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As of October 2021

APPLE

Buccheri, M., Picchi, V., Grassi, M., Gandin, D., Bianchi, G., & Scalzo, R. L. (2021). Dynamic changes of antioxidants and fermentative metabolites in apple peel in relation to storage, controlled atmosphere, and initial low oxygen stress. *Scientia Horticulturae*, *288*, 1103125. https://doi.org/10.1016/j.scienta.2021.110312

Abstract

Antioxidants and fermentative metabolites changed depending on storage conditions. CA and ILOS differently affected the stress-related compounds of apple peel. ILOS and CA induced an increase in reduced and total glutathione content. The antioxidant system might play a protective role against postharvest disorders. Storage of apples (Malus × domestica, Borkh.) in controlled atmosphere (CA) and/or the application of initial low oxygen stress (ILOS) are very effective in controlling postharvest disorders as bitter pit and superficial scald. This work aims to evaluate the effect of CA-storage and ILOS on the stress-related compounds of apple peel and to deepen the knowledge about the possible role of the antioxidant defense system against postharvest disorders. Fermentative metabolites, ascorbate (ASA), glutathione (GSH), total ascorbate (T-ASA) and total glutathione (T-GSH), ethylene, α-farnesene, conjugated trienols (CTols), as well as standard maturity indices, were monitored on the peel of apples (cv Red Chief) subjected or not to ILOS and stored 120 days in air or CA. CA-storage caused a reduction of conjugated trienols and ethylene production in Red Chief fruit compared to storage in air. ILOS induced an increase in the production of fermentative metabolites, especially when coupled with CA-storage, but the observed increase in ethanol concentration did not affect ethylene production. ILOS pretreatment and CA-storage induced higher T-GSH and GSH content in the peel of Red Chief fruit. In particular, ILOS caused a temporary shift of GSH towards its oxidated form, which finally resulted in an induction of GSH biosynthesis. Given the positive effect of ILOS on the GSH and T-GSH content, we hypothesize that the peel antioxidant compounds might play some role in the protection against postharvest disorders.

Keywords: /α-farnesene/ /Ascorbic acid/ /Borkh/ /Conjugated trienols/ /Ethanol/ /Ethylene/ /Glutathione/ /Malus x domestica/

APRICOT

Cui, K., Yang, L., Shu, C., Liu, J., Zhu, Z., Yang, Z., Zhu, X., & Jiang, W. (2021). Near freezing temperature storage alleviates cell wall polysaccharide degradation and softening of apricot (Prunus armeniaca L.) fruit after simulated transport vibration. *Scientia Horticulturae*, *288*, N.PAG. https://doi.org/10.1016/j.scienta.2021.110296

Abstract

NFT storage maintained the quality in vibration injured apricots. NFT storage could delay fruit softening of apricot after simulated transport vibration. NFT storage delayed the degradation of pectin fraction and ultrastructure modification in apricot fruit. NFT storage has the potential to prevent losses of vibration injury. The commodity attribute of apricot fruits may greatly decline during transportation and storage. Although the efficacy of near freezing temperature (NFT) storage for maintaining apricot quality has been reported, previous studies did not investigate the effects on cell wall structure, cell ultrastructure, and the composition and activities of cell wall degrading enzymes after simulated transport vibration. The objective of the present study was to evaluate the cell wall metabolism and postharvest quality of 'Xiaobai' apricots during storage at 4–6 °C, 1–2 °C, or NFT for 49 d after simulated transport vibration. Quality parameters, cell wall composition, cell wall degrading enzymes, and cell ultrastructure were analyzed. The results indicated that NFT storage considerably delayed the senescence of apricots, including the inhibition of loss of firmness and decrease in total soluble solid content (TSS), titratable acid (TA) content

and L*, a*, b*, compared with storage at 4–6 °C and 1–2 °C after simulated transport vibration. NFT storage markedly suppressed the respiration rate and maintained a higher content of ascorbic acid and lower membrane permeability during the storage period compared with storage at 1–2 °C and 4–6 °C. Furthermore, NFT storage could delay apricot fruit softening after simulated transport vibration, as indicated by delayed the degradation of Na 2 CO 3 -soluble pectin (NSP) and cellulose content, and slowed down the increase in water-soluble pectin (WSP) and chelate-soluble pectin (CSP) of cell walls, maintained lower pectin methylesterase (PME) and polygalacturonase (PG) activity, and inhibited the increase in cellulase and β-galactosidase (β-Gal) activity compared with storage at 4–6 °C and 1–2 °C. Microscopic observation showed that NFT storage delayed the degradation of pectin fraction and protected the plant cell wall structure. In conclusion, NFT storage changes the cell wall structure and the composition and activities of cell wall degrading enzymes in apricot fruits. These results suggested that NFT storage is an effective method to delay the softening process and preserve the quality of apricots after simulated transport vibration.

Keywords: /Apricot/ /Cell wall metabolism/ /Near freezing temperature storage/ /Postharvest quality/ /Simulated transport vibration/

APPLE

Win, N. M., Yoo, J., Naing, A. H., Kwon, J.-G., & Kang, I.-K. (2021). 1-Methylcyclopropene (1-MCP) treatment delays modification of cell wall pectin and fruit softening in “Hwangok” and “Picnic” apples during cold storage. *Postharvest Biology & Technology*, *180*, 111599. https://doi.org/10.1016/j.postharvbio.2021.111599

Abstract

Despite an increase in the use of 1-methylcyclopropene (1-MCP) to delay fruit softening, the role of 1-MCP in the modification of cell wall pectin to maintain apple fruit firmness during storage is poorly understood. Hence, in this study, we investigated whether 1-MCP treatment delayed fruit softening through pectin modification, in “Hwangok” and “Picnic” apple cultivars, stored up to six months at 0 °C. In both cultivars, 1-MCP-treated apples maintained firmness and exhibited lower internal ethylene concentrations compared with untreated fruit. The depolymerization of pectin in all pectin fractions was attenuated in 1-MCP-treated fruit compared with untreated fruit. In addition, a peak location shift was observed in the molecular mass profile of untreated fruit. Neutral sugar contents (arabinose and galactose), which typically change as fruit ripen, were effectively maintained in 1-MCP-treated fruit. The activity of four important enzymes involved in pectin modification (exo-polygalacturonase, pectin methylesterase, β-galactosidase, and α-*L*-arabinofuranosidase) was reduced in treated fruit compared to the control. Furthermore, 1-MCP treatment reduced the expression of pectin-degrading candidate genes (*MdPG1*, *MdPME1*, *Mdβ-GAL1*, *Mdβ-GAL2*, and *Mdα-ARF2*). This study suggests that 1-MCP maintains cell wall pectin and delays the softening of the two apple cultivars by reducing the solubilization of polyuronides and neutral sugars, and limiting the activities of cell wall hydrolysis.

Keywords: /Apple/ /Softening/ /1-Methylcyclopropene/ /Pectin/ /Pectin-degrading enzymes/ /Cold storage/

Zhang, Z., Lu, Y., & Lu, R. (2021). Development and evaluation of an apple infield grading and sorting system. *Postharvest Biology & Technology*, *180*, 111588. https://doi.org/10.1016/j.postharvbio.2021.111588

Abstract

Infield pre-sorting is intended to remove processing-grade (inferior) fruit that are not suitable for the fresh market, so that growers can handle sorted apples differentially in postharvest storage and packing to achieve cost savings. To achieve this goal, we developed an apple infield grading and sorting system, in which fruit singulation, rotation, and transportation are achieved by using simple, compact pitch-variable

screw conveyors, fruit grading (for size and color) is accomplished with a low-cost imaging system, and fruit sorting is done by using paddle sorters. Experiments were conducted for 'Red Delicious' and 'Golden Delicious' apples to evaluate the overall performance of the infield grading and sorting system in terms of grading repeatability (i.e., chances of each apple that would be graded into the same quality grade in multiple runs and different lanes), bruising damage, and sorting accuracy (consistency between the imaging-based grading results and destinations). Results showed that the grading repeatability rates of the system were above 90 % and 81 % for intra- and inter-lane grading, respectively. The system achieved above 99 % sorting accuracy for the system throughputs of 7.5, 9.0, and 10.5 fruit s^{-1}, while 100 % of sorted apples were graded Extra Fancy and 55 % or higher of the apples incurred no bruising damage during the grading and sorting process. The infield grading and sorting system is compact and robust in performance, and it can meet commercial infield sorting needs.

Keywords: /Apple/Grading/ /Infield sorting/ /Bruising/ /High throughput/

Sánchez-Contreras, J., Rudell, D., Mattheis, J., & Torres, C. A. (2021). Sphingolipids associated with flesh browning onset and development in "Cripps Pink" apples (Malus domestica Borkh.). *Postharvest Biology & Technology*, *180*, 111623. https://doi.org/10.1016/j.postharvbio.2021.111623

Abstract

Flesh browning (FB) of 'Cripps Pink' apples can cause significant economic losses to apple producers worldwide. FB symptoms and etiology can vary for this cultivar. Specific metabolic fingerprints have the potential for identification and understanding of different disorders leading FB postharvest. Flesh tissue from fruit collected starting 150 days after full bloom, through harvest, then, until 7 months into cold storage were sampled for non-targeted metabolic analyses using gas and liquid chromatography coupled with mass spectrometry. Radial FB development was positively associated with sphingolipids metabolism. Elevated levels of multiple glucocerebrosides and ceramides were found in apples at risk for developing the disorder and with symptoms, while the concentrations of a different group of inter-related metabolites tentatively as sphingolipids increased in healthy tissue during storage. Based on previous reports in other plant and animal species, elevated sphingolipid concentrations may be associated with membrane lipid catabolism, cell apoptosis, and fruit senescence involved in FB symptom development.

Keywords:/Internal browning/ /Physiological disorder/ /Fruit quality/ /Chilling stress/

APRICOT

Yang, W., Liu, Y., Sang, Y., Ma, Y., Guo, M., Bai, G., Cheng, S., & Chen, G. (2021). Influences of ice-temperature storage on cell wall metabolism and reactive oxygen metabolism in Xinjiang (Diaogan) apricot. *Postharvest Biology & Technology*, *180*, 111614. https://doi.org/10.1016/j.postharvbio.2021.111614

Abstract

Ice-temperature storage is a new refrigeration method with temperatures ranging from sub-zero to the freezing point of the product being stored. However, few reports have evaluated the effects of ice-temperature (IT) storage on the cell wall metabolism and reactive oxygen metabolism of Xinjiang-grown Diaogan apricots. In this study, to determine the effects of ice-temperature storage on cell wall metabolism and reactive oxygen metabolism in Diaogan apricots, apricots were stored at −1.5 °C to−2.0 °C (ice temperature, IT), 0 °C–1 °C (low temperature), and 10 °C (control) for 70 d with sampling and evaluation every 10 d. Compared to storage at low temperature and 10 °C, IT storage (1) better maintained the firmness, ascorbic acid content, pectin content, and cellulose content of the fruit; (2) suppressed the activities of polygalacturonase and cellulase; (3) inhibited the rate of weight loss, respiration rate, ethylene production, plasma membrane permeability, and malondialdehyde accumulation; and (4) improved the activities of peroxidase, catalase, superoxide dismutase, and

ascorbate peroxidase, thereby inhibiting the accumulation of hydrogen peroxide and superoxide anion during storage. Overall, the results show that IT storage is an effective way to improve the storage quality and antioxidant capacity of Diaogan apricots.

Keywords: /Diaogan apricot/ /Ice temperature storage/ /Cell wall metabolism/ /Reactive oxygen metabolism/

BLUEBERRY

Dai, H., Ji, S., Zhou, X., Wei, B., Cheng, S., Zhang, F., Wang, S., & Zhou, Q. (2021). Postharvest effects of sodium nitroprusside treatment on membrane fatty acids of blueberry (vaccinium corymbosum, cv. Bluecrop) fruit. *Scientia Horticulturae*, *288*, 110307. https://doi.org/10.1016/j.scienta.2021.110307

Abstract

SNP-treatment maintains the fruit quality of blueberry during shelf life. SNP-treatment increased the relative content of unsaturated fatty acids. SNP-treatment increased acetyl CoA carboxylase activity. SNP-treatment reduced lipoxygenase activity and membrane peroxidation. Fatty acid plays an important role in maintaining membrane structural integrity. This study was conducted to evaluate the effects of postharvest sodium nitroprusside (SNP) treatment on fatty acid metabolism of blueberry fruit. The fruit harvested from a blueberry plantation were immersed in 0.10 mmol L−1 SNP aqueous solution at 20 °C for 10 min used for research (20 ± 0.5 °C and 80% RH for 8 d). SNP-treated fruit maintained a higher relative content of unsaturated fatty acids, exhibited higher fruit firmness and lower decay incidence than control. The SNP treatment increased fruit nitric oxide content, acetyl CoA carboxylase activity and the expression levels of the key genes for fatty acid synthesis. In contrast, SNP treatment decreased lipoxygenase activity and malondialdehyde content. Therefore, the postharvest SNP treatment maintains the fruit quality during shelf life by its positive effect on fatty acids metabolism.

