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APPLE

Huang, L.-N., Wu, G.-B., Zhang, S., Kuang, F.-Y., & Chen, F.-H. (2019). The identification and functional verification of the cinnamate 4-hydroxylase gene from wax apple fruit and its role in lignin biosynthesis during nitric oxide-delayed postharvest cottony softening. Postharvest Biology and Technology, 158, 110964. doi: 10.1016/j.postharvbio.2019.110964

Abstract

Cottony softening of harvested wax apple fruit is characterized by lignin accumulation, and it involves the activity of cinnamate-4-hydroxylase (C4H) and its encoding gene. This work investigated the characteristics and function of the *C4H* gene of wax apple fruit and discussed its relationship with lignin biosynthesis during nitric oxide (NO)-delayed cottony softening of harvested wax apple fruit. The *C4H* gene cloned from wax apple fruit was named *SsC4H*, and it has a length of 1849 bp and a 1518 bp open reading frame encoding 505 amino acids. The sequence of *SsC4H*-encoded amino acids contained typical C4H domains and shared high sequence similarity and close evolutionary relationships with C4H from other plants; in vitro catalytic activity of C4H was observed in the expressed and purified recombined SsC4H protein. Moreover, the *SsC4H* expression and C4H activities were inhibited in NO-treated wax apple fruit compared with control fruit, with lower lignin content and cottony softening index. Therefore, *SsC4H* was confirmed as the *C4H* gene for wax apple fruit, and the NO-retarded cottony softening of harvested wax apple fruit may be attributed to inhibited expression of *SsC4H* and C4H activity, delaying lignin biosynthesis.

Keywords: /Wax Apple Fruit/ /Nitric Oxide/ /Cinnamate 4-hydroxylase/ /Lignin Synthesis/ /Fruit Softening/

Saeys, W., Trong, N. N. D., Beers, R. V., & Nicolaï, B. M. (2019). Multivariate calibration of spectroscopic sensors for postharvest quality evaluation: A review. Postharvest Biology and Technology, 158, 110981. doi: 10.1016/j.postharvbio.2019.110981

Abstract

Vibrational spectroscopy methods are widely investigated as fast and non-destructive alternatives for postharvest quality evaluation. As these methods measure spectral responses at a large number of wavebands correlated to the quality traits of interest, multivariate calibration equations have to be built to estimate the quality traits from the acquired spectra. This paper provides an overview of the most important multivariate data analysis techniques for exploring spectral data, detecting outliers and building calibration models for predicting the quality traits of interest. Both linear and non-linear calibration methods are discussed for quantitative (continuous) and qualitative (discrete) quality traits. For each of the presented methods the theory is explained, followed by illustration of an example case from the postharvest domain and a discussion of applications of this technique for postharvest quality evaluation based on spectral sensors. As spectral preprocessing, careful validation and calibration transfer are crucial aspects for successful implementation of spectral sensors for postharvest quality evaluation, special attention is given to these aspects. Finally, conclusions are drawn and recommendations are made with respect to the steps to take and points of attention for successful calibration.

Keywords: /Multivariate Data Analysis/ /Spectra/ /Classification/ /Preprocessing/ /Validation/ /Transfer/

APRICOT

Fan, X., Jiang, W., Gong, H., Yang, Y., Zhang, A., Liu, H., … Cui, K. (2019). Cell wall polysaccharides degradation and ultrastructure modification of apricot during storage at a near freezing temperature. Food Chemistry, 300, 125194. doi: 10.1016/j.foodchem.2019.125194

Abstract

The effects of near freezing temperature (NFT) storage at −1.9 °C on cell wall degradation of 'Shushanggan' apricot was studied comparing to 0 °C and 5 °C storage. Our results indicated that NFT storage strongly inhibited the solubilization of Na2CO3-soluble pectin and cellulose, by the suppression of cell wall modifying enzymes (polygalacturonase, β-Galactosidase, pectin methyl esterase and cellulase) and related genes expressions. The loss of side chains was the main modification in CDTA (Cyclohexane-diamine-tetraacetic Acid)-soluble pectin during storage and made the main contribution to the softening of apricot, while the loss of side chain was suppressed by NFT storage. Microscopic observation showed that NFT storage delayed the degradation of pectin fraction and protected cell wall structure from loosing. This study proves that NFT storage is an effective technology to suppress the cell wall polysaccharides degradation and ultrastructure modification of apricot.

