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As of April 2022

APPLE

Liu, P., Shen, J., Wang, Y., Fang, Q., Yuan, S., Qu, G., & Cao, J. (2022). Effect of p-coumarate esters resistant against postharvest Botrytis cinerea infection in apple fruit. *Scientia Horticulturae*, *297*, N.PAG. https://doi.org/10.1016/j.scienta.2022.110926

Abstract

Methyl and ethyl p -coumarates inhibited infection of Botrytis cinerea on apples. Treatments with MpCA and EpCA acted via destroying plasma membranes of the pathogen. MpCA and EpCA enhanced apple phenylalanine ammonia-lyase and peroxidase activities. Exogenous MpCA and EpCA stimulated great accumulation of chlorogenic acid in apples. MpCA and EpCA would provide a promising approach for control of postharvest decays. Gray mold rot caused by Botrytis cinerea is one of the most common diseases resulting in considerable postharvest losses of fruits. The antifungal activity of esterified p -coumarates on Botrytis rot in apple fruit were investigated. Results showed that the mycelial growth and spore germination of B. cinerea were effectively inhibited by the application of methyl p -coumarate (MpCA) and ethyl p -coumarate (EpCA). Treatments with MpCA and EpCA resulted in a large leakage of intercellular electrolytes, soluble proteins and sugars, and ultrastructural distortion of the pathogen during growth, suggesting that p -coumarate esters may act via destroying the plasma membrane of the pathogen. In addition, treatments with MpCA and EpCA significantly inhibited the infection on apple fruit by B. cinerea. MpCA and EpCA up-regulated expression of genes encoding a pathogenesis-related protein (PR1), phenylalanine ammonia-lyase (PAL) and peroxidase (POD), enhanced activities of PAL and POD, and stimulated the accumulation of chlorogenic acid and catechin in the fruit. MpCA and EpCA thereby activated the disease-resistance system and the metabolism of polyphenols and flavonoids against the infection by B. cinerea. Collectively, two p -coumarate esters could not only exert their direct antifungal activity, but also induce the defense mechanism of host apple fruit. Application of MpCA and EpCA would provide a promising approach for the control of postharvest diseases of fruits.

Keywords: /Antifungal activity/ /Apple fruit/ /Botrytis cinerea/ /Disease resistance/ /Ethyl p-coumarate/ / Methyl p-coumarate/

Matabura, V. V. (2022). Modelling of firmness variability of Jonagold apple during postharvest storage. *Journal of Food Science and Technology*, *59*(4), 1487–1498. https://doi.org/10.1007/s13197-021-05159-5

Abstract

The firmness of Jonagold apples is an important quality attribute during the postharvest chain. However, postharvest handlers are faced with variability in the firmness that exists within apples even of those of the same batch and cultivar. Here, Jonagold apples were stored at 1 °C and 4 °C with different controlled atmospheric gas compositions for 170 d, and then exposed to shelf-life conditions for 15 d, and other portion of apples was immediately stored to shelf-life scenario for 21 d. The firmness and ethylene emission of the apples were quantified during storage. A kinetic model equation was established to predict the firmness breakdown of apples depending on storage conditions. The model was based on a stochastic technique that incorporated biological variability in firmness. A relative sensitivity analysis was carried out to analyze the utmost stochastic parameters and fruit-specific data were obtained. The Monte Carlo method was applied to predict how the initial fruit variability in firmness within Jonagold apples propagates throughout the postharvest storage. The simulation outputs suggest that the model established in study may be useful to manage the biological variability and describe how the initial firmness variability propagates during the postharvest chain.

Keywords: /Controlled atmosphere/ /Ethylene production/ /Firmness quality/ /Jonagold apples/ /Stochastic modeling/

APRICOT

Liu, M., Li, J., Zong, W., Sun, W., Mo, W., & Li, S. (2022). Comparison of calcium and ultrasonic treatment on fruit firmness, pectin composition and cell wall-related enzymes of postharvest apricot during storage. *Journal of Food Science and Technology*, *59*(4), 1588–1597. https://doi.org/10.1007/s13197-021-05170-w

Abstract

This study was conducted to examine the effects of calcium treatment (2%, 20 min) and ultrasonic treatment (400 W, 20 min) on postharvest apricot fruit during storage. The results showed that after calcium and ultrasonic treatment, compared with the control, the firmness of apricot fruit increased by 41.53% and 3.83% at 16 d, but juice yield and water-soluble pectin (WSP) content decreased by 8.26% and 3.55%, 28.57% and 4.08%, respectively. Both calcium and ultrasonic treatment were more effective in reducing polygalacturonase (PG), β-Galactosidase (β-Gal), pectin methylesterase (PME), polyphenol oxidase (PPO) and peroxidase (POD) activity. Moreover, fruit firmness was significantly negatively correlated with juice yield, WSP and PPO, and positively correlated with PG and β-Gal, PPO and POD. In contrast, calcium treatment was more effective than ultrasonic treatment in delaying postharvest softening of apricot.

Keywords: /Apricot/ /Calcium/ /Pectin/ /Storage/ /Ultrasonic/

AVOCADO

Mokgalapa, N., Akinola, S. A., Shoko, T., Pillai, S. K., & Sivakumar, D. (2022). Chitosan molecular weights affect anthracnose incidence and elicitation of defense-related enzymes in avocado (Persea americana) cultivar "Fuerte." *International Journal of Food Microbiology*, *366*, 109561. https://doi.org/10.1016/j.ijfoodmicro.2022.109561

Abstract

Anthracnose decay is one of the major causes of postharvest losses of avocados (Persea americana), during marketing. Currently, Prochloraz® fungicide is used to control anthracnose at post harvest stage which poses threat to consumer safety. Therefore, this study evaluated the effects of high and low molecular weight chitosan on the control of avocado anthracnose and fruit defense mechanism. In curative inoculation, avocados '(Fuerte') were inoculated via the wounds with C. gloeosporioides spore suspension (20 μL, 1 × 106 spores mL−1). Thereafter coated with different concentrations (0.5%, 1% and 1.5%) of low (LMWC) and high molecular weight (HMWC) chitosan and fruits were held at 25 °C for 5 days. The % anthracnose incidence in avocado fruits was recorded on day 5. During preventative inoculation, wounded fruits were dipped in different concentrations of LMWC or HMWC solutions, and subsequently inoculated with C. gloeosporioides suspension. Preventatively inoculated fruits were stored for 28 days at 6.5 °C, 85% RH and thereafter for 5 days at 25 °C and 75% RH to simulated market shelf condition. The % anthracnose incidence was recorded on day 5. Fruit treated with Prochloraz® and water were included as controls for both curative and preventative infected fruits. Promising chitosan coatings with the lowest anthracnose incidence and the controls were investigated for skin epicatechin content, defense-related genes; phenylalanine ammonia lyase (PAL), lipoxygenase (LOX), fatty acid elongase (avael) and desaturase (avfad 1 2–3), chalcone synthase (CHS) and flavonol synthase (FLS) using RT-qPCR method. The zeta potential of selected chitosan coatings was done following standard procedures. Percentage of anthracnose incidence were lowest in 1.5% LMWC (18%, 3 mm) compared to Prochloraz® (23%, 5 mm) and the untreated fruit (90%, 24 mm). The 1.5% LMWC had the highest up-regulation of PAL , avfael , avfad 12–3, CHS, FLS genes and down-regulation of LOX gene with concomitant increase

in epicatechin content (340 mg kg−1) relative to other chitosan treatments, untreated and Prochloraz® treated fruits. The superior positive zeta potential of LMWC 1.5% coating corroborates its effectiveness in controlling avocado anthracnose than HMWC 1.5%. It is possible that the interaction between the positively charged chitosan amino group (-NH 3 +) and the negatively charged microbial cell membrane is responsible for the enhanced antifungal activity. In late season naturally infected fruits dipped in 1.5% LMWC, anthracnose incidence dropped to 28% while Prochloraz® treated fruits showed anthracnose incidence of 82% on day 8 at the market shelf. LMWC 1.5% can replace the currently used Prochloraz®. [Display omitted] Chitosan coating elicits a defense mechanism against anthracnose in avocado fruit. LMWC (1.5%) coating up-regulates the phenylpropanoid and diene AFD genes. LMWC (1.5%) coating prevents anthracnose incidence in avocado Fuerte fruits. LMWC (1.5%) can replace Prochloraz to control anthracnose decay in avocado.