Keywords: /Blueberry/ /Fatty acid/ /Sodium nitroprusside/ /Softening/ /Storage/

Zhou, Q., Zhang, F., Ji, S., Dai, H., Zhou, X., Wei, B., Cheng, S., & Wang, A. (2021). Abscisic acid accelerates postharvest blueberry fruit softening by promoting cell wall metabolism. *Scientia Horticulturae*, *288*, 110325. https://doi.org/10.1016/j.scienta.2021.110325

Abstract

The plant hormone abscisic acid is important for the softening of blueberry fruit. • Abscisic acid promoted postharvest blueberry softening by regulating cell wall metabolism. • Exogenous ABA induced de novo endogenous ABA biosynthesis in postharvest. The plant hormone abscisic acid is important for the ripening of fruit. We investigated the relationship between abscisic acid and cell wall degradation and their roles in postharvest blueberry softening. The abscisic acid levels in harvested blueberries were hundreds of times higher than those of auxin, jasmonate, salicylate, and gibberellin and were negatively correlated with fruit firmness. Relative to the untreated control, fruit treated with abscisic acid softened faster, had higher soluble pectin, lower non-soluble pectin, cellulose, and hemicellulose content, and had enhanced pectinesterase, polygalacturonase, and β -galactosidase gene expression and enzyme activity. Moreover, exogenous abscisic acid induced endogenous abscisic acid biosynthesis. In contrast, the ABA inhibitor nordihydroguaiaretic acid downregulated key genes encoding abscisic acid biosynthesis, lowered abscisic acid content, and maintained firmness, cell wall-degrading gene expression levels, and sugar, total phenolic, and ascorbic acid content. Hence, abscisic acid promoted postharvest blueberry softening by regulating cell wall metabolism and phytohormone accumulation while nordihydroguaiaretic acid delayed abscisic acid-induced postharvest blueberry softening.

Keywords: /Abscisic acid/ /Blueberry/ /Cell wall metabolism/ /Softening/ /Storage/

BROCCOLI

Aghdam, M. S., & Razavi, F. (2021). Octapeptide NOP-1 treatment delays yellowing in broccoli floret during low temperature storage. *Postharvest Biology & Technology*, *180*, 111628. https://doi.org/10.1016/j.postharvbio.2021.111628

Abstract

During postharvest life, floret yellowing confines broccoli's economic and nutritional worth. This study aimed to investigate the mechanisms activated by octapeptide NOP-1 (LKRYKRRL-NH_2) treatment at 0, 250, 500, 750, or 1000 μM for retarding floret yellowing in broccoli during storage at 4 °C for 28 d. Our results revealed that the 750 μM NOP-1 treatment retarded chlorophyll degradation by suppressing pheophytinase (PPH) and pheophorbide a oxygenase (PaO) genes expression along with inhibiting Mg^{2+} dechelatase (MDC), and PPH enzymes activity. Besides, 750 μM NOP-1 treatment prevented jasmonic acid (JA) biosynthesis by suppressing phospholipase A (PLA), 13-lipoxygenase (13-LOX), allene oxide synthase (AOS), allene oxide cyclase (AOC), and OPDA reductase (OPR3) genes expression. Interestingly, 750 μM NOP-1 treatment maintained the membrane integrity in broccoli floret, evaluated by malondialdehyde (MDA) accumulation, which could be ascribed to the suppressing phosphatidylinositol 3-kinase (PI3K), phospholipase D (PLD), and 9-lipoxygenase (9-LOX) genes expression. Our results demonstrated that NOP-1, as an innovative, safe, and eco-friendly anti senescence octapeptide, significantly advances our technological proficiency to delay floret yellowing in broccoli during low temperature storage.

Keywords: /Chlorophyll degradation/ /Jasmonic acid/ /Floret/ /yellowing/ /Postharvest senescence/

Zhang, Y., Ma, Y., Guo, Y., Yang, M., Fu, R., Chen, Y., & Sun, Y. (2021). Comprehensive insight into the chlorophyll degradation mechanism of postharvest broccoli heads under elevated O2 controlled atmosphere. *Scientia Horticulturae*, *288*, 110395. https://doi.org/10.1016/j.scienta.2021.110395

Abstract

Elevated O 2 concentration accelerated chlorophyll degradation. H 2 O 2 content decreased along with O 2 concentration elevated. H 2 O 2 down-regulated the expression of BoSGR1, BoNYC, BoPPH, BoPAO , and BoRCCR. Elevated O 2 concentration enhanced Chl-POX activity at the transcription level. Chl oxidative dominated the Chl degradation under elevated O 2 concentration. Postharvest broccoli heads undergo yellowing quickly in unsuitable conditions, which diminishes their quality and commercial value. We investigated the pattern and molecular regulatory mechanism of chlorophyll (Chl) degradation in broccoli under an elevated O 2 controlled atmosphere. As a result, the 40% O 2 + 5% CO 2 treatment accelerated the Chl degradation and the change in color of postharvest broccoli heads, while the 5% O 2 + 5% CO 2 treatment delayed the yellowing. The results indicated that the Chl degradation pattern of postharvest broccoli heads concurrently involved the Pheide a oxygenase (PAO)/phyllobilin and oxidative degradation pathways, and the latter might be the dominant pathway of Chl degradation. The regulatory mechanism of elevated O 2 on Chl degradation may be related to its ability to accelerate cell damage and death, destroy the light-harvesting complex II, and promote up-regulation of genes in the PAO/phyllobilin and oxidative degradation pathways. In contrast, low O 2 treatment may down-regulate the expression of Chl degradation-related genes by increasing H 2 O 2 content, thus delaying the yellowing of broccoli heads.

Keywords: /Broccoli/ /Chlorophyll degradation/ /Chlorophyll-degradation peroxidase/ /Controlled atmospheres/ /O2concentration/

CANTALOUPE

Rothwell, J. G., Safianowicz, K., McConchie, R., Bell, T. L., Carter, D. A., & Bradbury, M. I. (2021). Mixing postharvest fungicides and sanitizers results in unpredictable survival of microbes that affect cantaloupes. *Food Microbiology*, *99*, 103797. https://doi.org/10.1016/j.fm.2021.103797

Abstract

Postharvest treatments with sanitizers and fungicides are applied to increase the quality, safety and shelf life of fresh produce including cantaloupes (also known as rockmelons). The primary role of sanitizers during cantaloupe washing is to prevent cross contamination of potentially pathogenic bacteria in wash water. Postharvest fungicide sprays or dips are employed to inhibit spoilage-causing fungi. While assessing the compatibility of these antimicrobials based on the measurement of active ingredient levels provides some indication of antimicrobial capacity, there is limited data on whether the interaction between these chemicals in wash water modifies their overall efficacy against relevant microorganisms. The aim of this research was to determine how chlorine- and peroxyacetic acid-based sanitizers interact with commercial guazatine- and imazalil-based fungicide formulations used on cantaloupes, and whether mixing these augments or suppresses anti-microbial activity against relevant human pathogens and spoilage fungi in wash water. The results were unpredictable: while most combinations were antimicrobial, the chlorine-based sanitizer when mixed with the guazatine-based fungicide had significantly reduced efficacy against pathogenic Salmonella spp. (~2.7 log) and the fungal spoilage organisms, Trichothecium roseum and Rhizopus stolonifera. Mixing the chlorine-based sanitizer with an imazalil-based fungicide produced a range of outcomes with antagonistic, indifferent and synergistic interactions observed for the fungal species tested. The peroxyacetic acid-based sanitizer led to indifferent interactions with the guazatine-based fungicide, while antagonism and synergy were observed when mixed with the imazalil-based fungicide. This study demonstrates that mixing postharvest agrichemicals used in the cantaloupe industry may increase the risk of microbial contamination and thereby potentially compromise food safety and quality.

Keywords: /Cantaloupes/ /Fungicide/ /Guazatine/ /Hypochlorite/ /Imazalil/ /Peroxyacetic acid/ /Sanitizer/

CHERRY

Sharafi, Y., Jannatizadeh, A., Fard, J. R., & Aghdam, M. S. (2021). Melatonin treatment delays senescence and improves antioxidant potential of sweet cherry fruits during cold storage. *Scientia Horticulturae*, *288*, 110304. https://doi.org/10.1016/j.scienta.2021.110304

Abstract

Melatonin treatment promotes endogenous melatonin and hydrogen sulfide accumulation. Melatonin treatment triggers melatonin and hydrogen sulfide biosynthesing genes expression. Melatonin treatment promotes phenols, flavonoids, and anthocyanins accumulation. Melatonin treatment attenuates endogenous hydrogen peroxide and malondialdehyde accumulation. Melatonin treatment retards browning and attenuates decay in sweet cherry fruits. This study aimed to investigate the mechanisms activated by melatonin treatment at 0, 1, 10, 100, and 1000 μM for retarding senescence and improving the antioxidant potential of sweet cherry fruits during storage at 0 °C for 45 days. The results showed that sweet cherry fruits treated with 100 μM melatonin exhibited the lowest flesh browning and decay incidence after 45 days of storage at 0 °C. Moreover, endogenous melatonin accumulation occurring by higher tryptophan decarboxylase, tryptamine 5-hydroxylase, serotonin N-acetyltransferase , and N-acetylserotonin methyltransferase expression concomitant with endogenous hydrogen sulfide accumulation occurring by higher l -cysteine desulfhydrase and d -cysteine desulfhydrase expression and activity was promoted by melatonin in sweet cherry fruits. Besides, phenols, flavonoids, and anthocyanins accumulation and antioxidant potential were enhanced by melatonin in sweet cherry fruits via enhancing phenylalanine ammonia-lyase and chalcone synthase activities along with suppressing polyphenol oxidase activity. Interestingly, melatonin treatment maintained the membrane entirety in sweet cherry

fruits, evaluated by malondialdehyde and hydrogen peroxide accumulation, which could be attributed to the enhanced activities of superoxide dismutase, catalase, ascorbate peroxidase, and glutathione reductase enzymes while suppressed the activities of phospholipase D and lipoxygenase. Taken together, this study highlights the beneficial effects of melatonin in retarding senescence and improving the antioxidant potential of sweet cherry fruits during cold storage.

Keywords: /Antioxidant potential/ /Phenylpropanoid pathway/ /Phospholipase D/ /ROS scavenging system/ /Sweet cherry fruits/

CUCUMBER

Lu, Y., Lu, R., & Zhang, Z. (2021). Detection of subsurface bruising in fresh pickling cucumbers using structured-illumination reflectance imaging. *Postharvest Biology & Technology*, *180*, 111624. https://doi.org/10.1016/j.postharvbio.2021.111624

Abstract

Pickling cucumbers are susceptible to bruising during harvest and postharvest handling. It is thus desirable to segregate bruised fruit before they are marketed as fresh products or processed as pickles. Structured-illumination reflectance imaging (SIRI) is an emerging optical imaging modality for food quality inspection. This study reported the first demonstration of SIRI for detecting subsurface bruising in fresh pickling cucumbers. Two independent sets of images, i.e., direct component (DC) and amplitude component (AC), were demodulated from phase-shifted sinusoidal pattern images at 740 nm; AC was found more effective than DC for ascertaining bruises that exhibited no visual symptoms. Classification models based on support vector machines were built using extracted image features, to classify cucumbers into bruised and normal classes. The highest classification accuracy of 91 % was achieved by the ensemble of DC, AC and their ratio (AC/DC) images, which represented 7.6 percentage-point improvement over that obtained using the DC images alone. Using features selection for five sets of image features led to further improvements in the classification performance. Incremental evaluation of top 50 most informative features resulted in an averaged overall accuracy of 94 %, with the highest accuracy of 97 % attained by 31 features; and using a subset of only 5 features, 3 from AC and 2 from DC, also produced a high overall accuracy of 96 %. This study demonstrates that SIRI can provide a potentially effective means for visualizing subsurface bruising in pickling cucumbers, which otherwise could barely be achieved by imaging under uniform illumination, and thus for enhancing the differentiation of normal and bruised fruit. More research is, however, needed to optimize and implement SIRI for real-time inspection of cucumber defects.

