

Breaking the ripening barrier in 'Rocha' pears treated with 1-MCP: the role of abscisic and glyoxylic acids

Extending the cold storage of 'Rocha' pears through 1-methylcyclopropene (1-MCP) and controlled atmosphere storage is a widely used strategy to prevent postharvest disorders. However, this approach inhibits natural fruit ripening, often compromising consumer quality and presenting a significant challenge to the fruit industry. Basically, 1-MCP binds to the ethylene receptor proteins found in fruit, not allowing ethylene to bind, and triggering the ripening response. Recently, several studies, strategies to mitigate the antagonist ripening effect of 1-MCP have been attempted. In this study, we investigated the potential of abscisic acid (ABA) and glyoxylic acid (GLA) to counteract the antagonist effects of 1-MCP and restore normal ripening. 'Rocha' pears treated with 1-MCP were immersed in ABA or GLA solutions, respectively, and stored at 20 ± 2 °C for 15 days. Ripening indicators, including firmness, skin color, ethylene and volatile organic compound (VOC) production, sugar content, and the expression of ethylene-related genes (PcACS, PcACO, PcETR1, PcETR2, and PcETR5), were assessed throughout storage. Our multivariate and clustering analysis revealed that ABA effectively disrupted the 1-MCP-induced ripening inhibition, significantly boosting ethylene production and, consequently, promoting fruit softening, degreening, sugar accumulation, and specific pear-ripening volatile emissions. These changes were justified by the significant measured increased expression of ethylene biosynthesis (PcACS, PcACO) and receptor (PcETR2) genes, highlighting ABA's pivotal role in reactivating ethylene perception, signaling, metabolism and, therefore, the ripening process. In contrast, GLA did not promote an increase in ethylene production or other ripening-related changes, likely due to limited ACC synthase activity. Interestingly, GLA-treated fruits showed elevated respiration rates and higher levels of hexanal, (E)-2-hexenal, and ethanol compared to the control, indicating an influence on alternative stressed metabolic pathways unrelated to ripening. This study sheds light on the regulatory interplay between ABA, GLA, and fruit ripening, providing innovative strategies to overcome ripening inhibition caused by 1-MCP in climacteric fruits, with particular focus on 'Rocha' pear.