Osondu, H., Akinola, S., Shoko, T., Pillai, S., & Sivakumar, D. (2022). Coating properties, resistance response, molecular mechanisms and anthracnose decay reduction in green skin avocado fruit ('Fuerte') coated with chitosan hydrochloride loaded with functional compounds. *Postharvest Biology and Technology, 186,* 111812. https://doi.org/10.1016/j.postharvbio.2021.111812

Abstract

Chitosan hydrochloride coating loaded with vanillic acid (CH-V) (0.07 %) or caffeic acid (CH-C) (0.07 %) controlled the anthracnose decay in preventatively inoculated green skin avocado Fuerte with *C. gloeosporioides* and in naturally infected fruit; decay was reduced less than 10 % after cold storage at 6.5 °C and 85 % RH for 28 d and at 7 d market shelf conditions at 18 °C. CH-V or CH-C coating induced higher upregulation of *PAL* (phenylalanine ammonia lyase), *CHS* (Chalcone synthase), *avfad12−3* (Δ12 fatty acid desaturase), *avfael* (Fatty acid elongase) genes with a concomitant increase in skin epicatechin and lowest *LOX* (lipoxygenase) expression. CH-V coating showed a higher impact on mode of action than the CH-C. CH-phytochemicals coated fruit ripened with higher overall acceptance. FTIR data showed the chemical interaction of phytochemicals with CH. Complex of CH and phytochemicals, optimal adhesion agent between the pathogens and the fruit, possibly favoured the phenolic compound-fungus interaction and cell damage.

Keywords: */Persea Americana/ /*Fruit coatings/ /Phytochemicals/ /Defense mechanism/ /Postharvest decay/ /Fourier transform infrared spectroscopy/

BANANA

Lai, X., Zhu, X., Chen, H., Pang, X., Chen, W., Li, X., & Song, Z. (2022). The MaC2H2-like zinc finger protein is involved in ripening and ripening disorders caused by chilling stress via the regulation of softening-related genes in 'Fenjiao' banana. *Postharvest Biology and Technology, 186*, 111817. https://doi.org/10.1016/j.postharvbio.2021.111817

Abstract

Abstract
As one of the largest transcription factor families, C2H2 zinc finger proteins contain a zinc finger motif and a conserved DNA-binding homeodomain. Although C2H2 zinc finger proteins have been found to play an essential role in ethylene biosynthetic and cold stress in banana fruit, their transcriptional regulatory mechanisms involved in the softening of 'Fenjiao' bananas remain largely elusive. In this study, a new *MaC2H2-like* gene was identified, which is closely related to fruit softening. *MaC2H2-like* localizes in the nucleus. MaC2H2-like activated the transcription of four starch (*MaBAM4*, *MaBAM6*, *MaISA2* and *MaPWD1*) and five cell wall (*MaEXP-A2*, *MaEXP-A8*, *MaSUR14*, *MaSUR14-like* and *MaXYL32*) degradation-related genes, by specifically interacting with their promoters. Protein-protein interaction assays showed that MaC2H2-like cooperates with ethylene-insensitive 3-binding F-box protein (MaEBF1) *in vitro* and *vivo*, and their interaction enhanced the binding and activated the promoter activities of

MaBAM4, *MaPWD1*, *MaISA2*, *MaEXP-A2*, *MaSUR14-like* and *MaXYL32*. The transient overexpression of *MaC2H2-like* in ‘Fenjiao’ banana fruit promoted fruit ripening and softening by accelerating ethylene production, decreasing fruit firmness and inducing the transcription of starch and cell wall degradation-related genes. Collectively, we uncovered a novel module of MaC2H2-like-MaEBF1 that cooperates in actively impacting starch and cell wall degradation by up-regulating the transcript level of genes related to the degradation of starch and cell walls.

Keywords: /MaC2H2-like/ /Ripening disorder/ /Cold stress/ /Starch and cell wall degradation/ /‘Fenjiao’ banana/

Wantat, A., Seraypheap, K., & Rojsitthisak, P. (2022). Effect of chitosan coatings supplemented with chitosan-montmorillonite nanocomposites on postharvest quality of “Hom Thong” banana fruit. *Food Chemistry*, *374*, 131731. https://doi.org/10.1016/j.foodchem.2021.131731

Abstract

The chitosan (CTS) solutions supplemented with chitosan-montmorillonite (CTS-MMT) nanocomposites at various concentrations were prepared for free-standing films by the casting technique. Incorporating 2% CTS-MMT nanocomposites into the free-standing CTS films could improve the water-resistance and oxygen barrier of the film. For the postharvest experiment, CTS and CTS supplemented with CTS-MMT nanocomposite solutions were applied as banana fruit coating by the dipping technique. The CTS supplemented with 2% CTS-MMT showed a significant retarding in peel color change, reduced electrolyte leakage, and MDA content, while CTS coating could maintain fruit firmness and reduce plasma membrane destruction for only the first few days. In addition, the CTS supplemented with 2% CTS-MMT coating could reduce ethylene production and respiration rate of the banana fruit. Overall results suggest that the CTS supplemented with 2% CTS-MMT nanocomposites is a novel coating material for maintaining the postharvest quality of 'Hom Thong' banana fruit.

Keywords: /Banana fruit/ /Chitosan/ /Coating/ /Montmorillonite nanocomposites/ /Postharvest physiology/ /Shelf life/

BROCCOLI

Wang, H., Cheng, Y., Hsiao, J., Sheu, F., & Kuan, Y. (2022). 7-(Allylamino)-17-demethoxygeldanamycin treatment induces the accumulation of heat shock proteins and alleviates senescence in broccoli. *Postharvest Biology and Technology, 186,* 111818. https://doi.org/10.1016/j.postharvbio.2021.111818

Abstract

Heat shock proteins (HSPs) are chaperones that elicit stress tolerance in plants. Treatments that induce HSPs accumulation have been widely used as a means to improve stress tolerance and extend shelf life of postharvest produces. Broccoli is a vegetable appreciated worldwide for its high nutrition value. However, the quality of harvested broccoli deteriorates quickly due to rapid senescence. Here, we examined the expression of broccoli HSP and investigated the effect of 17-(allylamino)-17-demethoxygeldanamycin (17-AAG), an HSP inducer, on broccoli senescence. Through RNA-sequencing and *de novo* assembly of the broccoli transcriptome, 11 HSP and related genes were identified. The expression of *ClpB1*, *HSC70*, *GRP78*, *HSP18.1*, and *HSP17.6CII* were upregulated in broccoli during 20 °C storage. Treatment of 1–100 nM 17-AAG dose-dependently induced HSP101 and HSP70 proteins accumulation, while treatment of 10 nM 17-AAG induced the expression of all 11 HSP and related genes and substantially alleviated yellowing of broccoli. In addition, 10 nM 17-AAG treatment significantly suppressed the expression of chlorophyll catabolic genes *NYC1*, *CLH1*, and *PAO*. Taken together, we provide the first report of the broccoli HSP and demonstrate the potential of using HSP inducers such as 17-AAG to tune up HSP level and enhance stress tolerance in postharvest crops.

Keywords: /Broccoli/ /Chlorophyll degradation/ /Heat shock factor/ /Heat shock protein/ /Transcriptome/

CHERRY

Meng, X., Chen, C., Song, T., Xu, J., Zhang, X., Wang, J., Pan, Z., Zhang, H., & Zhang, H. (2022). Effect of nano-silica coating combined with pressurized Ar treatment on postharvest quality and reactive oxygen species metabolism in sweet cherry fruit. *Food Chemistry*, *374*, 131715. https://doi.org/10.1016/j.foodchem.2021.131715

Abstract

The mechanisms of effect of nano-silica coating and pressurized Ar on regulating reactive oxygen species (ROS) generation and scavenging in the senescence of sweet cherries remains unclear. The amounts of reactive oxygen species, hydrogen peroxide, non-enzymatic antioxidants and antioxidases, and cell membrane lipid peroxidation in sweet cherries were determined. Nano-silica coating, pressurized Ar, and the combination of these two treatments, all significantly delayed senescence by suppressing decay rate, and maintained good sensory quality. In addition, all treatments inhibited the generation and accumulation of superoxide anion and hydrogen peroxide, and mitigated the lipid peroxidation of cell membranes of sweet cherries. The combination of these two treatments maintained higher contents of ascorbic acid and glutathione, and enhanced the activities of antioxidases in sweet cherries. It is suggested that nano-silica coating and pressure Ar mediated the ROS metabolism, which might have a role in retaining the quality sweet cherries during cold storage.