Keywords: /Pickling cucumber/ /Subsurface bruising/ /Structured illumination/ /Machine learning/

Valverde-Miranda, D., Díaz-Pérez, M., Gómez-Galán, M., & Callejón-Ferre, Á.-J. (2021). Total soluble solids and dry matter of cucumber as indicators of shelf life. *Postharvest Biology & Technology*, *180*, 111603. https://doi.org/10.1016/j.postharvbio.2021.111603

Abstract
The objective of the present study was to show the relationship between total soluble solids (TSS) and dry matter content (DMC) at harvest and of shelf life of cucumber (*Cucumis sativus* L.) cultivars. Two groups of cultivars with different production cycles were studied during two agricultural seasons. Sample cucumbers were stored for 28 d in the dark, at 10 °C, and 85–95 % relative humidity. The DMC, TSS, and commercial quality were determined every seven days. The crop cycle, harvest month, type of cultivar, and storage time affected cucumber DMC and TSS. The TSS content showed a linear relationship with DMC, which was maintained from harvest to senescence. In addition, the values of these two parameters decreased progressively during storage. The DMC and TSS at the time of collection may influence the shelf life of cucumbers, the higher their contents at harvest, the longer the shelf life. Therefore, the TSS and DMC of cucumbers measured at harvest can be used as indicators of cucumber shelf life.

Keywords: /Probability of marketability/ /*Cucumis sativus*/ /Quality/ /Storage/

Wang, B., Wu, C., Wang, G., He, J., & Zhu, S. (2021). Transcriptomic analysis reveals a role of phenylpropanoid pathway in the enhancement of chilling tolerance by pre-storage cold acclimation in cucumber fruit. *Scientia Horticulturae*, *288*, 110282. https://doi.org/10.1016/j.scienta.2021.110282

Abstract

Cucumber fruits are susceptible to chilling injury, which can cause severe quality losses. In this study, pre-storage cold acclimation (PsCA, 10°C for 72 h) significantly induced chilling tolerance in cucumber fruits. To gain insight into the induction mechanisms of PsCA, comparative transcriptome analysis of fruit samples at 0 h, 12 h and 72 h during cold treatments were conducted. High-throughput transcriptome sequences were de novo assembled into 24878 unique transcripts. A total of 10164 differentially expressed genes (DEGs) were identified during cold stress, and 6205 DEGs were identified during cold acclimation, and 7976 DEGs were identified in cold acclimation compared to cold stress. Large numbers of DEGs were commonly detected between cold stress and cold acclimation, suggesting that these DEGs are related to cold response. Twelve DEGs were selected for qRT-PCR validation, and confirmed the credibility and accuracy of transcriptome data. Gene ontology (GO) enrichment and Kyoto Encyclopedia of Genes and Genomes (KEGG) pathway analysis of DEGs indicated that biological processes or pathways such as plant hormone signal transduction, carbon metabolism, and biosynthesis of amino acids were commonly affected by cold stress and acclimation treatments when compared to fruits just harvested. However, compared with cold stress, cold acclimation-affected DEGs were most enriched in phenylpropanoid pathway. Moreover, PsCA upregulated the expression of six DEGs in phenylpropanoid pathway in cold-stored cucumbers. These results suggest that phenylpropanoid pathway may play a role in PsCA-enhanced chilling tolerance. These findings provide novel insights into understand the induction mechanisms underlying PsCA-induced chilling tolerance in cold-stored cucumbers. Pre-storage cold acclimation induced the chilling tolerance of cucumber fruits; Both of stress and acclimation temperatures strongly induced changes of transcriptomic profiles; Postharvest cold acclimation significantly affected the expression of genes in phenylpropanoid pathway; DEGs in phenylpropanoid pathway may play a role in the acquisition of chilling tolerance.

Keywords: /Chilling tolerance/ /Harvested cucumber/ /Phenylpropanoid pathway/ /Postharvest cold acclimation/ /RNA sequencing/

CUT FLOWERS

Liu, J., Lai, L., Liu, H., Li, H., Yu, G., Sun, Y., & He, S. (2021). Nano-silver treatment reduces bacterial proliferation and stem bending in cut gerbera flowers: An in vitro and in vivo evaluation. *Postharvest Biology & Technology*, *180*, 111595. https://doi.org/10.1016/j.postharvbio.2021.111595

Abstract

Stem bending during vase time is a major problem in many cultivars of cut gerbera flowers. In this study, we focused on the involvement of postharvest bacteria and evaluated the efficacy of nano-silver (NS) in reducing bacterial proliferation and stem bending in cut gerbera ‘Real’ flowers *in vitro* and *in vivo*. Four species of dominant bacteria, *Pseudomonas* sp., *Acinetobacter junii*, *Bacillus stearothermophilus*, and *Myroides* sp., were isolated from the stem ends of cut gerberas. Exogenous addition of 3–5 $\log_{10}$ colony forming units (CFU) mL^{-1} of each bacterial species resulted in a sharp reduction in vase life, relative fresh weight, and water uptake of cut gerbera flowers. However, *Pseudomonas* sp. had little impact on their vase life and ornamental quality at concentrations of 3–4 $\log_{10}$ CFU mL^{-1}. *In vitro* assessments showed that the minimum inhibitory concentrations (MICs) of NS for both *A. junii* and *Myroides* sp. were 2.5 mg L^{-1}, and NS MICs for *B. stearothermophilus* and *Pseudomonas* sp. were 5 and 7.5 mg L^{-1},

respectively. Additionally, compared with the control, pretreatment with 5 and 10 mg L^{-1} NS for 24 h nearly doubled the vase life of cut gerberas, maintained their relative fresh weight, and improved water uptake. Furthermore, scanning electron microscopy revealed that the NS pretreatment reduced bacterial colonization on the stem ends. Overall, our findings indicate that all four genera of dominant bacterial species isolated from the stem ends of cut gerberas are involved in stem bending, and NS pretreatment effectively alleviated bacteria-induced xylem blockage and improved water uptake, thereby reducing the incidence of stem bending and extending the vase life of cut gerberas.

Keywords: /Cut gerbera/ /Bacterial proliferation/ /Nano-silver/ /Vase life/ /Stem bending/

FIGS

Afsah-Hejri, L., Toudeshki, A., Homayouni, T., Mehrazi, S., Gholami Pareh, A., Gordon, P., & Ehsani, R. (2021). Potential of ozonated-air (OA) application to reduce the weight and volume loss in fresh figs (Ficus carica L.). *Postharvest Biology & Technology*, *180*, 111631. https://doi.org/10.1016/j.postharvbio.2021.111631

Abstract

This study investigated the effect of ozonated air (OA) on weight loss, volume reduction (shriveling), and skin firmness on fresh figs and monitored the changes in the epidermis of OA-treated fruits within 14 d of storage at 4 °C and 65 % RH. In Phase 1 of the study, fresh Kadota figs at two different maturity levels, commercial-ripe and tree-ripe, were exposed to OA for up to 11 h at room temperature to find the optimum parameters for ozone treatment. The 3-h OA-treated (15 ppm) fig samples showed 10 % less weight loss, 16 % less shrivel, had a better appearance, showed fewer brown spots, and had less fungal growth than the control. In Phase 2, Kadota and Black Mission figs were treated with OA (15 ppm for 3 h) and their aging parameters were evaluated. The Mission figs in the control group showed the highest rate of weight loss (25.8 %) and volume reduction (32.5 %). Kadota figs had the lowest weight loss (18.8 %) and volume reduction (9.8 %) in 14 d. Due to the oxidation, the OA treatment resulted in a considerable decrease in skin firmness in both Kadota and Mission figs; however, the skin firmness increased in the Kadota samples on Day 7. The recovery of Kadota epidermises continued at a very slow rate until Day 14. However, Mission samples did not show any firmness increase on Day 7. Scanning electron microscopy showed the differences between the control and the OA-treated Kadota and Mission figs. Ozone treatment affected the epidermis of figs, specifically the stomata and epicuticular wax crystals, resulting in stomata blockage or deformation, and irregular shapes in the wax platelets. Although the fruit epidermis was affected by OA treatment, the self-assembly properties of the epicuticular wax layer helped the fruit to recover from the oxidative damage caused by ozone by Day 7. Small microcracks and cell wall disassembly were observed on the fruit surface after 14 d of cold storage; they were very noticeable in the control samples and resulted in considerable water loss and weight loss, decreased shelf life, and significant fungal infection. This study showed that OA treatment of fresh figs can be used to minimize the volume and weight loss and improve the overall quality of fresh figs.

Keywords: /Fresh figs/ /Ozonated air/ /Weight loss/ /Volume reduction/ /Skin firmness/ /Epidermis changes/

FRUITS AND VEGETABLES

Hoffmann, T. G., Ronzoni, A. F., da Silva, D. L., Bertoli, S. L., & de Souza, C. K. (2021). Impact of household refrigeration parameters on postharvest quality of fresh food produce. *Journal of Food Engineering*, *306*, N.PAG. https://doi.org/10.1016/j.jfoodeng.2021.110641

Abstract

The main phenomena involved in the food refrigeration process are heat and mass transfer. In this context, the aim of this study was to evaluate the influence of refrigeration system parameters on food quality during postharvest storage. Experiments were conducted where the mean air temperature, air temperature fluctuation, air velocity, thermal oscillation period and humidity ratio were controlled, to quantify the food mass transfer, cooling rates and sensorial acceptance. The food sample under evaluation was lettuce packed in perforated polyethylene bags. A standardized test (IEC 63169:2020) was performed under the same experimental conditions for comparison. Food cooling rate was influenced by air velocity and a gradual increase (0.1–1.1 °C) in food temperature was observed during storage. A temperature increase from 3.0 to 7.0 °C, raised the mass loss of the food by 8.8%, which was directly influenced by the driving force provided by the humidity. Higher temperature fluctuations led to negative results in the sensorial analysis, with less freshness and higher consumption rejection. An experimental facility was designed to simulate household refrigerator operation. Domestic refrigerated storage conditions for food preservation were evaluated. A standardized test, based on IEC 63169:2020, was performed for comparison. Food cooling kinetics, mass transfer and sensorial parameters were assessed.

Keywords: /Cooling rate/ /Food preservation/ /Lettuce/ /Mass transfer/ /Postharvest storage/ /Refrigeration parameters/

Jasper, J., Elmore, J. S., & Wagstaff, C. (2021). Determining the quality of leafy salads: Past, present and future. *Postharvest Biology & Technology*, *180*, 111630. https://doi.org/10.1016/j.postharvbio.2021.111630

Abstract

The relatively high proportion of avoidable waste from leafy salads and the under-consumption of fruits and vegetables generally is contributing toward renewed interest in the value of on-pack dates, particularly those that indicate quality. Current methods of predicting shelf-life in fresh vegetables and salad are relatively conservative due to the high variability of the product and few reliable markers that can be used to predict shelf-life. This is evidenced by the proportion of wastage in this category where fresh vegetables and salad account for almost a quarter of all avoidable food waste by weight. We have looked at the historical context in which date markings have been derived, how they function currently and look at how the current system could be improved. We review the three primary factors that influence the quality of a product – microbiology, visual quality, aroma – and suggest that if more accurate predictions of shelf-life are to be obtained non-destructive methods of testing need to be developed in order to provide the consumer with accurate information about the current state of the product.

Keywords: /Shelf-life/ /Salad/ /Non-destructive/ /Waste/

Jayarajan, S. & Sharma, R.R. (2021). Melatonin: A blooming biomolecule for postharvest management of perishable fruits and vegetables. *Trends in Food Science and Technology, 116,* 318-328. https://doi.org/10.1016/j.tifs.2021.07.034

Abstract

The role of melatonin as a neurotransmitter has been much discussed and studied topic in the animal kingdom but its possible role as a ubiquitous biomolecule with the pleiotropic effect is still at an infancy stage in the plant kingdom. Melatonin was just known to be the hormone in the human body which regulates our sleep through its involvement in circadian rhythm or biological clock until its detection in the plant kingdom in the early 90s. Since then, scientists worldwide started working prospectively about its various functions and roles in plants. Now its role in attenuating abiotic and biotic stresses in standing crops has been studied and validated at a commercial level in various cereal and horticultural crops. Food is thy medicine but the abusive use of chemicals rendered them poisonous and consumers being more

vigilant and mindful about the food they are consuming are now demanding the chemical free food stuff. So, in recent years, the trend of using safer alternatives for the control of postharvest diseases of fresh fruits and vegetables have shown a significant increase and hence pressurized the scientists to think about the potential use of melatonin for various postharvest problems.In this review, we have discussed briefly about melatonin's function as potent postharvest treatment for controlling biotic and abiotic stresses and had made an attempt to gather information on its possible roles in postharvest management of fruits and vegetables.Melatonin can be a good alternative to harmful chemicals which are used commercially in postharvest management of fruits. The use of melatonin addresses the major hurdles in postharvest management of fruits such as chilling injury and fruit decay, and it helps in extending the shelf life of fruits and vegetables by delaying ripening and senescence whilst maintaining better fruit quality.