Keywords: /Near Freezing Temperature/ /Apricot/ /Neutral Sugar/ /Cell Wall Polysaccharides/ /Ultrastructure Modification/

Li, Y., Ma, Y., Zhang, T., Bi, Y., Wang, Y., & Prusky, D. (2019). Exogenous polyamines enhance resistance to Alternaria alternata by modulating redox homeostasis in apricot fruit. Food Chemistry, 301, 125303. doi: 10.1016/j.foodchem.2019.125303

Abstract

The effects of exogenous polyamines treatment on reactive oxygen species (ROS) metabolism in apricot fruits were systematically analyzed through the investigation of their curative and preventive effects on black spot disease. Results showed that 1.5 mM spermine (Spm), 1.5 mM spermidine (Spd) and 10 mM putrescine (Put) treatment significantly inhibited black spot development, additionally, the efficacy of this control was dependent upon the type of polyamines used and concentration level applied. Further studies have shown that exogenous polyamines treatments significantly improved production of $O_2^{\bullet -}$ and H_2O_2, and increased the activities and gene expression levels of NADPH oxidase (NOX), super oxide dismutase (SOD), catalase (CAT) ascorbate peroxidase (AXP) and glutathione reductase (GR) in apricot fruit. Increased ascorbic acid (AsA) and reduced glutathione (GSH) content were also observed after exogenous polyamines treatment. These results have revealed that postharvest polyamines treatment effectively enhanced disease resistance through the maintenance of homeostasis in apricot fruits.

Keywords: /Apricot Fruit/ /Exogenous Polyamines/ /Black Spot/ /Induced Resistance/ /ROS Metabolism/

BANANA

Fernando, I., Fei, J., & Stanley, R. (2019). Measurement and analysis of vibration and mechanical damage to bananas during long-distance interstate transport by multi-trailer road trains. Postharvest Biology and Technology, 158, 110977. doi: 10.1016/j.postharvbio.2019.110977

Abstract

Mechanical damage induced by vibration is a known cause of quality deterioration and wastage of fresh produce in post-harvest supply chains. The need to minimize visual defects in fruits, such as bananas, is

being driven by the growing consumer preference for high quality produce. Transport of produce interstate and internationally from the growing regions to major retail markets, however, increases the risk of exposure of fruits to injurious vibration excitation. This study measured the vibration, and consequential mechanical damage, to bananas stacked at different stack heights and positions in a multi-trailer road train during an interstate road transport of over 3000 km in distance. Significantly different damage levels in bananas were observed in different pallet positions of the road train with the highest damage propensity revealed at the most rear pallet position. The damage levels in each pallet position were found to closely correspond with the Root-Mean-Square (RMS) acceleration of the vibration excitation on the trailer floor. The highest energy Power-Spectral Density (PSD) peaks were revealed to be concentrated in the lower frequency range (0.1–5 Hz). The cartons stacked in the top tiers of each pallet showed significantly increased mechanical damage followed by the bottom tiers with the middle-tiers exhibiting minimal damage. Palletized banana cartons subjected to simulated vibration, on a laboratory vibration simulator, demonstrated that vibration in the high frequency range (>30 Hz) was attenuated with the height of the carton in the pallet. However, the transmissibility of vibration energy in the range of 3–20 Hz was the greatest in the top-tier cartons, resulting in excessive mechanical damage to the bananas. The characterization of damage to bananas at different stack positions\heights of multi-trailer road trains is an integral step for the development of damage reduction mechanisms. These would require the design, optimization, and simulation testing of better packaging alternatives targeted at minimizing the occurrence of mechanical injury in-transit.