Keywords: /Antioxidases/ /Nano-silica coating/ /Pressurized Ar/ /Reactive oxygen species/ /Sweet cherry/

FEIJOA

Oseko, J., East, A., & Heyes, J. (2022). Recent advances in the postharvest technology of feijoa. *Scientia Horticulturae*, *297*, N.PAG. https://doi.org/10.1016/j.scienta.2022.110969

Abstract

Short storage life of 4 weeks for feijoa poses a challenge to sea freight. Early harvesting of 'Unique', 'Triumph' and 'Kakariki' has shown potential to increase storage life up to 6 weeks. Application of AVG retains fruit firmness and flesh hue angle (colour), reduces fruit drop (fruit remained on shrubs longer) and inhibits postharvest production of ethylene. Complementing firmness with dry matter (DM) or sugar content measurements provides potential to segregate fruit maturity into form homogenous batches. Feijoa is an important minor fruit grown in New Zealand, Georgia, Colombia, United States, Italy, Portugal and Brazil. Commercial production and export is reported majorly in New Zealand and its major markets include USA, Asia, Australia and Europe, however the main challenge is its short storage life that limits its economic value, thereby needing innovative efforts to extend storage life. Postharvest technologists have applied techniques such as low temperature, controlled atmosphere, ethylene, 1- Methylcyclopropene (1-MCP), CaCl 2 dips, hot water dipping, step down temperature conditioning and intermittent warming with minimal success. Non-destructive methods such as near infrared have been discussed as alternative approaches to assist in segregating fruit at harvest into more homogenous batches with differing storage potential. This review highlights technologies that merit further testing for extending storage life, and promising technologies for at-harvest fruit segregation. The techniques need to fit readily into industrial practice after harvest. Technologies that support early harvesting of fruit, non-destructive analysis to segregate fruit into maturity classes at grading speed and optimal storage for differing markets, hold significant potential to expand the export industry of feijoa.

Keywords: /Chilling injury/ /Chlorophyll fluorescence/ /Controlled atmospheres/ /Ethylene/ /Feijoa sellowiana/ /Fruit segregation/ /NIR/

FRUIT AND VEGETABLE

Basumatary, I. B., Mukherjee, A., Katiyar, V., & Kumar, S. (2022). Biopolymer-based nanocomposite films and coatings: recent advances in shelf-life improvement of fruits and vegetables. *Critical Reviews in Food Science & Nutrition*, *62*(7), 1912–1935. https://doi.org/10.1080/10408398.2020.1848789

Abstract

Consumers increasingly prefer healthy and nutritious diets worldwide, and demands for fresh fruits and vegetables are rapidly growing. Fresh produce are perishable commodities, and physical damage, moisture loss, biochemical changes, and postharvest microbial decay are primary causes of quality loss and reduced shelf-life. Packaging, including plastic films and coatings is an effective strategy to improve postharvest-life of whole and cut fruits and vegetables. However, plastic packaging is a significant environmental concern globally. Biopolymer based films and/or coatings are environment-friendly alternative packaging for food. But, these biopolymers, derived from plant, animal and microbial sources, lack some of the primary physico-chemical and mechanical properties compared to conventional plastic packaging. Reinforcement of biopolymer with nanomaterials addresses these shortcomings, and adds functional properties such as antimicrobial and/or antioxidant activities to the nanocomposites. Organic (e.g. nanocellulose fibrils), and inorganic (e.g. montmorillonite, zinc oxide, silver) nanomaterials are effective in achieving these improvements in biopolymer based nanocomposite. Plant-extracts and compounds derived from plants (e.g. essential oil) are also effective in imparting antimicrobial and antioxidant properties to biopolymer based nanocomposites. This is an extensive review of research works on effectiveness of biopolymer based nanocomposite films and coatings used for packaging of whole and cut fruits and vegetables to extend their shelf-life. Numerous reports have demonstrated effectiveness of biopolymer based nanocomposites in improvement in shelf-life of packaged and/or coated whole and cut fruits and vegetables by at least 4–5 days to as much as a few months. Fresh produce are perishable commodities requiring packaging or coating. Conventional plastics and waxes are major environmental and health concerns. Biopolymer based nanocomposites are environment-friendly alternatives. These nanocomposite films and coatings are effective in enhancing shelf-life.

Keywords: /Bio-based polymer/ /Bionanocomposite/ /Cut-fruits and vegetables/ /Food packaging and preservation/ /Natural antimicrobials/ /Postharvest-life/

Chávez, Z. K., Morales, G. A., Colín, C. C., Tovar, D. L., Ornelas, P. J. de J., Osuna, C. J. A., Vargas, A. I., Martínez, T. M. A., & Virgen, O. J. J. (2022). Improving the nutraceutical value of mango during ripening by postharvest irradiation with blue LEDs via enhancing of antioxidant enzyme activities. *International Journal of Food Science & Technology*, *57*(4), 2498–2509. https://doi.org/10.1111/ijfs.15623

Abstract

Light-emitting diodes (LEDs) are emerging as a clean technology for improving the postharvest preservation of fruits. Mangoes were irradiated with blue LEDs (75 μmol s-1 m−2) and then stored for 15 days. The fruit quality, including the content of antioxidant compounds and activities of antioxidant enzymes, was evaluated during storage. The treatment with blue LEDs delayed the changes associated with the senescence processes, including the changes in softening, weight loss, total soluble solids content, and titratable acidity. Treatment also caused increases in the antioxidant capacity (1.33-fold), ascorbic acid (1.69-fold), total phenolic (1.33-fold), flavonoids (1.50-fold), and carotenoids content (1.18-fold) compared to control. At the end of storage, blue LEDs treatment maintained higher phenylalanine ammonia-lyase (1.28-fold), peroxidase (1.58-fold), catalase (2.21-fold), and ascorbate peroxidase (1.51-fold) activities. Our findings indicate that blue LEDs might be a potential elicitor that modulates oxidative homeostasis and improves the antioxidant and nutritional status of mango by enhancing the activity of antioxidant enzymes.

Keywords: /Antioxidant enzymes/ /Bioactive compounds/ /Fruit preservation/ /Mangifera indica L./ /Non‐ionizing radiation/ /Postharvest senescence/

Moggia, C., Peñaloza, O., Torres, J., Romero-Bravo, S., Sepulveda, D., Jara, R., Vivanco, S., Valdés, M., Zúñiga, M., Beaudry, R., & Lobos, G. (2022). Within-plant variability in blueberry (Vaccinium corymbosum L.) II: Is a shorter harvest interval always the ideal strategy to maximize fruit firmness? *Postharvest Biology and Technology, 186*, 111815. https://doi.org/10.1016/j.postharvbio.2021.111815

Abstract

Harvesting blueberries at an optimal maturity stage is an important determinant of quality, especially when fruit are intended for long term storage. However, because blueberries set and ripen asynchronously, several pickings are needed. In general, shorter harvest intervals (<4 d) are advised to maximize fruit firmness, but due to labor shortages, the industry has sometimes been forced to increase the number of days between harvests. Thus, the objective of this study was to compare the postharvest impact of picking regimes where labor is not limiting (every 3 d) *vs.* a strategy driven by a labor shortage that would force a single harvest on the ninth day (9 d) in two cultivars with contrasting ripening windows: 'Duke' (~30 d) and 'Brigitta' (~60 d). Following an initial synchronizing picking (~4 – 7% full blue fruit), harvest interval intensity was studied: harvests after 3 d (3 × 1), after 3 and 6 d (3 × 2), after 3, 6, and 9 d (3 × 3), and after 9 d (9 × 1). Of these, only 3 × 1, 3 × 3, and 9 × 1 were evaluated. Fruit position within the canopy (east- and west-oriented sides) was considered as a second factor. Data suggests that shorter harvest intervals (3 d) would be more suitable for cultivars with a prolonged ripening window (e.g., 'Brigitta') compared to a cultivar with shorter harvest season (e.g., 'Duke'), for which longer cycles (9 d) would be preferred. Although the results show that, at harvest time, the picking management strategy had a greater effect than east-west position of the fruit, interactions between the factors were found after storage. Finally, although firmness values at harvest can be an important descriptor of storage potential of each cultivar, the rate and extent of softening after harvest were also strongly impacted by the cultivar.