Keywords: /Antioxidant/ /Biomolecule/ /Melatonin/ /N-acetyl-5-methoxytryptamine/ /ROS/

Linke, M., Praeger, U., Mahajan, P. V., & Geyer, M. (2021). Water vapour condensation on the surface of bulky fruit: Some basics and a simple measurement method. *Journal of Food Engineering*, *307*, 110661. https://doi.org/10.1016/j.jfoodeng.2021.110661

Abstract

In the postharvest chain of fruit and vegetables, temperature fluctuations frequently occur in the surrounding air, which can lead to condensation of water vapour on the surface of fresh produce. Such processes can have a negative impact on the shelf life of horticultural products. Available sensors for measuring condensation phenomena, in particular on the curved surfaces of bulky fruit, are not suitable or can only be used to a very limited extent. The aim of the present study was to measure condensation on curved surfaces of bulky fruit and to evaluate the influence of the process parameters involved. Some fundamental aspects of condensation on the surface of single apples were analysed using the standard methods of condensation measurement that involve the continuous weighing of the product and measuring the dew-point undershoot. In the context of two typical postharvest scenarios, an in-house developed sensor based on the electrical resistance was tested and validated. The wetness sensor allowed reliable determination of the condensation retention time during re-warming and in both uniform and non-uniform temperature fluctuations on apple fruit. While the retention time of condensed water on the fruit surface was successfully measured, only qualitative statements can be made regarding the intensity of the condensation. Some basic principles of condensation on the surface of bulky fruits have been studied. Three independent methods were used to measure condensation processes on individual apples. An in-house developed sensor to determine the retention time of condensed water was tested and validated successfully. We measured condensation on fruit surfaces in two typical post-harvest scenarios.

Keywords: /Apple/ /Condensation retention time/ /Dew point temperature/ /Fruit/ /Postharvest/ /Surface active agent/ /Wetness sensor/

Mao, L., Mhaske, P., Zing, X., Kasapis, S., Majzoobi, M., & Farahnaky, A. (2021). Cold plasma: Microbial inactivation and effects on quality attributes of fresh and minimally processed fruits and Ready-To-Eat vegetables. *Trends in Food Science and Technology*, *116,* 146-175. https://doi.org/10.1016/j.tifs.2021.07.002

Abstract

Due to the increasing consumer awareness and rapidly changing lifestyle, there has been an exponential increase in the demand for healthy, fresh, minimally processed and Ready-To-Eat food products, especially fresh fruits and vegetables globally. These products, though convenient, nutritious, and preferred as healthy alternatives, are also a source of increasing foodborne outbreaks due to their minimal processing marked with insufficient decontamination and preservation. Recent literature was reviewed through search engines and scholarly journals in the areas of food processing and engineering

and other related areas. The focus was on the papers published over the last 10 years. The efficacy of cold plasma as a mild, yet effective non thermal technique in inactivating pathogenic microorganisms while maintaining the quality of fresh and minimally processed fruits and vegetables and extending their shelf life is summarized and reviewed. Cold plasma is capable of producing safe fresh fruits and vegetables. The efficiency of the technique depends on product surface properties and several processing parameters that need to be optimized to achieve desirable results.Further research is needed to fine tune and streamline cold plasma processing in order to have a widespread industrial application for safe fresh and minimally processed fruits and Ready-To-Eat vegetables. Future research would focus on expanding industrial applications of cold plasma technology through product safety as well as designing and modeling universal plasma application systems capable of processing different fruits and vegetables without requiring time consuming set up trials.

Keywords: /Cold plasma/ /Fresh/ /Fruits/ /Microbial inactivation/ /Ready-to-eat/ /Safety/ /Vegetables/

Nugraha, B., Verboven, P., Janssen, S., Hertog, M. L. A. T. M., Boone, M., Josipovic, I., & Nicolaï, B. M. (2021). Oxygen diffusivity mapping of fruit and vegetables based on X-ray CT. *Journal of Food Engineering*, *306*, 110640. https://doi.org/10.1016/j.jfoodeng.2021.110640

Abstract

Oxygen (O 2) diffusion affects respiration of fruit and vegetables and, thus, their behavior under controlled or modified atmosphere storage conditions. Effective gas diffusivity expresses, at a macroscopic level, the overall ability of the tissue to exchange gasses and is determined by the porous structure of the tissue. Variations of the tissue microstructure across the fruit and vegetable organs may result in an effective O 2 diffusivity that is position dependent. A method was developed to create three-dimensional (3-D) effective O 2 diffusivity maps in fruit and vegetables based on low resolution X-ray computed tomography (CT) images. The effective tissue diffusivity was first calculated for representative small tissue samples of eggplant, turnip, apple, and pear fruit, using microscale diffusion simulations with a finite volume model on high resolution CT images, which served as ground truth. Then the dependence of the effective O 2 diffusivity on the total and open porosity and tortuosity of the samples was investigated. The regression model of the diffusivity with respect to total porosity had an RMSE = 6.90 × 10−7 m2 s−1 and R2 = 0.92, while that with respect to open porosity had an RMSE = 5.41 × 10−7 m2 s−1 and R2 = 0.95, for all samples and organs. The incorporation of the pore network tortuosity did not improve the goodness of fit of the correlation. The correlation based on total porosity was found sufficient for eggplant and turnip that has a large porosity, while diffusivity profiles in apple and pear fruit correlated better with the open porosity due to the presence of disconnected (closed) pores in these fruits that contribute less to the effective diffusion. Thereto, open porosity was estimated from a correlation model between total porosity and open porosity with RMSE = 5.76% for apple and RMSE = 0.93% for pear. Porosity profiles of organs computed from low resolution CT grayscale images were translated to O 2 diffusivity profiles using the correlation model and tested against the high resolution ground truth values. Finally, effective diffusivity maps were created for intact organs, which for the first time provides insight in the spatial variation in gas exchange capability of different plant species. Effective O 2 diffusivity in an intact product was mapped based on X-ray CT. Diffusivity models were developed based on total and open porosity, and tortuosity. O 2 diffusivity of fruit and vegetables was found heterogeneous.

Keywords: /Apple/ /Eggplant/ /Open porosity/ /Pear/ /Tissue microstructure/ /Tortuosity/ /Turnip/

Wu, X., Ren, J., Huang, X., Zheng, X., Tian, Y., Shi, L., Dong, P., & Li, Z. (2021). Melatonin: Biosynthesis, content, and function in horticultural plants and potential application. *Scientia Horticulturae*, *288*, N.PAG. https://doi.org/10.1016/j.scienta.2021.110392

Abstract

The melatonin level varies greatly in different horticultural plants. The key melatonin synthetase genes have been identified in many horticultural plants. Melatonin plays a crucial role in biotic and abiotic resistance in plants. Melatonin has the potential as a growth stimulator and postharvest preservative. Derived from tryptophan, melatonin is a nontoxic indolic molecule that is widely identified in species ranging from bacteria to mammals. It plays vital roles in the circadian rhythm, antioxidant activity and immunological enhancement in animals and in photosynthesis, biomass production, osmoregulation during the response to abiotic and biotic stress in plants. Horticultural plants are consideredto be among the most important plants, providing people with fruits, vegetables, beverages, medicinal herbs and ornamentation. Since the presence of melatonin was first observed in horticulture plant Japanese morning glory (Pharbitis nil) in 1993, melatonin levels, synthetic pathways and roles during horticulture plant growth and postharvest storage have attracted increasing attention in recent 20 years. In this review, our aim is to provide an overview of the multiple pathways for the synthesis of melatonin from tryptophan in plants, summarize the levels of melatonin and the influencing factors in horticultural plants, highlight the role of melatonin on the plant growth and development, postharvest quality, and resistance to biotic or abiotic stresses and propose the potential application of melatonin in nutrition and agriculture.

Keywords: /Abiotic stress/ /Biotic stress/ /Horticultural plants/ /Melatonin/ /Postharvest quality/

GRAPE

Liu, H.-N., Pei, M.-S., Wei, T.-L., Yu, Y.-H., & Guo, D.-L. (2021). Molecular cloning and expression analysis of hydrogen peroxide sensors under H2O2 and ROS inhibitor treatment in "Kyoho" grape berry. *Postharvest Biology & Technology*, *180*, 111617. https://doi.org/10.1016/j.postharvbio.2021.111617

Abstract

Hydrogen peroxide is an important factor involved in the senescence and quality deterioration of postharvest fruit. However, few studies have examined hydrogen peroxide sensors and their expression patterns in grapes. Here, postharvest grape berries were treated with H_2O_2 and the ROS inhibitor hypotaurine (HT). HT reduced the H_2O_2 content by increasing ROS-scavenging enzyme activity, whereas H_2O_2 accelerated senescence. Four hydrogen peroxide sensors (*VvHPCA1*, *2*, *3*, and *4*) were identified and isolated from the grape genome. Sequence analysis indicated that *VvHPCAs* shared a conserved structure, including the LRR-RK and hydrogen peroxide (HP) domains, with other homologous hydrogen peroxide sensor genes. Furthermore, the expression patterns of the four *VvHPCAs* were investigated under H_2O_2 and HT treatment in grapes. The expression levels of the four *VvHPCA*s were lower in grape berries treated with HT than in grape berries treated with H_2O_2 or water treatment (Control) in at least one of the sampling points during storage. VvHPCAs are cytomembrane proteins with stress-responsive cis-acting elements in their promoters, indicating that these four identified VvHPCAs might function as hydrogen peroxide sensors in grape and regulate hydrogen peroxide signaling and metabolism. Thus, VvHPCAs are capable of responding to postharvest ROS stress. These findings provide new insight into the function of these four VvHPCAs, which are potential candidate genes involved in regulating ROS stress in grapes.

Keywords: /Grape/ /Hydrogen peroxide sensor/ /H_2O_2/ /Hypotaurine/ /ROS inhibitor/

JAPANESE PLUMS

Kyaw, P. N., Singh, Z., & Tokala, V. Y. (2021). Aqueous formulations of 1H-cyclopropabenzene modulate ethylene production and fruit quality in Japanese plums. *Postharvest Biology & Technology*, *180*, 111625. https://doi.org/10.1016/j.postharvbio.2021.111625

Abstract

The efficacy of aqueous formulations of 1*H*-cyclopropabenzene (BC) containing different adjuvants to retard ethylene production and maintain fruit quality of Japanese plums (*Prunus salicina* Lindl. cvs. 'Angeleno', 'Fortune' and 'Tegan Blue') following 25 d and 40 d cold storage (1 °C) was evaluated. Plum fruit were sprayed with different solutions of 2 μM BC (i.e., aqueous solutions containing distilled water only or 5 % ethanol or 0.02 % Tween® 20 or 5 % β-cyclodextrin) or fumigated with 1 μM BC at ambient temperature. Plum fruit without any treatment were regarded as control. Regardless of the cultivars tested, all formulations of BC remarkably suppressed the ethylene production, while the fumigation was the most effective treatment, when compared to control. Effects of BC on fruit firmness, weight loss and all other fruit quality parameters varied among formulations and cultivars. The fruit treated with BC had lower total anthocyanins levels than control whilst, total phenolic content and total antioxidant capacity did not differ significantly. BC solutions prepared containing 5 % ethanol or 0.02 % Tween® 20 outperformed other BC aqueous formulations in impeding production of ethylene and maintaining quality of cold stored Japanese plums.

Keywords: /Ethylene antagonist/ /Ethanol/ /Tween® 20/ /Spray formulations/ /Ripening/ /Bioactive compound

JUJUBE

Yu, Y., Guo, W., Liu, Y., Sang, Y., Yang, W., Guo, M., Cheng, S., & Chen, G. (2021). Effect of composite coating treatment and low-temperature storage on the quality and antioxidant capacity of Chinese jujube (Zizyphus jujuba cv. Junzao). *Scientia Horticulturae*, *288*, 110372. https://doi.org/10.1016/j.scienta.2021.110372

Abstract

Three kinds of preservatives (1-MCP, chitosan, Nata) were applied to jujube storage. Comparison of different storage temperatures reflects the advantages of low temperature. Comparison of different treatments shows the advantages of composite membrane treatment. The purpose of this study was to explore the effects of coating treatment using a composite of 1-methylcyclopropene (1-MCP), chitosan and natamycin (NATA) on the quality and antioxidant capacity of Chinese jujube (Zizyphus jujuba cv. Junzao) stored at different temperatures (Room temperature and 0 ± 1 °C). Respiration, ethylene release, and decay rates; Malondialdehyde (MDA); total phenol, flavonoid, and Ascorbic Acid (AsA) contents; Peroxidase (POD), Polyphenol Oxidase (PPO), Superoxide Dismutase (SOD), and Ascorbate Peroxidase (APX) activities; and free-radical scavenging ability were considered. The results showed that the low-temperature composite coating treatment of Chinese jujube effectively inhibits its decay and MDA accumulation; delays its respiration and ethylene release peaks; increases the activities of the antioxidant enzymes POD, SOD, and APX; and inhibits its PPO activity. Furthermore, the jujube retains its high concentrations of total phenols, flavonoids, and AsA as well as its free-radical-scavenging rate into the later storage period. Thus, the low-temperature composite coating treatment is an effective method for improving the postharvest quality of Chinese jujube and extending its preservation period.