Keywords: /Fruit/ /Bananas/ /Transport/ /Road Train/ /Vibration/ /Mechanical Damage/

Chen, J., Li, F., Li, Y., Wang, Y., Wang, C., Yuan, D., & Jiang, Y. (2019). Exogenous procyanidin treatment delays senescence of harvested banana fruit by enhancing antioxidant responses and in vivo procyanidin content. Postharvest Biology and Technology, 158, 110999. doi: 10.1016/j.postharvbio.2019.110999

Abstract

Banana fruit has high nutritional value and is consumed worldwide. However, rapid senescence shortens the storage time of harvested banana fruit after ripening. Procyanidins (PAs) are excellent antioxidants, but their effects on harvested fruit are obscure. Here, we explored the effects of exogenous PAs on senescence in banana fruit. Notably, a 1% PA solution delayed senescence of banana fruit, as demonstrated by reduced decrease in pulp firmness, peel color changes, and total soluble solids accumulation in pulp. Reactive oxygen species levels, malondialdehyde content, and relative conductivity rates in peels were significantly decreased, whereas superoxide dismutase, catalase, and peroxidase activity and expression were enhanced by PA treatment. The DPPH· scavenging activity in peels of PA-treated fruit was also enhanced, and in vivo PA contents in the peel and pulp were induced by PA treatment. Overall, PA-dependent delayed senescence could help maintain the freshness of harvested banana fruit.

Keywords: /Banana Fruit/ /Senescence/ /Procyanidins/ /Anti-oxidation/ /Anthocyanidin reductase/

Wu, Q., Ma, Z.-Z., Qin, Y.-L., Li, Y.-M., Huang, B.-Z., Zhang, X.-L., … Pang, X.-Q. (2019). Imbalanced expression of stay-green 1 alleles in banana AAB/ABB cultivars prevents high-temperature-induced green ripening as in AAA Cavendish fruit. Postharvest Biology and Technology, 158, 110980. doi: 10.1016/j.postharvbio.2019.110980

Abstract

Cavendish banana (*Musa* AAA) shows green-ripening at high temperatures above 24 °C, while Bluggoe fruit (*Musa* ABB) turns completely yellow. To understand the genomic constitution of the fruit de-greening

trait, we compared fruit ripening and chlorophyll (Chl) degradation in 4 banana cultivars, belonging to the Cavendish (AAA), Mysore (AAB), Pisang Awak (ABB) and Bluggoe (ABB) subgroups, at 30 °C and 20 °C. Compared with fruit at 20 °C, ripening progress of the 4 cultivars at 30 °C, as represented by the change in fruit firmness and expression of fruit ripening-related genes, *ACS ACO* and *PG*, was accelerated, while the de-greening of fruits was repressed in the AAA cultivar but enhanced in the 3 hybrids (AAB/ABB). The expression of *Stay-Green 1* (*SGR1*), a key Chl degradation gene, was reduced in the AAA cultivar but induced in the hybrids, correlating to the fruit de-greening patterns. The *A-* and *B-SGR1* alleles, from the A- and B-genome, respectively, and a recombinant of the two alleles (*H-SGR1*) were identified in the AAB/ABB cultivars. A highly conserved polymorphism code was found to differentiate the *A/B/H-SGR1* alleles. Allele-specific expression analysis showed that the Bluggoe fruit transcribed only *B-SGR1*, while Pisang Awak and Mysore expressed *B/H-* and *A/B-SGR1*, respectively, and higher *B-SGR1* transcription levels were detected at 30 °C than at 20 °C. Transient expression of *A/B/H-SGR1* in tobacco leaves demonstrated that SGR1s were all targeted to chloroplasts, and A-SGR1 showed a weaker Chl degradation capacity than B/H-SGR1. The allelic imbalanced expression (AIE) of *SGR1* was demonstrated to confer the different fruit de-greening traits to the AAA and AAB/ABB cultivars at high temperatures.