Keywords: /Asynchrony/ /Softening/ /Harvest frequency/ /Fruit variability/ /Fruit picking/ /Leaf/fruit ratio/

Nicolau-Lapeña, I., Aguiló-Aguayo, I., Bobo, G., Viñas, I., Anguera, M., & Abadias,M. (2022). Ferulic acid application to control growth Listeria monocytogenes and Salmonella enterica on fresh-cut apples and melon, and its effect in quality parameters. *Postharvest Biology and Technology,186,*111831. https://doi.org/10.1016/j.postharvbio.2021.111831

Abstract

Listeria monocytogenes can grow under conditions at which fresh-cut fruit are stored, whereas *Salmonella* spp. has been associated with a number of outbreaks related to such products. It is therefore necessary to find products capable of reducing microbial counts while maintaining quality of the product. In this regard, ferulic acid (FA) has shown antimicrobial, antioxidant and many physiological functions in humans. This study aimed to test the efficacy of FA in fresh-cut apple and melon in two ways: (a) to prevent pathogenic growth and (b) to maintain fruit quality during storage, maintaining color and preventing enzymatic browning. For this purpose, *L. monocytogenes* (3 strains) and *S. enterica* (4 strains) were inoculated in both fruits. FA at concentrations ranging from 2.5–15 g L^{-1} were tested against individual strains and the results showed that FA did not have any bactericidal effect after application. FA effect was observed at the end of the storage (7 d, 10 °C) with higher effect against *L. monocytogenes* (averaging 4.2 ± 0.7 log CFU g^{-1}) than against *S. enterica* (averaging 1.9 ± 1.3 log CFU g^{-1}). The reductions were significantly different from the samples without FA, but significant differences were not found among the 3 tested concentrations. Comparison between immersion and spray applications of FA revealed that immersion was the best method. When the effect of the selected FA dose on quality was evaluated, we found that FA did not prevent the increase of browning index in apples. However, melon treated samples did not overcome significant color changes during storage at 4 °C. FA did not inhibit the

growth of total aerobic mesophylls and yeasts and molds, but maintained overall quality of the fruits, including pH, total soluble solids and titratable acidity. Overall, FA could be used in fresh-cut apple and melon to prevent growth of *L. monocytogenes* without affecting physicochemical quality, delivering a product with increased antioxidant activity and providing a new source of FA (0.25 ± 0.04 g kg^{-1} of apple, and 1.22 ± 0.07 g kg^{-1} of melon, dry weight basis).

Keywords: /Antimicrobial/ /Antioxidant/ /Shelf-life/ /Pathogens/ /Fruit/ /Anti-browning/

GRAPE

Liu, H., Pei, M., Wei, T., Yu, Y., & Guo, D. (2022). ROS scavenger Hypotaurine delays postharvest softening of 'Kyoho' grape by regulating pectin and cell metabolism pathway. *Postharvest Biology and Technology, 186,* 111833. https://doi.org/10.1016/j.postharvbio.2022.111833

Abstract

The rapid softening of postharvest fruit has a serious detrimental effect on quality and market value. In this study, postharvest grape berries treated with hypotaurine (HT) or H_2O_2 were employed to explore the dynamic physical and transcriptional changes after the treatment. The berry firmness and the content of propectin were higher in the berries with HT treatment compared to the control (CK) and H_2O_2 treatment. A total of 1774 differentially expressed genes (DEGs) were identified from comparisons of CK_vs_HT (1,020) and CK_vs_H_2O_2 (1,072). Weighted gene coexpression network analysis (WGCNA) showed that genes assigned to 'MEgreen' were predicted to be highly correlated to fruit firmness and propectin content. Based on transcriptome and quantitative real-time polymerase chain reaction (RT-qPCR), expression levels of *VvMYB-like*, *VvNAC22*, *VvPEI* and *VvCESA-like* were upregulated whereas *VvMADS-box* and *VvPG* were downregulated in HT-treated berries compared to H_2O_2 treatment. Dual luciferase reporter assay confirmed that VvMYB-like and VvNAC22 upregulate the expression of *VvPEI* and *VvCESA* respectively by binding to the corresponding sites of their promoters. Meanwhile, HT treatment triggered the differential expression of *Accelerated Cell Death 6* (*VvACD6*), *VvXyloglucan galactosyltransferase* (*VvXyG galactosyltransferase*) and *Cell wall/Vacuolar Inhibitor of Fructosidase 1-like* (*VvC/VIF1-like*). Finally, a possible regulatory model that HT delays berry softening by regulating pectin and cell metabolism pathway through VvMYB-like and VvNAC22 was proposed. This study laid a foundation for understanding the molecular mechanisms of delaying berry softening which HT mediated.

Keywords: /Hypotaurine/ /Grape/ /Postharvest softening/ /Pectin/ /Transcriptome/ /Cell wall metabolism/

Ranade, Y. H., Pathak, P. D., Chandrashekar, M., & Saha, S. (2022). Fungitoxicity profile of Cladosporium cladosporioides C1, as a leveraging tool for postharvest management of grapes. *Biologia*, *77*(4), 1173–1179. https://doi.org/10.1007/s11756-022-01008-8

Abstract

Cladosporium sp. causes berry rot in grapes. It is present in the vineyard throughout the berry developmental stage in dormant state. Since there is no recommended fungicide against Cladosporium, there is a significant concern about already available fungicides against different grape pathogens, the most effective time for application of these fungicides and their role in suppressing the growth of Cladosporium. The present study is the first report of a fungi toxicity study of C. cladosporioides with all the labeled fungicides for grape pathogens. The molecular sequencing study confirmed the identity of the fungus used in the study as C.cladosporioides. Fungitoxicity results showed that 65% of the fungicides recommended for grape farming, ranged from very toxic to toxic and 35% of the fungicides were moderately toxic to compatible category against C. cladosporioides. Fungicides used in the later stage of flowering and just before fruiting are Cyflufenamid 5% EW and Metrafenone 50% SC. Sulphur 80 WP (L), Cyflufenamid 5% EW and Metrafenone 50% SC did not affect C. cladosporioides activated at this stage. The data obtained on fungi toxicity will assess the effectiveness of pesticide management programs and

to develop a new strategy for control of C. cladosporioides in vineyards and prevent its onset at a later stage.

Keywords: /C. cladosporioides/ /Fungi Toxicity study/ /Grape (Vitis Vinifera L)/ /Postharvest pathogen/ /Quiescent/

KIWIFRUIT

Jiao, J., Jin, M., Liu, H., Suo, J., Yin, X., Zhu, Q., & Rao, J. (2022). Application of melatonin in kiwifruit (Actinidia chinensis) alleviated chilling injury during cold storage. *Scientia Horticulturae*, *296*, 110876. https://doi.org/10.1016/j.scienta.2022.110876

Abstract

Melatonin decreased water-soaking and lignification in kiwifruit under low-temperature storage. Melatonin suppressed lignin metabolism enzyme genes expressions and activities. Melatonin is attributed to enhance oxidation resistance and alleviate membrane damage. Functions of melatonin in fruit storage were studied, primarily focused on stress tolerance and delaying senescence. However, little is known about the role of melatonin in chilling injury on kiwifruit. The present study examined the roles of exogenous melatonin in coping with low temperature during storage of kiwifruit. Our results showed that melatonin application eased water-soaked and lignification symptoms in postharvest kiwifruit under low-temperature storage. Observation of the ultrastructure found that the plasma membrane and organelles maintain structural integrity accompanied with a thinner lignin layer in the cytoderm and cytoplasm with melatonin treatment. Melatonin treatment strongly inhibited the activity of lignin metabolism enzymes (PAL, 4CL and C4H) and the expression of structural genes while increasing the activity of antioxidant enzymes (SOD, CAT, APX and GR) and antioxidant substance (AsA and GSH) accumulation. These results suggest that melatonin actively participates in cold resistance and lignin accumulation via enzyme activity regulation in postharvest kiwifruit.