Keywords: /Antioxidant capacity/ /Chinese jujube/ /Composite coating preservation/ /Storage quality/

KIWI

Huan, C., Du, X., Wang, L., Kebbeh, M., Li, H., Yang, X., Shen, S., & Zheng, X. (2021). Transcriptome analysis reveals the metabolisms of starch degradation and ethanol fermentation involved in alcoholic off-flavour development in kiwifruit during ambient storage. *Postharvest Biology & Technology*, *180*, 111621. https://doi.org/10.1016/j.postharvbio.2021.111621

Abstract

Kiwifruit tends to develop alcoholic off-flavour after long-term storage, leading to decreased fruit market value. *Actinidia eriantha* 'White' and *Actinidia deliciosa* 'Bruno' are two major cultivated kiwifruits in China. Compared to *A. eriantha* 'White', *A. deliciosa* 'Bruno' is prone to developing alcoholic off-flavour associated with ethanol accumulation during storage at ambient conditions without any stresses. In this study, to better understand the complex mechanisms responsible for developing alcoholic off-flavour in kiwifruit during postharvest, transcriptome analysis was used to compare the difference in metabolic pathways between kiwifruits 'white' and 'Bruno' during ripening at ambient storage. Our results indicated that the development of alcoholic off-flavour in kiwifruit 'Bruno' might be associated with three metabolic pathways: the respiration and ethylene metabolism, starch and sucrose metabolism and ethanol fermentation metabolism. In kiwifruit 'Bruno', the higher respiration rate and ethylene production might increase the energy conversion and internal carbon dioxide (CO_2) accumulation. Moreover, the higher expressions of *starch phosphorylases* (*SPs*), *beta-amylases*, *UDP-glucose pyrophosphorylases* (*UGPases*), *sucrose synthase*s (*SSs*) and invertases (INVs) accelerated starch degradation along with soluble sugars accumulation in kiwifruit 'Bruno', which could provide adequate substrates for ethanol fermentation. In addition, the higher activity of ethanol fermentation metabolism associated with higher expressions of *pyruvate kinases (PKs), NADP-dependent malic enzymes (NADP-MEs), pyruvate decarboxylases (PDCs) and alcohol dehydrogenases (ADHs)* might directly increase the ethanol production.

Keywords: /Transcriptome analysis/ /Alcoholic off-flavour/ /Kiwifruit/ /Metabolic pathway/ /Storage/

LETTUCE

Liu, Z., Sun, J., Teng, Z., Luo, Y., Yu, L., Simko, I., & Chen, P. (2021). Identification of marker compounds for predicting browning of fresh-cut lettuce using untargeted UHPLC-HRMS metabolomics. *Postharvest Biology & Technology*, *180*, 111626. https://doi.org/10.1016/j.postharvbio.2021.111626

Abstract

Enzymatic browning negatively impacts product quality and shelf-life of packaged fresh-cut lettuce. Metabolite profiles of lettuce are affected by the browning process. The purpose of this study was to identify metabolomic marker compounds to predict lettuce browning, which could be applied to discern accessions suited for commercial production and industrial breeding programs. Romaine lettuce with different browning susceptibilities were evaluated in two independent trials and growing seasons. Metabolites were analyzed using ultra-high-performance liquid chromatography coupled with high-resolution mass spectrometry (UHPLC-HRMS). Principal component analysis (PCA) was performed to visualize clusters, trends, and discriminative ion features. Seven metabolites, including quinic acid, caffeoylquinic acid, 3-hydroxytetradecanedioic, cichorioside B, 8-deacetylmatricarin-8-sulfate, dicaffeoylquinic acid and 9S,12S,13S-trihydroxy-10Z-octadecenoic acid, increased with storage time (day 0 *vs.* day 3) Three metabolites, including lactucopicrin-15-oxalate, tri-4-hydroxyphenylacetyl glucoside and 15-deoxylactucin-8-sulfate, decreased with storage time (day 0 *vs.* day 3). Two additional phenolic metabolites, dicaffeoyltartaric and caffeoyltartaric acids, were identified as potential marker compounds, whose presence on day 0 samples immediately after cutting was negatively correlated with browning development (represented by ΔHue). The identified metabolites help to elucidate the biochemical metabolism and pathways during enzymatic browning and have the potential to serve as marker compounds for predicting browning resistant accessions.

Keywords: /Lettuce/ /Enzymatic browning/ /Multivariate analysis/ /Phenolic metabolites/ /Breeding program/

LITCHI

He, M., Wu, Y., Hong, M., Yun, Z., Li, T., & Jiang, Y. (2021). α-Lipoic acid treatment alleviates postharvest pericarp browning of litchi fruit by regulating antioxidant ability and energy metabolism. *Postharvest Biology & Technology*, *180*, 111629. https://doi.org/10.1016/j.postharvbio.2021.111629

Abstract

Litchi fruit has high commercial value and significant benefits for humans. However, pericarp browning, as the indicator of litchi fruit senescence, limits the shelf life of litchi fruit. Effect of α-lipoic acid (α-LA) that has great antioxidant potential on litchi fruit senescence was investigated. Results showed that α-LA delayed pericarp browning and attenuated redox stress of litchi fruit, indicated by lower hydrogen peroxide (H_2O_2) and superoxide radical ($O_2^{\cdot-}$) contents but higher hydroxy radical scavenging rate. Compared to control, α-LA treatment enhanced enzymatic: superoxide dismutase (SOD), catalase (CAT), ascorbate peroxidase (APX) and glutathione reductase (GR) as well as nonenzymatic antioxidants: glutathione (GSH) and ascorbate (AsA). Meanwhile, α-LA was protective against oxidative stress by inducing *glutaredoxin* (*LcGrx*), *thioredoxin* (*LcTrx*) and *methionine sulfoxide reductase* (*LcMsr*) expression levels. These α-LA-induced antioxidant systems directly increased the antioxidant capacity. Further research indicated that α-LA pretreatment maintained higher intracellular ATP level and activated extracellular ATP signaling through up-regulating *LcDORN1s* expression, indirectly increasing the antioxidant capacity. In conclusion, α-LA is effective to increase the antioxidant capacity and delay the pericarp browning of litchi fruit.

Keywords: /Reactive oxygen species/ /Antioxidant system/ /Postharvest storage/ /Senescence/ /Energy Fruit/

MANDARIN

Rey, F., Rodrigo, M. J., & Zacarias, L. (2021). Accumulation of tocopherols and transcriptional regulation of their biosynthesis during cold storage of mandarin fruit. *Postharvest Biology & Technology*, *180*, 111594. https://doi.org/10.1016/j.postharvbio.2021.111594

Abstract

Tocopherols are plant-derived isoprenoids with potent antioxidant activity, which have been implicated in the tolerance of plants to different stresses. However, tocopherol accumulation and biosynthesis in fruit, and their potential implication in postharvest chilling injury (CI), has been scarcely studied. Therefore, in this work, we have investigated tocopherol accumulation and biosynthesis in the peel of mandarin fruit of three cultivars with contrasting susceptibility to CI during storage at 2 °C ('Fortune'>'Nova'> 'Nadorcott'). α- and γ-tocopherol were the isoforms detected in the flavedo of the fruit, and a direct relationship between tocopherols content and CI-tolerance was found, since CI-tolerant fruit accumulated the highest tocopherol content whereas CI-sensitive fruit the lowest. Moreover, the transcriptional profiling of 14 genes related to the specific steps of tocopherol biosynthesis, and to their precursor's synthesis, were analyzed. Upstream genes *DXS1* and *DXS2* (1-deoxy-d-xylulose-5-phosphate synthase) and *GGDR* (geranylgeranyl diphosphate reductase), involved in the supply of phytyl pyrophosphate, and the *VTE3* (2-methyl-6-phytyl-1,4-benzoquinol methyltransferase) isoforms appear to be key for the differences in total tocopherol content among the cultivars at harvest. During cold storage, most genes involved in the precursor supply were up-regulated, whereas genes of the tocopherol-core pathway were in general repressed. Changes in *VTE4* during cold storage may account for the differences in γ-tocopherol among cultivars. Collectively, results suggest that the concentration of tocopherols at harvest may play a function in the natural tolerance of mandarin fruit to CI, and that changes in the expression of genes during storage appear to be cold-regulated responses, rather than involved in CI tolerance.

Keywords: /Antioxidant/ /Chilling injury/ /Gene expression/ /Mandarin/ /Tocopherols/

MANGO

Contreras-Soto, M., Medrano-Félix, J., Valdez-Torres, B., Chaidez, C., & Castro-del Campo, N. (2021). Chlorine dioxide: an evaluation based on a microbial decay approach during mango packing process. *International Journal of Environmental Health Research*, *31*(5), 518–529. https://doi.org/10.1080/09603123.2019.1670785

Abstract

Mango is highly consumed worldwide; nonetheless, its consumption has been related to foodborne outbreaks. This study was performed to evaluate bacterial transference during mango postharvest management and the feasibility of adopting chlorine dioxide as first choice disinfectant in mango packinghouses. Chlorine dioxide (3 and 5 ppm) and sodium hypochlorite (100 and 200 ppm) were evaluated at different turbidity and times against Salmonella Choleraesuis and Listeria monocytogenes. Bacterial transference was higher from water to fruit than vice-versa (49.17%). Chlorine dioxide (5 ppm) achieved the highest Salmonella reductions at low turbidity reaching 2.13 Log10 at 10 min; meanwhile, Listeria was totally reduced in all conditions. Bacterial decay kinetics showed that chlorine dioxide 5 ppm was 34-fold faster than sodium hypochlorite at 200 ppm in reducing 1 Log10 of Salmonella. Chlorine dioxide reached faster bacterial inactivation decay over sodium hypochlorite; its usage is safe and meets the regulatory standards set for mango processing.

Keywords: /Chlorine dioxide/ /Listeria monocytogenes/ /Mango/ /Microbial decay/ /Salmonella/ /Choleraesuis/

MUSHROOM

Qian, X., Hou, Q., Liu, J., Huang, Q., Jin, Z., Zhou, Q., Jiang, T., & Zheng, X. (2021). Inhibition of browning and shelf life extension of button mushroom (Agaricus bisporus) by ergothioneine treatment. *Scientia Horticulturae*, *288*, 110385. https://doi.org/10.1016/j.scienta.2021.110385

Abstract

EGT treatment inhibited the browning of mushrooms. EGT treatment inhibited the activities of PPO, POD and PAL in mushrooms. Expression of AbPPO1, AbPPO3, AbPPO5, abpal1 and AbPAL2 genes in mushrooms was inhibited by EGT. The effect of ergothioneine (EGT) on postharvest quality and possible browning mechanisms in button mushroom (Agaricus bisporus) was investigated. Mushrooms were sprayed with 0.12 mmol L −1 EGT solution, and then stored at 4 °C for 17 d Results demonstrated that EGT treatment effectively delayed the decline of lightness (L*) value and firmness, maintained higher levels of total phenolics and ascorbic acid, and reduced browning degree, malondialdehyde (MDA) content and electrolyte leakage rate. However, EGT treatment had no significant effect on weight loss. Further investigations showed that EGT inhibited the activities of polyphenol oxidase (PPO), peroxidase (POD), phenylalanine ammonia lyase (PAL), catalase (CAT), and browning-related gene expression level, including AbPPO1, AbPPO3, AbPPO5, AbPAL1 and AbPAL2. The results from this research indicated that EGT treatment had potential effect on maintaining the postharvest quality and controlling browning in button mushrooms.