Keywords: /Banana/ /Fruit Ripening/ /Chlorophyll Degradation/ /Imbalanced Expression/ /High Temperatures/

Li, J., Sun, Q., Sun, Y., Chen, B., Wu, X., & Le, T. (2019). Improvement of banana postharvest quality using a novel soybean protein isolate/cinnamaldehyde/zinc oxide bionanocomposite coating strategy. Scientia Horticulturae, 258, 108786. doi: 10.1016/j.scienta.2019.108786

Abstract

Soybean protein isolate (SPI) based coatings incorporating with plant-sourced cinnamaldehyde (CIN) or facile synthesized flower-like zinc oxide nanoparticle (ZnONP) have been used for the postharvest preservation of bananas. The effects of the pure SPI coating, SPI/CIN coating, and SPI/CIN/ZnONP nanocomposite coating on diverse physicochemical properties of bananas and antifungal performance were studied during the whole storage. Results demonstrated that SPI nanocomposite film could effectively delay ripening rate and weight loss of bananas. Compared with other SPI-based coating treatments, SPI/CIN/ZnONP nanocomposite coating could also hinder the harmful changes in fruit firmness, total soluble sugar, titratable acidity and sensory quality during the whole storage period. Moreover, the antifungal performance of SPI/CIN/ZnONP coating was 1.25-fold stronger than that of SPI/CIN treatment. This could be explained by the oxidative stress-mediated antifungal mechanism for CIN and ZnONP.

Keywords: /Biocomposite Material/ /Active Coating/ /Fresh-Keeping/ /Postharvest Quality/

BLACKBERRY

Kim, M. J., Lee, M. Y., Shon, J. C., Kwon, Y. S., Liu, K.-H., Lee, C. H., & Ku, K.-M. (2019). Untargeted and targeted metabolomics analyses of blackberries – Understanding postharvest red drupelet disorder. Food Chemistry, 300, 125169. doi: 10.1016/j.foodchem.2019.125169

Abstract

Red drupelet is a postharvest disorder of blackberries with several drupelets turning back to red. This affects visual quality and thus marketability and consumers' acceptance. However, the cause of this disorder as well as metabolite changes during color reversion have not been fully understood. Anthocyanins, cyanidin 3-glucoside, cyanidin 3-malonylglucoside, cyanidin 3-dioxalylglucoside, and total

anthocyanin, were significantly lower in red drupelets than in black drupelets after 7 days of storage. Sugars and organic acids, lipids, and free amino acids also changed with storage and by color reversion. The untargeted metabolomics analyses indicated that red drupelets were generally differentiated from berries at harvest or black drupelets at metabolite level. The results of this study help better understand the red drupelet disorder. To our knowledge, this is the first study investigating red drupelet disorder by comparing black and red drupelets at metabolite level.

Keywords: /Blackberry/ /Red Drupelet Disorder/ /Metabolomics/ /Anthocyanin/ /Postharvest/

BLUEBERRY

Yang, J., Shi, W., Li, B., Bai, Y., & Hou, Z. (2019). Preharvest and postharvest UV radiation affected flavonoid metabolism and antioxidant capacity differently in developing blueberries (Vaccinium corymbosum L.). *Food Chemistry*, *301*, 125248. doi: 10.1016/j.foodchem.2019.125248

