Expression and protein levels of ethylene receptors, CTRs and EIN2 during tomato fruit ripening as affected by 1- MCP

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Abstract

Many studies have focused on the plant hormone ethylene because of its key role in controlling, among others, climacteric fruit ripening and fruit senescence. These processes can be controlled by applying 1-MCP, which tightly binds to the ethylene receptors thereby blocking the ethylene signaling pathway. 1-MCP is known to inhibit the action of ethylene and to delay the climacteric ripening of tomato fruit. Less is known about its long term effect when the inhibitory effect 1-MCP inhibition is eventually released. Our objective was to study this transient 1-MCP inhibition during tomato fruit ripening in terms of fruit quality, ethylene production, respiration rate and the expression and protein abundance of receptors, CTRs and EIN2. For the identification and quantification of proteins, we used an LC–MS based targeted method of Parallel Reaction Monitoring (PRM), while gene expression was done using real time qPCR. Different color stages of tomatoes were harvested and treated with 1-MCP and subsequently stored to follow up postharvest fruit ripening. The difference with previous 1-MCP studies is that we sampled 1-MCP treated tomatoes at different physiological stages during ripening (and not time), matching the color stages of the untreated control fruit. This allows to properly compare the underlying regulation of the ethylene signaling pathway during a 1-MCP-mediated suppression of ripening. We hypothesized that the levels of the ethylene signaling components would be different for 1-MCP treated fruit due to a reduced ethylene-mediated autocatalytic feed-back. Our results showed that fruit treated with 1-MCP at mature green stage showed a lower respiration rate during subsequent ripening as compared to the untreated fruit, suggesting that climacteric ripening was effectively inhibited by 1-MCP. However, these 1-MCP treated fruit showed a higher ethylene production as compared to untreated fruit. The 1-MCP treated fruit also showed lower

to equal levels of gene expression and protein abundance of the ethylene receptors, CTRs and EIN2. As receptors and CTRs are negative regulators of ethylene signaling, decreasing the production of new signaling proteins could subsequently activate downstream ethylene signaling and with that expression of downstream genes. This could lead to higher ethylene production levels, which in turn can compensate 1-MCP mediated inhibition of fruit ripening.