Keywords: /Agaricus bisporus/ /Browning/ /Ergothioneine/ /Gene expression/ /Postharvest quality/ /

NECTARINE

Zhang, W., Jiang, H., Cao, J., & Jiang, W. (2021). UV-C treatment controls brown rot in postharvest nectarine by regulating ROS metabolism and anthocyanin synthesis. *Postharvest Biology & Technology*, *180*, 111613. https://doi.org/10.1016/j.postharvbio.2021.111613

Abstract

UV-C is a no residual environmentally friendly physical treatment that could activate the fruit defense system and induce resistance to control the postharvest disease. Herein, the study was performed to investigate the effect of UV-C on disease occurrence, antioxidant system, disease-resistant defense enzymes, and phenylpropane metabolic pathway, and anthocyanin biosynthesis in nectarine fruit inoculated with Rhizopus stolonifer. Compared with the fruit without treatment, the results showed 3 kJ m−2 UV-C treatment decreased lesion diameter as well as disease index. UV-C treatment increased the activities of antioxidant enzymes including superoxide dismutase (SOD), catalase (CAT), and ascorbate peroxidase (APX) and the contents of ascorbic acid (ASA) as well as glutathione (GSH). UV-C treatment activated the phenylpropane metabolic pathway and anthocyanin biosynthesis, thereby increasing the content of phenolic compounds, total flavonoids, anthocyanins, and lignin. Besides, UV-C treatment also promoted the activities of chitinase (CHI) and β-1,3-glucanase (GLU). These data demonstrated that UV-C treatment could promote the antioxidant system, stimulate phenylpropane metabolic pathway and anthocyanin biosynthesis, thus alleviate disease severity in R. stolonifer-inoculated nectarine during storage. This work concluded that UV-C was an eco-friendly treatment to control disease occurrence of postharvest nectarine fruit.

Keywords: /Nectarine fruit/ /Disease/ /UV-C/ /Induced resistance/

Zhang, W., Jiang, H., Zhang, Y., Cao, J., & Jiang, W. (2021). Synergistic effects of 1-MCP and hot air treatments on delaying softening and promoting anthocyanin biosynthesis in nectarines. *Postharvest Biology & Technology*, *180*, 111598. https://doi.org/10.1016/j.postharvbio.2021.111598

Abstract

The effects of 1-MCP, hot air (HA), and 1-MCP+HA treatments on softening and anthocyanin biosynthesis in nectarines during storage at 25 °C for 8 d were investigated. The results showed that 1-MCP and 1-MCP+HA treatments maintained the firmness and cell wall contents and reduced the activities of cell wall-modifying enzymes, including polygalacturonase, β-galactosidase (β-GAL), cellulase, and pectin methylesterase (PME) in nectarines. Furthermore, transmission electron microscopy of the cell walls showed that 1-MCP and 1-MCP+HA treatments maintained their structural integrity. HA and 1-MCP+HA treatments stimulated the accumulation of anthocyanins and accelerated the reddening of the flesh, possibly through increased activity of enzymes, including flavanone 3-hydroxylase, dihydroflavonol 4-reductase, and uridine diphosphate flavonoid 3-O-glucosyltransferase. Collectively, our results may shed new light on optimizing 1-MCP application for delaying softening of fruit.

Keywords: /Nectarine/ /1-MCP/ /Hot air/ /Firmness/ /Anthocyanin/ /

ORANGE

Soto-Muñoz, L., Palou, L., Argente-Sanchis, M., Ramos-López, M. A., & Pérez-Gago, M. B. (2021). Optimization of antifungal edible pregelatinized potato starch-based coating formulations by response surface methodology to extend postharvest life of "Orri" mandarins. *Scientia Horticulturae*, *288*, 110394. https://doi.org/10.1016/j.scienta.2021.110394

Abstract

Antifungal starch-based edible coating (EC) containing sodium benzoate was successfully developed for 'Orri' mandarins. Concentrations of starch, lipid and plasticizer were optimized by Box–Behnken design. Starch content influenced the viscosity of the emulsion, tacking and weight loss of mandarins. Optimized EC reduced weight loss of mandarins without negatively affecting the overall acceptability. Optimized EC controlled green and blue molds and sour rot on artificially inoculated mandarins. Antifungal composite edible coatings (ECs) formulated with pregelatinized potato starch (PPS, 1.0–2.0% w/w) as biopolymer,

glyceryl monostearate (GMS, 0.5–1.5%, w/w) as hydrophobe, glycerol (Gly, 0.5–1.5%, w/w) as plasticizer, and sodium benzoate (SB, 2%, w/w) as antifungal agent were optimized using the Box–Behnken response surface methodology to extend the postharvest life of 'Orri' mandarins. The second order polynomial models satisfactorily fitted the experimental data, with high values of the coefficient of determination for the different variables (R2>0.91). The individual linear effect of GMS concentration was significant in all the responses evaluated, whereas PPS only affected emulsion viscosity, fruit tacking, and weight loss of coated mandarins. Gly only affected acetaldehyde content in the juice of coated mandarins when interacted with PPS and in the quadratic effect. The optimum concentrations of PPS, GMS, and Gly based on maximum fruit quality and required emulsion properties were predicted to be 2.0, 0.5, and 1.0% (w/w), respectively. The optimized EC reduced weight loss of mandarins and created a modified atmosphere within the fruit without negatively affecting the overall acceptability of the fruit. On the other hand, the optimized EC significantly reduced postharvest green and blue molds and sour rot on mandarins artificially inoculated with the pathogens Penicillium digitatum, Penicillium italicum , and Geotrichum citri-aurantii , respectively. Therefore, the optimized antifungal EC containing SB showed potential to control the main postharvest diseases and maintain the overall quality of 'Orri' mandarins and could be a suitable alternative to commercial citrus waxes formulated with conventional chemical fungicides.

Keywords: /Citrus reticulata/ /Disease control/ /Geotrichum citri-aurantii/ /Penicillium digitatum/ /Penicillium italicum/ /Postharvest quality/

PEACH

Zhao, Y., Song, C., Brummell, D. A., Qi, S., Lin, Q., Bi, J., & Duan, Y. (2021). Salicylic acid treatment mitigates chilling injury in peach fruit by regulation of sucrose metabolism and soluble sugar content. *Food Chemistry*, *358*, 129867. https://doi.org/10.1016/j.foodchem.2021.129867

A pre-storage treatment with salicylic acid reduced chilling injury in peaches. Salicylic acid treatment regulated sugar metabolism and increased sucrose content. Treatment regulated the expression of genes related to sucrose metabolism. Treatment increased expression of two dehydration-responsive transcription factors. Peach fruit stored in the cold are susceptible to chilling injury. A pre-storage treatment with the natural hormone salicylic acid can alleviate chilling damage, although the mechanism is unclear. We found that a treatment with 1 μmol L−1 salicylic acid for 15 min prior to storage at 4 °C delayed and reduced fruit internal browning, a symptom of chilling injury. Salicylic acid had a large effect on sugar metabolism, increasing total soluble sugars via a substantial increase in sucrose content. The transcript abundance of genes related to sucrose biosynthesis and degradation was significantly regulated by salicylic acid, consistent with the changes in sucrose content. Salicylic acid treatment also increased the expression of two DREB cold stress-related proteins, transcriptional activators that regulate cold resistance pathways. The results show that salicylic acid alleviates chilling injury in peach by multiple mechanisms, including an increased content of sucrose and activation of cold response genes.

Keywords: /Chilling injury/ /DREB1/ /Internal browning/ /Salicylic acid/ /Soluble sugars/ /Sucrose/

PEARS

Cheng, S., Ouyang, H., Guo, W., Guo, M., Chen, G., & Tian, H. (2021). Proteomic and physiological analysis of “Korla” fragrant pears (Pyrus × brestschneideri Rehd) during postharvest under cold storage. *Scientia Horticulturae*, *288*, 110428. https://doi.org/10.1016/j.scienta.2021.110428

Abstract

2-DE and MALDI-TOF-MS were used to investigate the proteome of pear. Environmental stress can promote the up regulation of resistance protein expression. Differential proteins involved in energy metabolism, oxidative stress have been discovered. Low-temperature storage is widely used to maintain

the quality of postharvest fruit and prolong the shelf-life. Although the biochemical and physiological changes occurring during pear during storage have been explored in previous studies, the underlying mechanisms remain unclear. Herein, protein expression profiles of pears during cold storage were investigated by two-dimensional electrophoresis (2-DE). Proteomic analysis revealed 22 significantly differentially expressed proteins, 21 of which were identified by matrix-assisted laser desorption/ionisation time-of-flight mass spectrometry (MALDI-TOF-MS). Functional annotation of the differentially expressed proteins (DEP) revealed that many were involved in carbohydrate and energy metabolism, signal transduction and transcriptional regulation, stress response and antioxidants, and protein metabolism. An increase in the activity of ethylene synthesis-related enzymes and a decrease in protein synthesis capacity indicate that fruit senescence remained normal during cold storage. Two pathogenesis-related proteins (β-1,3-glucanase and Pyr c1) in the glycosyl hydrolyse pathway were up-regulated, which may increase the resistance of pears to low temperature or pathogen stress. Our results presented some useful information on the changes of protein during senescence of fragrant pear that will help to better understand cellular events in pears during cold storage, and minimize postharvest losses.

Keywords: /Antioxidant system/ /Cold storage/ /Energy metabolism/ /Ethylene synthesis/ /Pear/ /Proteomics/ /Senescence/

Lv, J., Xu, D., Zhang, Y., Ding, S., Sun, M., Bai, L., Ge, Y., & Li, J. (2021). Effects of abscisic acid (ABA) on ethanol fermentation during postharvest ripening of Nanguo pear fruit (Pyrus ussuriensis Maxim.). *Scientia Horticulturae*, *288*, 110388. https://doi.org/10.1016/j.scienta.2021.110388

Abstract

ABA accelerated postharvest ripening of nanguo pears, whereas NDGA delayed it. Ethanol fermentation was promoted by ABA while inhibited by NDGA during ripening. ABA had a promoting effect on glycolysis while NDGA had the opposite effect. The TCA cycle in Nanguo pears was modulated by ABA during ripening. Expression of PDC and ADH was differentially regulated by ABA during ripening. The aim of this study was to explore the role of abscisic acid (ABA) in ethanol fermentation during postharvest ripening of Nanguo pear fruit (Pyrus ussuriensis Maxim.). Pears harvested at commercial maturity were treated with 100 μmol L−1 ABA or its biosynthesis inhibitor nordihydroguaiaretic acid (NDGA). Our data indicated that ABA treatment promoted respiration rate and ethylene production during ripening compared with controls, while NDGA treatment had the opposite effects. During the early ripening stage, flesh firmness in the ABA treatment group was lower than in controls; while in the NDGA treatment group, it was higher than in controls. The contents of glucose, ethanol and acetaldehyde were increased by ABA treatment while reduced by NDGA treatment during ripening compared with the controls. ABA treatment promoted pyruvate and acetyl-CoA contents, whereas application of NDGA reduced pyruvate content and delayed the peak of acetyl-CoA content compared with the controls. The oxaloacetic acid (OA) and citric acid (CA) contents were reduced by ABA treatment while increased by NDGA treatment during ripening. ABA treatment promoted pyruvate decarboxylase (PDC) and alcohol dehydrogenase (ADH) activities, whereas NDGA treatment reduced their activities mainly at the early ripening stage. Quantitative real-time polymerase chain reaction (qPCR) showed that expression of PDC1, ADH1 and ADH2 was differentially up-regulated by ABA treatment during ripening while down-regulated by NDGA treatment compared with the controls. PDC2 expression was enhanced after application of NDGA during ripening while reduced by ABA treatment at the early ripening stage. Our data indicated that ABA had a promoting effect on ethanol fermentation during ripening of Nanguo pear fruit.

Keywords: /Abscisic acid/ /Ethanol fermentation/ /Pear fruit/ /Ripening/

Lwin, H. P., Rudell, D. R., & Lee, J. (2021). Metabolism and cold chain performance of "Chuhwangbae" Asian pears as impacted by 1-MCP treatment. *Scientia Horticulturae*, *288*, 110357. https://doi.org/10.1016/j.scienta.2021.110357

Abstract

Pears were treated with 1-MCP, kept at 1 °C for 3 M, held at 25 oC for 14 d to ripen. 1-MCP retained flesh firmness but enhanced fresh weight loss. 1-MCP reduced flesh browning severity but induced shriveling. Fructose and sorbitol were higher in 1-MCP-treated fruit during cold storage. Histidine, GABA, phenylalanine, and tyrosine were higher in 1-MCP-treated fruit during cold storage. The 'Chuhwangbae' Asian pear, a late-season cultivar that has become popular in Korea, is susceptible to physiological disorders during cold storage. The objective of this study was to evaluate the effect of 1-methylcyclopropene (1-MCP) treatment on fruit quality, physiological disorders, and targeted metabolites of 'Chuhwangbae' Asian pear fruit during cold storage and at the post-storage ripening stage. 'Chuhwangbae' Asian pear fruit were treated with 1-MCP immediately following harvest, stored at 1 °C for up to 3 months, and subsequently stored at 25 °C for 14 d to ripen. Indicators of fruit quality, namely the incidence of browning disorder and the degree of water loss or "shriveling," as well as levels of key metabolites, were repeatedly analyzed during the simulated cold chain. Fruit treated with 1-MCP lost more weight but slightly maintained firmness than did untreated fruit during the entire cold chain. Treatment with 1-MCP reduced the severity of flesh browning but enhanced the incidence and severity of shriveling during post-storage ripening after 3 months of cold storage. GABA, histidine, phenylalanine, and tyrosine levels were higher in the flesh of the 1-MCP-treated fruit than in untreated fruit. The results indicate that the overall changes in metabolite levels following 1-MCP treatment were less during cold storage than those during post-storage ripening. Therefore, postharvest 1-MCP treatment could be at least partially effective in retaining flesh firmness and reducing the severity of internal browning of 'Chuhwangbae' Asian pears during the entire cold chain.