Keywords: /Chilling injury/ /Kiwifruit/ /Lignin/ /Melatonin/ /Membrane integrity/

LONGAN

Chen, Y., Yu, J., Lin, H., Zheng, Y., Fan, Z.., Wang, H., Chen, Y., & Lin, Y. (2022). Phomopsis longanae Chi-induced longan pulp breakdown and softening in relation to cell wall polysaccharides disassembly. *Postharvest Biology and Technology, 186*, 111837. https://doi.org/10.1016/j.postharvbio.2022.111837

Abstract

Cell wall polysaccharides are crucial contributors to the structural properties of plants and perform as a barrier against fungal invasion. *Phomopsis longanae* Chi, a principal devastating pathogenic fungus, can induce a severe pulp breakdown and softening of postharvest longan. *P. longanae*-induced longan pulp breakdown and softening in relation to the disassembly of cell wall polysaccharides were explicated. Results suggested that a higher pulp breakdown index and a lower pulp firmness were obtained in *P. longanae*-infected fruit. More importantly, *P. longanae* infection promoted gene expression levels and activities of cell wall-disassembling enzymes (pectin methylesterase, polygalacturonase, *β*-galactosidase, cellulase, and xyloglucan endotransglycosylase), and facilitated the disassembly of polysaccharides like ionic-soluble pectin, covalent-soluble pectin, cellulose, and hemicellulose, which were closely relevant to pulp breakdown and softening. Given these results, the aggravated pulp breakdown and softening of longan after *P. longanae* inoculation were attributed to cell wall polysaccharides modification regulated by enzymes and related genes.

Keywords: /Longan/ /Cell wall-disassembling enzymes/ /*Phomopsis longanae* Chi/ /Gene expression/ /Cell wall polysaccharides/ /Firmness/

MANGO

Salazar-Salas, N., Chairez-Vega, D., Vega-Alvarez, M., González-Nuñez, D., Pineda-Hidalgo, K., Chávez-Ontiveros, J., Delgado-Vargas, F., & Lopez-Valenzuela, J. (2022). Proteomic changes in mango fruit peel associated with chilling injury tolerance induced by quarantine hot water treatment. *Postharvest Biology and Technology, 186*, 111838. https://doi.org/10.1016/j.postharvbio.2022.111838

Abstract

The aim of this study was to identify proteins associated with the chilling injury (CI) tolerance induced by hot water treatment (HWT) in 'Keitt' mango fruit. A comparative proteomic analysis was performed between fruit with HWT (46.1 °C, 90 min) and non-treated (Control) after cold storage (0 and 20 d at 5 °C) and ripening (7 d at 21 °C); the expression of genes encoding some selected proteins was analyzed by real-time PCR. Twenty-six proteins were differentially expressed after HWT, 36 after 20 days of cold storage and 33 after ripening. Polypeptides with higher accumulation in HWT fruit included eleven heat shock proteins (HSPs), eight enzymes of the energetic metabolism (ACO1, ACO2, GAPDH-1, GAPDH-2, ADH, SDH, ADK, and ACAA) and seven of the secondary metabolism (PAL, CHS, CHI, PDS, HPPD, IsoCH, and PPO), four antioxidant enzymes (CAT, POD, Prx, and APX,), four proteins involved in hormone metabolism (P-gp2, ARF, ERF, and GA3ox1), two pathogenesis-related proteins (β-Glu and 2 s alb), four enzymes of cell wall metabolism (EGase, β-Gal, Rab11 and αMan), and three proteins involved in chloroplast metabolism (RuBisCo, PDX1, and rpl2). Non-treated fruit showed higher accumulation of polyphenol oxidase and alcohol dehydrogenase, suggesting a higher oxidation of phenols and lower efficiency in energy production. The CI tolerance induced by the quarantine HWT in mango fruit appears to be associated with the prevention of protein denaturation, the maintenance of the membrane functionality and energy efficiency, the activation of antioxidant and defense systems, the preservation of cell wall metabolism, and the synthesis of secondary metabolites.

Keywords: /Mango/ /Chilling tolerance/ /Quarantine hot water/ /Proteomics/

MUSHROOM

Li, G., Wang, Y., Zhang, Z., Chen, Y., & Tian, S. (2022). Mushroom alcohol controls gray mold caused by Botrytis cinerea in harvested fruit via activating the genes involved in jasmonic acid signaling pathway. *Postharvest Biology and Technology, 186*, 111843. https://doi.org/10.1016/j.postharvbio.2022.111843

Abstract

Mushroom alcohol (also called 1-octen-3-ol) is a natural volatile product derived mainly from the enzymatic breakdown of linoleic acid in plants and fungi. In this study, the efficacy of mushroom alcohol on control of postharvest gray mold caused by *Botrytis cinerea* was investigated. Mushroom alcohol vapor treatment at 3, 6 or 12 μL L^{-1} exhibited a marked inhibitory effect on mycelial growth of *B. cinerea in vitro* and disease severity of gray mold on harvested fruit in a concentration-dependent manner. Likewise, mushroom alcohol efficiently reduced the natural disease incidence of sweet cherry fruit, while no adverse effect was observed on fruit weight loss, soluble solid and titratable acid contents during storage. The mode of action of mushroom alcohol was attributed to its direct inhibition on *B. cinerea*via mediating the expression of genes related to spore germination and pathogenicity. Furthermore, the inhibitory effect of mushroom alcohol on gray mold in sweet cherry fruit was also dependent on activating the expression levels of key genes participating in the jasmonic acid signaling pathway. These results demonstrated the

beneficial effect of mushroom alcohol in inhibiting *B. cinerea,* which may be used as an alternative to control gray mold.

Keywords: /1-Octen-3-ol/ /*Botrytis cinerea*/ /Inhibitory effect/ /Harvested fruit/ /Resistant Mechanism/

PEACH

Terzoudis, K., Hertog, M., & Nicolaï, B.M. (2022). Dynamic labelling reveals central carbon metabolism responses to stepwise decreasing hypoxia and reoxygenation during postharvest in pear fruit. *Postharvest Biology and Technology, 186,* 111816, https://doi.org/10.1016/j.postharvbio.2021.111816

Abstract

Storage of pears in low oxygen conditions after harvest and before commercialization induces several responses in their metabolism initiating survival, maintenance and low energy expenditure mechanisms. In the present study a metabolomics approach was used in combination with a ^{13}C feeding experiment to elucidate those metabolic responses in pear fruit under a stepwise induced hypoxic profile by monitoring changes in TCA, fermentation, GABA shunt associated metabolites and amino acids. A reoxygenation treatment was added at the end of the experiment to study the post hypoxic recovery mechanisms after prolonged hypoxia. Propagation of labels through metabolic pathways was monitored by GC–MS analysis. Results showed successful utilization of ^{13}C pyruvate from pear tissue under normoxia accompanied by fractional enrichment in organic acids, pyruvate and TCA cycle derived amino acids. Initiation of hypoxia at 5 kPa O_2 resulted in drop of fractional enrichment in malate, fumarate, citrate, valine, glutamate and alanine but not in α-ketoglutarate and succinate. Further induction of severe hypoxia (0.5 kPa O_2) resulted in a decrease of the TCA cycle activity, initiation of fermentation and primary evidence of an upregulated alanine-α-ketoglutarate shunt, a trend that continued until the 0.2 kPa O_2 incubation. Sucrose and fructose decreased below 0.5 kPa O_2 with a sharp increase of phosphorylated sugars that dropped by the end of the treatment. Reoxygenation caused upregulation of the TCA cycle but not glycolysis, reversed fermentation activity and a drop in concentration of all amino acids. Results were in line with common responses of plants under hypoxia and post anoxia recovery mechanisms and suggest that different mechanisms are implemented between normoxia and reoxygenation after prolonged hypoxia.