Abstract

Flavonoids can protect plants against UV but the mechanism by which specific flavonoids during fruit development is unclear, especially in blueberries on living plants. We analyzed the gene expression and metabolite profiles of flavonols, proanthocyanidins (PAs), and anthocyanins under preharvest UV-B/-C and postharvest UV-A/-B/-C irradiation in developing blueberries. Both pre- and postharvest UV irradiation significantly increased flavonol accumulation during early fruit development, while increased anthocyanin and PA contents during late fruit development. However, PAs decreased during postharvest but increased during preharvest UV irradiation in green fruit. The antioxidant capacity increased by postharvest UV irradiation, while hardly affected by preharvest UV irradiation. Overall, the gene expression changes paralleled the flavonoid contents after UV irradiation. Notably, *VcMYBPA1* was closely related with *VcLAR* and *VcANR* under pre- and postharvest UV irradiation, which could relate to PA biosynthesis. During natural fruit maturation and UV conditions, the elevated PA content exhibited higher potential antioxidant activity. Our results show that UV resistance is greater in living plants than detached fruits, the former showing a systemic and moderate response and the latter a non-systemic but strong response. These results might contribute to the development of pre- and postharvest technologies to promote healthier fruit consumption.

Keywords: /Blueberry/ /Flavonoid/ /Antioxidant Activity/ /Gene Expression/ /Preharvest and Postharvest UV Irradiation/

Wang, H., Wu, Y., Yu, R., Wu, C., Fan, G., & Li, T. (2019). Effects of postharvest application of methyl jasmonate on physicochemical characteristics and antioxidant system of the blueberry fruit. Scientia Horticulturae, 258, 108785. doi: 10.1016/j.scienta.2019.108785

Abstract

The effects of postharvest methyl jasmonate (MeJA) treatment on quality, antioxidant system, and H2O2 content in blueberry fruit were investigated. Results indicated that 50 and 100 μmol/L MeJA treatment could reduce the increase in weight loss, maintain sensory and nutritional qualities, and prolong the shelf-life of blueberry. Meanwhile, MeJA significantly increased the antioxidant capacity by increasing the content of non-enzymatic antioxidants, namely, phenolics, flavonoids, anthocyanin, ascorbic acid, reduced glutathione, and the activity of enzymatic antioxidants, namely, superoxide dismutase, catalase and ascorbate peroxidase. However, increased H2O2 generation was detected in MeJA-treated fruits during the initial period, which occurred before peaks in antioxidant levels. This result suggests that H2O2 was induced by MeJA, which may act as a signaling molecule involved in the regulation of antioxidant

system of blueberry during storage. In summary, MeJA treatment could increase the antioxidant capacity of postharvest blueberry by activating the generation of H2O2.

Keywords: /Anthocyanins/ /Flavonoids/ /Polyphenols/ /Weight Loss/

BROCCOLI

Kao, N.-Y., Tu, Y.-F., Sridhar, K., & Tsai, P.-J. (2019). Effect of a high voltage electrostatic field (HVEF) on the shelf-life of fresh-cut broccoli (Brassica oleracea var. italica). *Lwt*, *116*, 108532. doi: 10.1016/j.lwt.2019.108532

Abstract

High voltage electrostatic field (HVEF), non-thermal processing technology, was used to prolong the shelf-life of fresh-cut broccoli (*Brassica oleracea* var. *italica*) at 4 °C. Moreover, we further examined the quality parameters of the HVEF treated fresh-cut broccoli at 4 °C. Fresh-cut broccoli samples were treated with HVEF (50-400 kV/m) based on electric field strength (kV/m × time). Data revealed that HVEF could reduce the loss of hardness (27.68 N and 19.56 N) and maintained the greenness (−0.48 and 1.99) of fresh-cut broccoli samples after 40 days of storage. Moreover, HVEF treated samples further reported a lower electrolyte leakage (6.03% and 14.68%) and higher SOD-like activity (646.68 U/mL and 595.17 U/mL). Based on the above findings, we concluded that HVEF could extend the shelf-life of fresh-cut broccoli up to 40 days and has the potential on the storage quality of fresh-cut broccoli that might be useful in food processing industries.