Keywords: /1-Methylcyclopropene/ /Pears/ /Cold Storage/ /Phenylanine/ /Fruit quality/ /Fruit/

Xu, M., Zhang, X., Dhanasekaran, S., Godana, E. A., Yang, Q., Zhao, L., & Zhang, H. (2021). Transcriptome analysis of postharvest pear (Pyrus pyrifolia Nakai) in response to Penicillium expansum infection. *Scientia Horticulturae*, *288*, 110361. https://doi.org/10.1016/j.scienta.2021.110361

Abstract

Pear gene expression responses to P. expansum were clustered by STEM analysis. Functional annotation of DEGs in profiles were done by GO and KEGG enrichment. Pears can produce a complex defense reactions after P. expansum infection. P. expansum can increase the activities of resistant enzymes in pears. In pears, blue mold decay caused by Penicillium expansum, is a destructive postharvest disease around the world, which leads to stasis of the pear industry and creates huge economic losses. Our previous research work proved that P. expansum mainly secretes cell wall degrading enzymes (CWDEs) to infect pears. To further understand the molecular basis of P. expansum infection and disease progression, in the present study we have tried to investigate the transcriptome of pears infected with P. expansum. The differentially expressed genes (DEGs) identified from the RNA-seq results were clustered into 2 upward trends and 6 downward trends according to their gene expression patterns. Comparison of Gene ontology (GO) terms in downward and upward trend profiles evidenced that the enriched GO terms (included metabolic processes for l -phenylalanine, aromatic amino acid family and ethylene, etc.), found in upward trend profiles were more relevant to pear defense. Moreover, the Kyoto Encyclopedia of Genes and Genomes (KEGG) results revealed that pears can produce a complex defense response against P. expansum infection. Briefly, P. expansum produced CWDEs to establish infection, which triggers relevant transduction pathways in pear. These pathways led to further activation of the secondary regulatory networks. Finally, some metabolites were synthesised to defense against P. expansum. In general, the information obtained in this study will be supportive to develop new strategies to control fungal diseases.

Keywords: /Defense mechanism/ /Pear/ /Penicillium expansum/ /Plant secondary metabolite/ /RNA-seq/ /Transcription factor/

POSTHARVEST DISEASE

Cui, X., Ma, D., Liu, X., Zhang, Z., Li, B., Xu, Y., Chen, T., & Tian, S. (2021). Magnolol inhibits gray mold on postharvest fruit by inducing autophagic activity of Botrytis cinerea. *Postharvest Biology & Technology, 180,* 111596. https://doi.org/10.1016/j.postharvbio.2021.111596

Abstract

Botrytis cinerea, a phytopathogen causing gray mold on over 1400 species worldwide, has led to huge losses in agricultural products. Efforts have been made to control this notorious pathogen. However, efficient plant metabolites for suppressing *B. cinerea* are still seldom reported and data on their potential targets of action are scarce. In this study, magnolol, a functional ingredient in *Mangnolia officinalis*, substantially inhibited *B. cinerea* mycelial growth and its virulence on harvested fruit. The inhibitory effect was mainly caused by the activation of autophagic activity in *B. cinerea*, damages in normal structures of mitochondria and accumulation of excessive reactive oxygen species (ROS). Furthermore, the ROS-induced oxidative stress impaired membrane integrity and attenuated cell vitality, resulting in reduced mycelial growth and virulence. Collectively, these results suggest that magnolol shows efficacy in suppressing *B. cinerea* and thus may be further explored as an alternative for controlling gray mold.

Keywords: /Autophagic structures/ /*Botrytis cinerea*/ /Fruit/ /Magnolol/ /Membrane integrity/

POSTHARVEST TECHNOLOGIES

Fonseca, J. de M., Pabón, N. Y. L., Nandi, L. G., Valencia, G. A., Moreira, R. de F. P. M., & Monteiro, A. R. (2021). Gelatin-TiO2-coated expanded polyethylene foam nets as ethylene scavengers for fruit postharvest application. *Postharvest Biology & Technology*, *180*, 111602. https://doi.org/10.1016/j.postharvbio.2021.111602

Abstract

The efficacy of polyethylene foam nets coated with gelatin-TiO_2 photocatalytic nanocomposite to postpone the climacteric fruit ripening was evaluated. The gelatin-TiO_2 nanocomposite was deposited on the foam nets by dip-coating and used to degrade ethylene produced by papayas. Fruit treated with TiO_2 photocatalysis showed an ethylene accumulation 60 % less than the control experiment fruit after four days under UV-A light. The photocatalytic degradation of ethylene produced by papayas over four days caused an effective delay of their ripening. It was characterized by the respiration rate reduction during the climacteric peak, absence of scalds and superficial fungi growth and more remarkable preservation of green color and firmness than control samples. The results showed that nanocomposite foam nets degraded ethylene under UV-A light and postponed the fruit ripeness and quality changes.

Keywords: /Active properties/ /Nanocomposite materials/ /Food packaging/ /Biopolymers/ /Semiconductor photocatalyst/

Maan, A. Ahmed, Z., Khan, M., Riaz, & Nazir, A. (2021). *Aloe vera* gel, an excellent base material for edible films and coatings. *Trends in Food Science and Technology, 116*, 329-341. https://doi.org/10.1016/j.tifs.2021.07.035

Abstract

Edible films/coatings are thin layers of eatable materials which, when applied to foods, can modify the exchange of molecules between food and environment as well as between different compartments of the same food. The films/coatings help the foods to maintain their freshness and also facilitate their

transportation, storage and display. As demand for healthy foods is increasing rapidly, various novel materials from herbal sources are extensively being explored as raw materials for edible films/coatings. *Aloe vera* is a popular herbal plant and is well known for its therapeutic properties. The gel extracted from *Aloe vera* leaves comprises a variety of bioactive compounds, minerals and phenolic contents. For this reason, *Aloe vera* gel has attracted considerable attention as edible and active film/coating material. The present paper provides a detailed literature review on extraction, suitability and applications of *Aloe vera* gel as edible film/coating material, either alone and in combination with conventional film forming materials. *Aloe vera* gel films/coating are quite effective for shelf-life extension of various perishable food commodities (in a dose-dependent manner); however, the optimum gel concentration still needs to be investigated. The blending of *Aloe vera* gel with traditional biopolymers (proteins and polysaccharides) and lipids (emulsions) seems a promising approach for tuning properties of films/coating in terms of transparency, smoothness, rigidity, elasticity, water vapor permeability, and bio-functionality. Further research is needed to address some technological challenges to develop *Aloe vera* gel-based films/coatings with easily tunable properties.
Graphical abstract

Keywords: /*Aloe vera*/ /Edible coatings/ /Composite films/ /Emulsions/ /Active packaging/

STRAWBERRY

Sun, Y., Wang, Y., Xu, Y., Chen, T., Li, B., Zhang, Z., & Tian, S. (2021). Application and mechanism of benzyl-isothiocyanate, a natural antimicrobial agent from cruciferous vegetables, in controlling postharvest decay of strawberry. *Postharvest Biology & Technology*, *180*, 11604. https://doi.org/10.1016/j.postharvbio.2021.111604

Abstract

Gray mold, caused by *Botrytis cinerea*, is an important cause of postharvest loss of strawberry fruit. In the present study, we found that benzyl-isothiocyanate (BITC), a natural compound widely existing in cruciferous vegetables with anti-cancer effect, was effective in controlling postharvest gray mold of strawberry fruit, and also strongly inhibited the natural decay of strawberry. The mode of action of BITC against *B. cinerea* was mainly attributed to its direct inhibition on spore germination. BITC application could disrupt the plasma membrane integrity and induce ROS accumulation in the spores of *B. cinerea*, eventually leading to cell death. To further investigate the inhibitory mechanisms of BITC against *B. cinerea*, we conducted a comparative transcriptome analysis. Most of the differentially expressed genes (DEGs) participated in the metabolism of carbohydrate, lipid and amino acid, the genetic information processing, as well as the biosynthesis of other secondary metabolites. This study provides a safe and promising method to control strawberry postharvest diseases based on BITC, and gets insight into the antimicrobial mechanism of BITC.

Keywords: /Strawberry/ /Postharvest disease/ /Benzyl-isothiocyanate/ /Antifungal activity/ /Transcriptome/

SWEET POTATO

Pang, L., Lu, G., Cheng, J., Lu, X., Ma, D., Li, Q., Li, Z., Zheng, J., Zhang, C., & Pan, S. (2021). Physiological and biochemical characteristics of sweet potato (Ipomoea batatas (L.) Lam) roots treated by a high voltage alternating electric field during cold storage. *Postharvest Biology & Technology*, *180*, 111619. https://doi.org/10.1016/j.postharvbio.2021.111619

Abstract

Physical methods for preserving agricultural products without using chemicals or radiation are increasingly being explored. The effects of high-voltage alternating electric field (HVAEF) on the physiology and biochemical processes of sweet potato roots during cold storage for 60 d were

investigated in this study. Roots were treated with HVAEF (4 kV m^{-1}) and stored at 13 ± 1 °C and 85–90 % relative humidity. Studies on sweet potato root quality, antioxidant metabolic pathway, and sugar metabolic pathway showed that HVAEF treatment could maintain the integrity of cell membrane, reduce respiration rate, and delay the loss of starch and water in the sweet potato roots. Scanning electron microscopy analysis revealed that HVAEF treatment was helpful in maintaining the integrity of starch granules. Nuclear magnetic resonance analysis revealed that HVAEF treatment could affect the distribution and migration of water in sweet potatoes. Furthermore, the hydrolysis of starch and loss of water in sweet potatoes were effectively inhibited. These results implied that HVAEF could not only inhibit the activities of metabolism-associated enzymes, but also prevent enzymatic browning, maintain nutritional quality, and delay starch degradation and reduce the accumulation of reducing sugars during cold storage. The current findings suggest that HVAEF is a promising technique for the preservation of quality in sweet potato roots during postharvest.

Keywords: /Sweet potato/ /High-voltage alternating electric field/ /Enzyme activity/ /Quality/ /Cold storage/

Zhang, H., Zhou, S., Pristijono, P., Golding, J. B., Yang, H., Chen, G., & Li, Y. (2021). Role of AOX in low-temperature conditioning induced chilling tolerance in sweetpotato roots. *Scientia Horticulturae*, *288*, 110365. https://doi.org/10.1016/j.scienta.2021.110365

Abstract

LTC pre-treatment alleviated CI, suppressed MDA and ROS levels in sweetpotato. The application of AOX inhibitor SHAM counteracted the effect of LTC on CI. SHAM crippled the antioxidant system and reduced proline and ATP content. SHAM suppressed IbAOX1a and IbAOX1b expression and AOX protein abundance. Chilling injury is a significant postharvest physiological disorder in sweetpotatoes during storage. This study investigated the role of alternative oxidase (AOX) in low-temperature conditioning (LTC) induced chilling tolerance in sweetpotato storage roots. Roots were pre-treated with a LTC treatment (12°C for 5 days) or with salicylhydroxamic acid (SHAM, AOX inhibitor) combined with LTC, followed by storage at 4°C for 35 days. Results showed that LTC pre-treatment significantly lowered root chilling injury symptoms, suppressed malondialdehyde levels and the accumulation of reactive oxygen species. However, SHAM reduced the impact triggered by LTC and resulted in lower antioxidant enzyme activities and free proline content, reduced glutathione and adenosine triphosphate contents compared with LTC alone. The results from gene expression analysis showed that LTC-induced higher transcript levels of IbAOX1a and IbAOX1b during storage at 4°C. However, SHAM suppressed the effect of LTC. SHAM treatment not only reduced AOX activity but also resulted in a lower AOX transcript and protein abundance, which might contribute to the lower AOX activity observed in the SHAM treated roots. These results suggest that AOX participates in LTC-induced chilling tolerance of sweetpotato storage roots.