Keywords: /Conference pear/ /Hypoxic stress/ /Metabolomics/ /Reoxygenation/ /^{13}C-label/ /GC–MS analysis/

Yang, Q., Yang, X., Wang, L., Zheng, B., Cai, Y., Ogutu, C. O., Zhao, L., Peng, Q., Liao, L., Zhao, Y., Zhou, H., & Han, Y. (2022). Two R2R3‐MYB genes cooperatively control trichome development and cuticular wax biosynthesis in Prunus persica. *New Phytologist*, *234*(1), 179–196. https://doi.org/10.1111/nph.17965

Abstract

The fruit surface has an enormous impact on the external appearance and postharvest shelf‐life of fruit. Here, we report two functionally redundant genes, PpMYB25 and PpMYB26, involved in regulation of fruit skin texture in peach.PpMYB25 can activate transcription of PpMYB26 and they both induce trichome development and cuticular wax accumulation, resulting in peach fruit with a fuzzy and dull appearance. By contrast, nonfunctional mutation of PpMYB25 caused by an insertional retrotransposon in the last exon in nectarine fails to activate transcription of PpMYB26, resulting in nectarine fruit with a smooth and shiny appearance due to loss of trichome initiation and decreased cuticular wax accumulation.Secondary cell wall biosynthesis in peach fruit pubescence is controlled by a transcriptional regulatory network, including the master regulator PpNAC43 and its downstream MYB transcription factors such as PpMYB42, PpMYB46 and PpMYB83.Our results show that PpMYB25 and PpMYB26 coordinately regulate fruit

pubescence and cuticular wax accumulation and their simultaneous perturbation results in the origin of nectarine, which is botanically classified as a subspecies of peach.

Keywords: /Cuticular wax/ /PpMYB25/ /PpMYB26/ /Prunus persica/ /Trichome/

PEPPER

Liu, Y.-L., Chen, S.-Y., Liu, G.-T., Jia, X.-Y., Haq, S. ul, Deng, Z.-J., Luo, D.-X., Li, R., & Gong, Z.-H. (2022). Morphological, physiochemical, and transcriptome analysis and CaEXP4 identification during pepper (Capsicum annuum L.) fruit cracking. *Scientia Horticulturae*, *297*, 110982. https://doi.org/10.1016/j.scienta.2022.110982

Abstract

The cracking-susceptible cultivar'L92'was subjected to morphological, physiochemical and transcriptome analyses and an assay of postharvest water loss. The polygalacturonase, peroxidase, and cellulase activity levels and water-soluble pectin and lignin contents were significantly higher in FSC (fruit seriously cracking) fruits than in FNC (fruit without cracking) fruits. By comparing the FSC with the FNC fruits and analyzing DEG profiles during the fruit cracking process, 45 DEGs were found to be significantly enriched in KEGG pathways related to cell wall metabolism and lignin biosynthesis, which are involved in the fruit cracking process. The silencing of CaEXP4 induced cells in the epidermal layer to be smaller and more neatly and tightly arranged, with a greater number of cell layers of the sub-epidermal layer compared with control fruit. In pepper (Capsicum annuum L.), fruit cracking is a common physical deformation that not only affects the fruit quality, but also increases the water loss rate during storage and reduces shelf-life and economic value. To comprehensively unravel the putative genes and mechanism underlying fruit cracking, the cracking-susceptible cultivar 'L92' was subjected to morphological, physiochemical and transcriptome analyses and an assay of postharvest water loss. The polygalacturonase, peroxidase, and cellulase activity levels and water-soluble pectin and lignin contents were significantly higher in FSC (fruit seriously cracking) fruits than in FNC (fruit without cracking) fruits. The hemicellulose and cellulose contents of FSC fruits were lower than those of FNC fruits; with non-significant differences in chelator trans-1,2-diaminocyclohexane-N,N,N0,N0-tetraacetic acid-soluble pectin and sodium carbonate-soluble pectin levels. By comparing the FSC with the FNC fruits and analyzing differentially expressed gene (DEG) profiles during the fruit cracking process, 1,574 DEGs were identified. Among them, 45 unigenes were significantly enriched in KEGG pathways related to cell wall metabolism and lignin biosynthesis. The silencing of CaEXP4 induced cells in the epidermal layer to be smaller and more neatly and tightly arranged, with a greater number of cell layers of the sub-epidermal layer compared with control fruit. Small structural modifications may lead to changes in cell wall structure and elasticity, which might have caused the fruit cracking. To the best of our knowledge, this is the first morphological, histological, physiochemical, and transcriptome analysis to show the role of CaEXP4 during cracking of pepper fruit.

Keywords: /CaEXP4/ /Cell wall degrading/ /Differentially expressed genes/ /Fruit cracking/ /Gene identification/

PERSIMMON

Guo, Y., Liang, P., Tang, Y., Zhang, M., & Li, B. (2022). Effects of postharvest deastringency and 1-methylcyclopropene treatments on membrane permeability, membrane-degrading enzymes and their encoding genes in persimmon (Diospyros kaki, cv Mopanshi) fruit. *Scientia Horticulturae*, *297*, 110941. https://doi.org/10.1016/j.scienta.2022.110941

Abstract

CO 2 deastringency treatment induced a large increase in respiratory rate and ethylene production of persimmon fruits. Deastringency treatment caused a significant increase in MDA production and

membrane permeability, resulting in serious membrane damage. After deastringency treatment, the activity of LOX and PLD and the expression of DkLOX3 and PLD?1 were significantly upregulated. The 1-MCP may reduce membrane damage and delay fruit softening, mainly by inhibiting LOX activity and DkLOX3 gene expression and partly by inhibiting DkPLD?1 expression. Astringent persimmon fruit softens rapidly after harvest deastringency treatment. The purpose of this study was to understand the characteristics of membrane deterioration and its mechanism during rapid softening. The experiment included three treatments: (1) control, (2) CO 2 treatment (≈100% CO 2 , 24 h), and (3) CO 2 plus 1-methylcyclopropene (1-MCP, 1.5 μL·L-1) treatment. CO 2 treatment can effectively remove the astringency of persimmon fruit and cause a sharp drop in fruit firmness. The addition of 1-MCP was beneficial for firmness maintenance, but the process of astringency removal was delayed by one day. The fruit respiration rate and ethylene evolution rate were significantly increased by CO 2 treatment, regardless of the presence or absence of 1-MCP, but the addition of 1-MCP could reduce the peak value and delay the occurrence of ethylene peaks by one day. The deastringency treatment resulted in a significant increase in membrane permeability and malondialdehyde content, and 1-MCP could significantly reduce membrane damage. CO 2 treatment induced an enormous increase in LOX activity and the transcription of DkLOX3 ; however, 1-MCP significantly inhibited these increases. The PLD activity and DkPLDα1 expression level of the CO 2 -treated fruit were significantly promoted, and the addition of 1-MCP had less inhibition effect on the PLD activity and no significant inhibition on the DkPLDα1 expression. These results demonstrate that CO 2 deastringency treatment could cause severe damage to the membrane integrity by promoting LOX and PLD activities and related gene expression. 1-MCP may ameliorate membrane damage mainly by inhibiting LOX activity and DkLOX3 gene expression and partly by suppressing PLDα1 expression.