Keywords: /Electrostatic Field/ /Fresh-Cut Broccoli/ /Hardness/ /Shelf-Life/ /SOD-Like Activity/

CARROT

Liu, Q., Jin, X., Feng, X., Yang, H., & Fu, C. (2019). Inactivation kinetics of Escherichia coli O157:H7 and Salmonella Typhimurium on organic carrot (Daucus carota L.) treated with low concentration electrolyzed water combined with short-time heat treatment. *Food Control*, *106*, 106702. doi: 10.1016/j.foodcont.2019.06.028

Abstract

In the present study, the synergistic disinfection efficacy of low concentration electrolyzed water (LcEW) (free available chlorine, 4 mg/L) combined with brief heat enhancement was evaluated and the bactericidal mechanism was investigated by atomic force microscopy (AFM). The inactivation kinetics of *Escherichia coli* O157:H7 and *Salmonella* Typhimurium on organic carrot were fitted with Weibull model to evaluate the synergistic effects. LcEW is effective at inactivating *E. coli* O157:H7 and *S*. Typhimurium on organic carrots, and the efficacy is dependent on the temperature. The combined treatment with LcEW at 80 °C resulted in decimal reduction time (*TR*) of 7.42 and 3.27 s for *E. coli* O157:H7 and *S.* Typhimurium, respectively. The reactive oxygen species generated from LcEW were responsible for the microbial inactivation. In addition, AFM observation of *E. coli* O157:H7 and *S.* Typhimurium revealed morphological alterations in the bacterial cell structure, which illustrated the damage of cell membrane injury and intracellular component leakage. Quality attributes of carrot treated with LcEW and short-time heating (70 °C, 1 min) were not significantly different from controls. Compared to the control group, the combined treatment exhibited significantly ($P < 0.05$) greater inhibition of naturally occurring microbiota on organic carrots during storage at 4 °C. Consequently, the application of LcEW combined with short-time heat improved safety of organic carrot, without negatively affecting the sensory properties, which can be explored by the organic industry.

Keywords: /Electrolyzed Water/ /Electrolyzed Oxidizing Water/ /Electrolysed Water/ /Weibull Model/ /Organic Vegetable/ /Atomic Force Microscopy/ /*Escherichia coli* O157:H7/ /*Salmonella* Typhimurium/ /Organic Food/ /Food Nanotechnology/ /Minimal Processing/ /Pathogen/ /Heat Treatment/ /Carrot/ /Postharvest/ /Fresh-Cut/ /Fresh Produce/ /Modelling/ /Prediction/ /Sanitation/

CAULIFLOWER

Mashabela, M., Mahajan, P. V., & Sivakumar, D. (2019). Influence of different types of modified atmosphere packaging films and storage time on quality and bioactive compounds in fresh-cut cauliflower. Food Packaging and Shelf Life, 22, 100374. doi: 10.1016/j.fpsl.2019.100374

Abstract

Minimal or fresh processing of cauliflower is becoming much more common than using the intact cauliflower in food service and retail markets as a convenience product. Therefore, the objective is to investigate the effect of different types of modified atmosphere packaging films and storage time on postharvest quality and bioactive compounds in fresh-cut cauliflower. Fresh-cut cauliflowers were packed in different films [Polypropylene (gas concentrations at equilibrium: (0.38%, O2, 28.53%, CO2), Peakfresh (19.4%O2 & 1.62% CO2), 20% fixed area of NatureFlex film + 80% Bi-axially Polypropylene (6.06%O2 & 11.43%CO2) and 40% fixed area of NatureFlex film + 60% Bi-axially Polypropylene (16.87% O2 & 5.87% CO2) and stored at 5 C and 85% RH for up to 12 days. Samples were withdrawn at 4 day intervals. The optimal colour retention, characteristic cauliflower odour, and overall acceptance was highest up to day 8 in a package with 20% fixed area of NatureFlex, which can be recommended for packaging of fresh-cut cauliflower. The Polypropylene packed samples showed the highest total phenol, flavonoid (quercetin), FRAP, ABTS+ activity on day 4. On day 8, retention of glucobrassicin, 4-methoxy glucobrassicin, 1-methoxy glucobrassicin concentrations showed the following order: Poplypropylene >20% fixed area of NatureFlex >40% fixed area of NatrueFlex.

