exposure to 1 or 3 ppm of ethylene. Even at 3 ppm, the stage 1 and 2 buds did not abscise and continued normal development. These studies showed that hibiscus are sensitive to ethylene, which can result in loss of larger buds and flowers. However, the pattern of flower bud drop during shipping was not found to be parallel to flower bud drop on plants exposed to ethylene.