Keywords: /1-methylcyclopropene/ /Astringency removal/ /Diospyros kaki/ /Fruit softening/ /Lipoxygenase/ /Membrane permeability/ /Phospholipase D/

PLUM

Xu, R., Wang, L., Li, K., Cao, J., Zhao, Z. (2022). Integrative transcriptomic and metabolomic alterations unravel the effect of melatonin on mitigating postharvest chilling injury upon plum (cv.Friar) fruit. Postharvest Biology and Technology, 186,111819. https://doi.org/10.1016/j.postharvbio.2021.111819

Plum fruit often suffer severe chilling injury (CI) during storage. Plum (*Prunus salicina* Lindl. cv. Friar) fruit were treated with melatonin at various concentrations and stored at 0 ℃ for 6 w and additional 3 d of shelf-life at 23 ℃. Observations revealed that the treatment with 1.0 mmol L^{-1} melatonin mitigated CI of the fruit by reducing flesh-reddening and 'ethylene burst'. The melatonin treatment also suppressed fruit softening and maintained energy status. Results from UPLC-MS assay showed that several individual phenolic compounds involved in the biosynthesis of flavonoids and anthocyanins, especially, the red pigment of cyanidin-3-*O*-glucoside, were stimulated by cold stress and its removal, but the stimulation was effectively inhibited by melatonin treatment, and thereby flesh-reddening was alleviated. Results from RNA-sequencing unraveled that cold stress and its removal altered transcriptomic profiling of the plum fruit, but the melatonin treatment hindered the transcription of genes related to the anthocyanin biosynthesis. Correlation analysis indicated that seven MYBs were positively correlated with anthocyanin biosynthesis, which were generally down-regulated in the melatonin-treated plums. The integrative analysis of transcriptomic and metabolic alterations revealed differentially but delicately coordinated inhibition of postharvest physiological metabolisms of 'Friar' plums by melatonin in response to cold stress.

Keywords: /Plum fruit/ /Melatonin/ /Flesh-reddening/ /Anthocyanins/ /Transcriptomic profiling/ /MYB transcription factor/

POMEGRANATE

Shi, J., Wang, S., Tong, R., Wang, S., Chen, Y., Wu, W., He, F., Wan, R., Jian, Z., Hu, Q., & Zheng, X. (2022). Widely targeted secondary metabolomics explored pomegranate aril browning during cold storage. *Postharvest Biology and Technology, 186*, 111839. https://doi.org/10.1016/j.postharvbio.2022.111839

Abstract

Pomegranate is sensitive to low temperature, and aril browning is considered as a typical symptom of chilling injury, affecting greatly fruit quality and marketability. A comprehensive comparison of aril traits and secondary metabolites using widely targeted secondary metabolomics was performed between healthy and browning arils. A total of 399 metabolites were identified in arils. Moreover, 75 up-accumulated and 14 down-accumulated were presented in browning arils. According to the Kyoto Encyclopedia of Genes and Genomes (KEGG) enrichment analysis, the biosynthesis of plant secondary metabolites related aril browning mainly involved in flavonoid, flavonol, and isoflavonoid, particularly, phenylpropanoid biosynthesis. Additionally, the correlation analysis was carried out between aril traits and weighted gene co-expression network of metabolites. Collectively, aril browning was mainly attributed to water loss, the oxidization of polyphenol oxidase (PPO), and hydrolysis reaction. It was noted that p-coumaric acid may greatly affect pomegranate aril browning. These findings will contribute to elucidating aril browning of pomegranate during cold storage, and developing appropriate postharvest treatments to improve fruit quality.

Keywords: /Pomegranate/ /Aril browning/ /Secondary metabolites/ /Phenolics compounds/ /Polyphenol oxidase/

POSTHARVEST DISEASE

Ma, Q., Xu, Y., Li, D., Wu, X., Zhang, X., Chen, Y., Li, L., & Lou, Z. (2022). Potential epigenetic regulation of RNA 5'-terminal NAD decapping associated with cellular energy status of postharvest Fragaria × ananassa in response to Botrytis cinerea invasion. *Postharvest Biology and Technology,*
***186,* 111840. https://doi.org/10.1016/j.postharvbio.2022.111840**

Abstract
Nicotinamide adenine dinucleotide (NAD), a vital energy metabolite, functions as a signal substance in plant immunity, which has emerged as a 5'-terminal capping of RNA. In response to gray mold disease, the association among NAD decapping (deNAD), fruit immunity and energy status was studied in strawberries. Obvious necrosis was observed at 3 d corresponded to the upregulation of BcActin A/FaActin at 2 d which was 18.9-fold than 1 d. With the development of disease, the energy status of strawberries decreased with ATP content constantly decreased to 5.21 ± 0.59 mg kg^{-1} at 6 d. Accordingly, NAD content reached 158.25 ± 22.5 μmol kg^{-1} but decreased at the following days of infection. Conversely, contents of NADPH and NADH were decreased during 6 days of inoculation. Immune genes expressed distinctly in response to gray mold and the change of energy status. Especially FaBIK1 expression in 6 d was 120-fold than in 1 d. However, FaCERK, FaPBL2 and genes related to NAD biosynthesis were presumably manipulated and suppressed by pathogens. FaDXO1, the only reported gene associated with deNAD was identified in Fragaria species and was highly conserved to Arabidopsis DXO1. In response to gray mold, expression of FaDXO1 in 1 d was downregulated 3-fold less than 0 d, but was induced by the decline of energy status and *Botrytis cinerea* infection at the following stage of inoculation. This study first reported the identified NAD decapping genes in strawberry and evaluated its expression pattern in response to gray mold disease. The relationship between deNADing and pathogenic invasion of postharvest strawberry was linked by the energy status, which shed a light on the biological function of RNA noncanonical NAD cap.

Keywords: /NAD decapping/ /Energy metabolism/ /Strawberry/ /Gray mold/ /Plant immunity/ /Epigenetic/

Zhang, B., Gao, X., Wang, Q., Li, Y., He, C., Luo, H., & An, B. (2022).Integrated application of transcriptomics and metabolomics provides insights into the antifungal activity of α-phenylcinnamic acid against Colletotrichum gloeosporioides. *Postharvest Biology and Technology, 186,* 111834. https://doi.org/10.1016/j.postharvbio.2022.111834

Abstract

Anthracnose caused by *Colletotrichum gloeosporioides* leads to significant economic loss of varieties of tropical and subtropical fruit. In the present study, a cinnamic acid derivative α-phenylcinnamic acid (α-PA) was found effective in control of postharvest anthracnose on mango fruit. α-PA strongly inhibited conidia germination, germ tube elongation, and appressorium formation. To elucidate the underlying molecular mechanisms by which α-PA shows antifungal activity, a transcriptomics and a widely targeted metabolomics analysis were conducted to study the changes in gene expression and metabolic profile. The result showed that the expression of 1477 genes and content of 198 metabolites were changed by α-PA. The following KEGG enrichment and correlation analysis suggested that biosynthesis of amino acids and some secondary metabolites were interfered by α-PA, including indoles which are one group of melanin precursors. In addition, qRT-PCR analysis and measurement of melanin revealed that α-PA down-regulated the expression of melanin biosynthesis genes and reduced melanin biosynthesis. Taken together, these data suggest that α-PA could decrease anthracnose in postharvest fruit by interfering with amino acid and secondary metabolite metabolism of *C. gloeosporioides*.

Keywords: /Anthracnose/ /*Colletotrichum gloeosporioides*/ /α-Phenylcinnamic acid/ /Metabolomics/ /Melanin/

POTATO

Xu, X., Liu, P., Dong, T., Zhang, S., & Wang, Q. (2022). Short-term warming inhibits polyphenol oxidase activity and influences free amino acid accumulation and de novo synthesis of tyrosine in fresh-cut potato. *Postharvest Biology and Technology, 186,*111830.https://doi.org/10.1016/j.postharvbio.2021.111830

Abstract

Potatoes cut immediately after being taken out from cold storage easily undergo browning. Researchers have reported that long-term warming alleviates the browning of fresh-cut potatoes. However, long-term warming is not commercially applicable. The present study investigated the effect of short-term warming (SW) at 25 °C for 12 h on the browning of fresh-cut potatoes. The browning index of potatoes stored at 4 °C for 8 months was tested. The analysis revealed that SW efficiently blocked enzymatic browning by inhibiting polyphenol oxidase (PPO) activity, decreasing total phenolic content and malondialdehyde (MDA) content, and increasing peroxidase (POD), superoxide dismutase (SOD), and catalase (CAT) activity, and 1,1-Diphenyl-2-picrylhydrazyl (DPPH) and 2,20-azino-bis (3-ethylben zothiazoline) 6-sulphonic acid (ABTS) inhibition rates. Moreover, SW treatment induced the expression of the serine protease inhibitor (*SPI)* gene and enhanced SPI activity, increased the soluble protein content and decreased free tyrosine, and lysine content in fresh-cut potatoes during the 5 d storage at 2~4 °C. The contents of glutamic acid, aspartic acid, and proline in the fresh-cut potatoes increased after SW treatment. Furthermore, the amino acid complementation experiments showed that tyrosine and lysine aggravated browning while glutamic acid and aspartic acid reduced browning. The SW treatment reduced the activity of chorismate mutase (CM), repressed the transcript levels of CM synthesis-related genes (*CM1* and *CM2*), and inhibited free tyrosine synthesis. These results indicate that SW treatment alleviates the browning of potato tubers after cold storage, probably due to its influence on PPO, metabolism of tyrosine, other FAAs and phenolics, and antioxidants.