Keywords: /Alternative oxidase/ /Antioxidant enzymes/ /Chilling injury/ /Low-temperature conditioning/ /Sweetpotato/

TOMATO

Huo, X.-L., Zhu, C.-C., Jiang, H., Yuan, Q., Wang, J.-J., Wang, J.-Y., Pan, Z.-Q., Chen, C.-L., Wu, Z.-Q., & Bao, N. (2021). Rapid profiling of IAA and SA in tomato fruit during ripening using low-cost paper-based electroanalytical devices. *Postharvest Biology & Technology*, *180*, 111635. https://doi.org/10.1016/j.postharvbio.2021.111635

Abstract

Fruit ripening is a progress involving many physiological changes regulated by various plant hormones such as indole-3-acetic acid (IAA) and salicylic acid (SA). The levels of these hormones in fruit with the

spatial-temporal resolution can provide detailed information for the study and evaluation of the fruit ripening. Herein paper-based analytical devices and the microsampling technique were coupled for the analysis of IAA and SA in different locations of the tomato fruit during ripening. Because of its excellent electric conductivity, the ITO glass was used as the substrate of the disposable working electrodes and modified with conductive carbon cement. The ITO modified electrodes in the paper-based analytical devices were utilized for analysis of IAA and SA in tiny tomato samples obtained with the technique of microsampling. Our results showed that the amounts of IAA and SA in the locular tissue of tomato fruit decreased via time in the process of ripening. More importantly, the spatial profiling of IAA and SA in immature and mature tomatoes could be directly differentiated at the molecular level. This study suggested that low-cost paper-based electroanalytical devices could become an effective platform for rapid evaluation of the fruit ripening.

Keywords: /Tomato ripening/ /Indole-3-acetic acid/ /Salicylic acid/ /Paper-based analytical device/ /Disposable working electrode/

Li, Z., Min, D., Fu, X., Zhao, X., Wang, J., Zhang, X., Li, F., & Li, X. (2021). The roles of SlMYC2 in regulating ascorbate-glutathione cycle mediated by methyl jasmonate in postharvest tomato fruits under cold stress. *Scientia Horticulturae*, *288*, 110406. https://doi.org/10.1016/j.scienta.2021.110406

Abstract

MeJA promoted ascorbate-glutathione (AsA-GSH) cycle in tomato under cold stress. l MeJA treatment activated the SlICE-SlCBF-SlCOR (ICC) signaling pathway. l SlMYC2 silence counteracted the effects of MeJA and aggravated the chilling injury. l SlMYC2 positively regulated MeJA-mediated AsA-GSH cycle and ICC signaling pathway. This study parsed the mechanism of SlMYC2 involving methyl jasmonate (MeJA)-mediated tomato fruit chilling tolerance. The data indicated that the application of MeJA significantly prevented chilling injury (CI) and inhibited the accumulation of hydrogen peroxide (H 2 O 2) and superoxide anions (O 2 •−) in tomato fruit during cold storage. The accumulation of endogenous ascorbate (AsA) and glutathione (GSH) contents in fruit were enhanced by MeJA treatment resulting from increasing activities of enzymes related to AsA-GSH cycle. Meanwhile, the MeJA-treated fruit exhibited significantly higher expression levels of C-repeat-binding factor 1 (SlCBF1), cold regulated gene (SlCOR413) and inducer of SlCBF expression (SlICE1 and SlICEa), which belong to the SlICE-SlCBF-SlCOR (ICC) signaling pathway. However, the effects of MeJA were inhibited by the silence of SlMYC2. The expression levels of SlCBF1, SlCOR413, SlICE1 and SlICEa were reduced in SlMYC2 -silenced fruits, and there was no significant difference in CI index and the indexes related to AsA-GSH cycle between (SlMYC2-silenced+MeJA)-treated fruit and control during most storage periods. In addition, correlation analysis indicated that the indexes involved in AsA-GSH cycle and ICC signaling pathway were closely related to the transcription of SlMYC2. Therefore, these results illustrated that SlMYC2 was involved in the regulation of ASA-GSH cycle and ICC signaling pathway mediated by MeJA during the cold tolerance of tomato fruit.

Keywords: /Ascorbate-glutathione cycle/ /Chilling tolerance/ /Methyl jasmonate/ /SlICE-SlCBF-SlCOR signaling pathway/ /SlMYC2/ /Tomato fruits/

Li, C., Hou, X., Qi, N., Liu, H., Li, Y., Huang, D., Wang, C., & Liao, W. (2021). Insight into ripening-associated transcription factors in tomato: A review. *Scientia Horticulturae*, *288*, 110363. https://doi.org/10.1016/j.scienta.2021.110363

Abstract

The mechanism of action of tomato ripening-associated TFs. Direct target genes of TFs. The roles of interaction between TFs and proteins in ripening. The regulation of ripening in fleshy fruits has been the subject of considerable scientific study, mainly due to that it directly affects the shelf life and quality of

such fruits. Fruit ripening is controlled by many factors, including hormones, environmental signals and transcription factors. Tomato (Solanum lycopersicum) has long served as an excellent model for fleshy fruit ripening. Here, we present a comprehensive overview of the recent developments of the mechanisms that regulate fruit ripening in tomato by transcription factors, including NAC, MADS-box and bHLH transcription factors, ZFPs, SRs/CAMTA and HD-zip homeobox proteins. The involvement of ethylene- and auxin-related transcription factors in controlling ripening has been highlighted in this review. Interestingly, some transcription factors regulate fruit ripening in tomatoes via directly targeting ripening-related genes. Protein-protein interaction also plays a vital role in modulating tomato fruit ripening. Moreover, we also review the advances in the application of RNAi and CRISPR/Cas technology for crop improvement, which may help develop many mutant crop varieties in the future. The identification of the key transcription factors in tomato ripening has opened new horizons in our understanding of fruit ripening. This review will be useful for researchers engaged in fruit ripening and crop improvement around the globe.

Keywords: /Fruit ripening/ /Protein-protein interaction/ /Target/ /Tomato/ /Transcriptional factors/

Liu, Y., Sun, Y., Ye, M., Zhu, L., Zhang, L., & Zhu, S. (2021). Improvement in storage quality of postharvest tomato fruits by nitroxyl liposomes treatment. *Food Chemistry*, *359*, 129933. https://doi.org/10.1016/j.foodchem.2021.129933

Abstract

The HNO liposomes were successfully prepared. HNO liposomes inhibited water loss in tomato fruit. HNO liposomes inhibited oxidative browning of tomatoes. HNO liposomes slowed down the aging of tomato fruit. Nitroxyl (HNO) has attracted much attention due to its unique biological activity. To investigate the preservation effect of HNO on fruits, a nitroxyl liposome based on 1-nitrosocyclohexyl acetate was prepared and characterized by infrared spectroscopy and transmission electron microscopy. The optimal preparation conditions were explored, and then HNO liposomes were prepared under the optimal conditions to study the effect of HNO liposomes on postharvest quality of tomatoes. The tomato fruits were treated with different concentrations (0, 5, 10, 15 and 20 μmol L-1) of HNO liposomes and stored at room temperature. The results indicated that treatment with HNO liposomes can more effectively delay the browning and slow down the decrease in lightness of tomatoes. Additionally, HNO liposomes can reduce the activity of PPO and POD, inhibit the increase of MDA and total phenol content. These results suggest that treatment with HNO liposomes can effectively preserve the quality of tomatoes.

Keywords: /HNO liposomes/ /Nitroxyl/ /Postharvest quality/ /Tomato/

Tilahun, S., Lee, Y. M., Choi, H. R., Baek, M. W., Lee, J.-S., Park, D. S., Kang, H.-M., & Jeong, C. S. (2021). Modified atmosphere packaging combined with CO2 and 1-methylcyclopropene prolong the storability and maintain antioxidant properties of cherry tomato. *Scientia Horticultura*e, *288*, 110401. https://doi.org/10.1016/j.scienta.2021.110401

Abstract

MAP + CO 2 and MAP + 1-MCP maintain the physicochemical parameters. MAP + CO 2 and MAP + 1-MCP maintain the antioxidant properties. MAP, AMAP, MAP + 1-MCP, and MAP + CO 2 treatments maintain DPPH inhibition. The order of importance could be MAP + CO 2 > MAP + 1-MCP > AMAP > MAP. Cherry tomato is a perishable fruit vegetable that requires packaging for a relatively long distribution period. In this study, we combined the effects of changing the normal composition of air in the package and short-term pre-storage treatment of fruits with 1-methylcyclopropene (1-MCP) and high CO 2 to maintain quality and extend the distribution period of 'Unicorn' cherry tomato. The treatments were modified atmosphere packaging (MAP), active modified atmosphere packaging (AMAP), high CO 2 + MAP, and 1-MCP + MAP. All the treatments were sealed with 40,000 cc/m2 day atm oxygen transmission

rate (OTR) film and stored at 20 and 10 °C up to 11 and 15 days, respectively. Based on the observed results of physicochemical and antioxidant parameters, the order of importance to prolong storability and maintain antioxidant properties of cherry tomatoes could be MAP + CO 2 > MAP + 1-MCP > AMAP > MAP. The current study provides important practical information on the packaging systems of cherry tomatoes to extend the distribution period and maintain antioxidant properties for the satisfaction of either the domestic or the neighboring overseas consumers.

Keywords: /Distribution period/ /Nutritional quality/ /Physicochemical properties/ /Pre-storage treatments/

Uluisik, S., & Oney-Birol, S. (2021). Uncovering candidate genes involved in postharvest ripening of tomato using the Solanum pennellii introgression line population by integrating phenotypic data, RNA-Seq, and SNP analyses. *Scientia Horticulturae*, *288*, 110321. https://doi.org/10.1016/j.scienta.2021.110321

Abstract

RNA-Seq was used to identify genes related to tomato softening by comparing transcriptomic variations between the firmest and softest S. pennellii ILs. • Forty-two DEGs were screened as putative ripening related genes in which SlERF.H10 was an especially promising softening related gene identified in this study. • SNP regions between selected lines and M82 were identified for use in future molecular breeding approaches. Fruit shelf life in tomato (Solanum lycopersicum) and many other fleshy fruits is determined by several factors including cell wall structure, turgor, and cuticle properties. In this study, an introgression line (IL) population derived from a cross between Solanum pennellii (LA0716) and the S. lycopersicum cultivar M82 was used to identify candidate genes (CGs) that might be responsible for controlling tomato shelf life. IL4-2 and IL4-3-2 were identified as soft lines, IL5-1 and IL9-1-3 as firm lines based on their Br7 and Br14 firmness and shelf-life performance. To gain deeper insights into the genes that might play a regulatory key role in tomato shelf-life, transcriptome profiling was performed for the four ILs and M82 as the reference genome. A total of 5,580 Differentially Expressed Genes (DEGs) with 2,333 up-regulated and 3,247 down-regulated genes, were differentially expressed in IL4-2 vs M82, IL4-3-2 vs M82, IL5-1vs M82, and IL9-1-3 vs M82 combinations. Forty-two DEGs were selected as putative ripening related genes. The expression of nine genes potentially involved in ripening/softening process out of 42 DEGs was verified by qPCR. The RNA-Seq data was also used to discover SNPs between the ILs and the reference genome. The SNPs on CGs were converted to Cleaved Amplified Polymorphic Sequence (CAPS) markers which could be used in breeding programs in the future.

Keywords: /CAPS marker/ /Cell wall/ /Postharvest ripening/ /RNA-Seq/ /Shelf-life/ /Tomato/

Zhang, Y., Ntagkas, N., Fanourakis, D., Tsaniklidis, G., Zhao, J., Cheng, R., Yang, Q., & Li, T. (2021). The role of light intensity in mediating ascorbic acid content during postharvest tomato ripening: A transcriptomic analysis. *Postharvest Biology & Technology*, *180*, 111622. https://doi.org/10.1016/j.postharvbio.2021.111622

Abstract

Ascorbic acid (ASA) is an essential antioxidant, participating in diverse processes. In this study, tomato fruit at two maturity stages (mature-green, breaker) were first exposed to light at four photosynthetic photon flux density (PPFD) levels [0 (darkness), 50, 300, 600 μmol m^{-2} s^{-1}], and then to darkness. As PPFD increased, ASA content was enhanced. The light-induced ASA content increase was dependent on the maturity stage, and persisted following darkening. High PPFD up-regulated the expression of key genes of the D-mannose/L-galactose pathway, showing the biosynthesis contributed, while the ASA recycling had a limited contribution. Weighted correlation network analysis showed that high PPFD potentially enhances the photosynthetic photon transduction, especially cyclic electron flow to excess photons. High PPFD up-regulated the expression of genes encoding non-enzymatic antioxidant

biosynthesis. We show that photosynthetic photon transduction mediates fruit adaptation to light intensity, and provides new insights into the interactive regulation of fruit ASA accumulation.

Keywords: /Ascorbic acid/ /D-Man/L-Gal pathway/ /Mature-green/ /Photosynthetic photon flux density/ /Photosynthetic photon transduction/ /Postharvest/ /*Solanum lycopersicum*/