Physiological role of reactive oxygen species, ethylene, and jasmonic acid on UV light induced phenolic biosynthesis in wounded carrot tissue

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Abstract

Phenolic biosynthesis in carrots is increased when subjected to wounding and ultraviolet (UV) light stresses. In this study, the physiological role of reactive oxygen species (ROS), ethylene (ET), and jasmonic acid (JA) as signaling molecules to elicit this stress response was evaluated. ROS (O_2^- and hydrogen peroxide) were the first signaling molecules produced, then ET, followed by lipoxygenase (LOX) activity, which is a key enzyme in JA biosynthesis. After a sequence of syntheses of these signaling molecules, phenylalanine ammonia-lyase (PAL) was activated and phenolics were accumulated. We followed a chemical biology approach (using chemical inhibitors of stress-signaling pathways) to determine the physiological role of ROS, ET, and JA on the wound and UV (UVA, UVB, and UVC) induced biosynthesis of phenolics. Results indicated that ROS play a major role on the combined UV and wounding stress response. It is proposed that UV induces ROS which acts as a signal for ET biosynthesis, which in turn activates JA biosynthesis following the wound signaling cross-talk model we previously proposed. When both stresses are applied simultaneously, an enhanced effect on the accumulation of phenolics is observed due to higher levels of signaling molecules.