Keywords: /Short-term warming/ /Fresh-cut potato/ /Browning/ /Serine protease inhibitor/ /Tyrosine/

Wang Su, Guangji Ye, Yun Zhou, & Jian Wang. (2022). Starch synthesis and gelatinization properties of potato tubers. *Ciência Rural*, *52*(4), 1–14. https://doi.org/10.1590/0103-8478cr20210050

Abstract

Biosynthesis is the only source of potato starch which is an important raw material for food processing, modified starch and biomass energy. However, it is not clear about the evolution of starch synthesis with tuber development in potatoes. The present study evaluated the differences of starch synthesis and gelatinization properties of potato tubers with different starch content. Relative to cultivars of medium and low starch content, cultivars of high starch content showed significantly higher SBEII gene expression, AGPase and SSS enzyme activity, and total starch content after middle stage of starch accumulation, and had smaller average starch granule size during whole process of tuber development, and had higher pasting temperature before late stages of tuber growth, and had lower pasting temperature after middle stage of starch accumulation. Path analysis showed that, after middle stage of starch accumulation, effects on starch gelatinization of cultivars with high, medium and low starch content represented starch synthesis enzyme activity > starch accumulation > starch granule distribution > starch synthesis enzyme gene expression, starch synthesis enzyme gene expression > starch synthesis enzyme activity > starch accumulation > starch granule distribution, starch synthesis enzyme gene expression > starch granule distribution > starch synthesis enzyme activity > starch accumulation, respectively. In the study, phases existed in the starch biosynthesis of potato tuber, and the starch quality and its formation process were different among varieties with different starch content. The findings might contribute to starch application and potato industries.

Keywords: /Potatoes/ /Starch/ /Gelation/ /Tubers/ /Biomass Energy/ /Potato Industry/

STRAWBERRY

Wang, L., Luo, Z., Yang, M., Liang, Z., Qi, M., Dong, Y., Xu, Y., Lin, X., & Li, L. (2022). The action of RED light: Specific elevation of pelargonidin-based anthocyanin through ABA-related pathway in strawberry. *Postharvest Biology and Technology, 186*, 111835. https://doi.org/10.1016/j.postharvbio.2022.111835

Abstract

Light exposure could trigger a series of physiological progress in strawberry and influence the commercial values. In the present study, the red-light irradiation promoted the red coloration of postharvest strawberry, combined with the doubled content of pelargonidin-based anthocyanins. Alternatively, no significant difference was found in cyanidin- and peonidin-based anthocyanin compounds between control and red-light-exposed strawberry. Additionally, it was evident at the transcriptional level that red light induced more flux into the pelargonidin-based side branch, rather than into the cyanidin and peonidin-based branches. Besides, genes involved in abscisic acid (ABA) biosynthesis and deglycosylation were upregulated, while those in ABA hydroxylation and glycosylation were downregulated, resulting in the increased ABA accumulation by red light. The expression level of ABA downstream effector, *FaMYB10,* was also upregulated, probably responsible for the precise regulation of anthocyanin biosynthesis. These findings shed light on the potential role of red-light exposure on the pelargonidin-based anthocyanin accumulation through the ABA-related pathway in strawberry.

Keywords: /Red light/ /Anthocyanin/ /Abscisic acid/ /Strawberry/ /Pelargonidin/

SWEET POTATO

Li, Y., Zhang, L., Zhang, L., Nawaz, G., Zhao, C., Zhang, J., Cao, Q., Dong, T., & Xu, T. (2022). Exogenous melatonin alleviates browning of fresh-cut sweetpotato by enhancing anti-oxidative

process. *Scientia Horticulturae*, *297*, N.PAG. https://doi.org/10.1016/j.scienta.2022.110937

Abstract

Melatonin treatment delayed the browning of postharvest fresh-cut sweetpotato. Melatonin can enhance the anti-oxidative process of sweetpotato. Melatonin has great potential to inhibit the browning in fresh-cut produce. Sweetpotato is an important and nutritionally rich crop. Melatonin (MT) possesses great potential for promoting the postharvest preservation of vegetables and fruit. However, the function of MT in postharvest sweetpotato is rarely characterized. Here, the functional mechanism of exogenous MT was evaluated in the fresh-cut tuberous root of sweetpotato. Experimental results revealed that MT treatment strongly delayed the browning of postharvest fresh-cut sweetpotato. During the storage of the fresh-cut tuberous root of sweetpotato, exogenous MT reduced the activities of enzymes related to browning, and decreased the contents of reactive oxygen species (ROS) and the degree of membrane lipid peroxidation. Meanwhile, MT treatment maintained higher antioxidants levels, thus effectively inhibiting browning and prolonged shelf life of fresh-cut sweet potato. In addition, exogenous MT induced the expression of genes related to the antioxidant pathway in sweetpotato. In conclusion, this study demonstrated that exogenous MT alleviates fresh-cut sweetpotato browning by enhancing anti-oxidative process, thereby laying a theoretical foundation and providing a scientific basis for delaying the browning in sweetpotato by MT treatment in the future.

Keywords: /Antioxidant activity/ /Browning/ /Melatonin/ /Sweetpotato/

TOMATO

Morales-Rabanales, Q. N., Coyotl-Pérez, W. A., Rubio-Rosas, E., Cortes-Ramírez, G. S., Sánchez Ramírez, J. F., & Villa-Ruano, N. (2022). Antifungal properties of hybrid films containing the essential oil of Schinus molle: Protective effect against postharvest rot of tomato. *Food Control*, *134*, N.PAG. https://doi.org/10.1016/j.foodcont.2021.108766

Abstract

The control of postharvest diseases in tomatoes using hybrid films represents an efficient and inexpensive alternative to avoid economic losses. This work reports on the design, characterization, and in situ application of hybrid films containing chitosan combined with the leaf essential oil of Schinus molle (SmEO) as antifungal agents. These materials were tested in situ on Lycopersicon esculentum cv. uva showing symptoms of soft rot caused by Fusarium oxysporum. According to our analytical conditions, SmEO contained β-phellandrene (15.7%), α-phellandrene (12.1%), elemol (9.1%), apiole (6.4%) and camphene (6.2%) as the most abundant volatiles. Four distinct hybrid films were prepared from 1% chitosan combined with different amounts of SmEO (0.05, 0.1, 0.3 and 0.7% w/v) to generate four hybrid films named FSm1, FSm2, FSm3 and FSm4. The spectroscopic properties (FT-IR), texture and thickness (SEM), and optical properties (transmittance) of these films revealed that FSm3 and FSm4 had the best physicochemical and in situ antifungal properties to avoid conidial germination and mycelial proliferation of F. oxysporum. The fruits treated with films and essential oil showed a statistically significant delay (>50%) in mycelial growth compared with the control groups ($p < 0.05$) and a substantial decrease in conidial viability over 6 days (<2%). According to our results, FSm3 and FSm4 significantly avoided the in situ growth of F. oxysporum in tomatoes. Interestingly, all of the films significantly improved fruit firmness in comparison with untreated tomatoes ($p < 0.05$). The properties of the films reported in this work may improve the shelf life of Lycopersicon esculentum cv. uva. Films based on chitosan and the essential oil from Schinus molle improved tomato quality. The physicochemical properties of films suggested their potential use as a new fruit barrier. In situ tests revealed that films delayed the mycelial proliferation of F. oxysporum. Same tests revealed that films avoided the germination of fungal conidia.

Keywords: /Chitosan/ /Edible films/ /Essential oil/ /Fungistatic activity/ /Fusariosis/ /Schinus molle/