Keywords: /Brassica Crops/ /Postharvest Quality/ /Minimal Processing/ /Head Space Gas Composition/ /Glucosinolates/

CHERRY TOMATO

Buendía−Moreno, L., Soto−Jover, S., Ros−Chumillas, M., Antolinos, V., Navarro−Segura, L., Sánchez−Martínez, M. J., … López−Gómez, A. (2019). Innovative cardboard active packaging with a coating including encapsulated essential oils to extend cherry tomato shelf life. Lwt, 116, 108584. doi: 10.1016/j.lwt.2019.108584

Abstract

An active cardboard tray coated with a water-based emulsion including encapsulated (in *β*−cyclodextrins (CDs)) essential oils (EOs) was used to study the quality changes of cherry tomatoes (flow-packaged using a macroperforated film) during storage up to 24 days at 8 °C. Commercial polyethylene and non-active cardboard trays were used as control materials. Firmness of samples was well maintained for 24 days, while decay incidence was reduced from 8% to <1% at day 24. Tomato colour was also better preserved with the active cardboard tray. Sensory analyses revealed that cherry tomato shelf life was extended from 20 to 24 days at 8 °C. The tray material (polyethylene or cardboard) itself did not affect tomato quality during storage. EOs were completely released from the active cardboard tray after 16 days at 8 °C, although EOs beneficial effect on tomato was maintained until day 24. In conclusion, the studied active cardboard tray was able to highly maintain cherry tomato quality extending its shelf life from 20 to 24 days at 8 °C.

Keywords: /β−cyclodextrin/ /Inclusion Complex/ /Carvacrol/ /Decay Incidence/ /Firmness/

CITRUS

Li, X., Wang, W., Liu, S., Ruan, C., Yi, L., Deng, L., … Zeng, K. (2019). Effects of the peptide H-OOWW-NH2 and its derived lipopeptide C12-OOWW-NH2 on controlling of citrus postharvest green mold. Postharvest Biology and Technology, 158, 110979. doi: 10.1016/j.postharvbio.2019.110979

Abstract

The present study evaluated the antifungal properties of tetrapeptide H-OOWW-NH2 (O3TR) and its derivative lipopeptide C12-OOWW-NH2 (C12O3TR) against Penicillium digitatum, one of the main postharvest pathogens in citrus, and the possible mechanisms of their antifungal action. The results showed that the peptides O3TR and C12O3TR could inhibit conidial germination, induce conidia death and reduce the survival of mycelia of P. digitatum in vitro. The antifungal properties of O3TR and C12O3TR against P. digitatum were thermostable (40 °C–80 °C), insensitive to the change of pH (3–10) and varying sensitive to the presence of cations (Na+, Ca2+). In addition, the two peptides could effectively control green mold on citrus in vivo study. In terms of safety evaluation, the hemolytic activity of O3TR was neglectable, and significantly lower than that of C12O3TR, both of which were much lower than that of commercial prochloraz. The signals and intensity of fluorescent dye SYTOX Green (SG) and Propidium Iodide (PI) showed that O3TR and C12O3TR could enhance the mycelial and conidial membrane permeabilization. The antifungal action of O3TR and C12O3TR was further demonstrated by the release of cellular constituents and extracellular conductivity. In conclusion, the two peptides have a promising prospect to be applied as antifungal agents for the control of the green mold of citrus postharvest diseases.

Keywords: /Tetrapeptide/ /Lipopeptide/ /Citrus/ /Green Mold/ /Antifungal Properties/ /Mechanisms/

FRESH FRUIT

Delgado, J., Ballester, A.-R., Núñez, F., & González-Candelas, L. (2019). Evaluation of the activity of the antifungal PgAFP protein and its producer mould against Penicillium spp postharvest pathogens of citrus and pome fruits. *Food Microbiology*, *84*, 103266. doi: 10.1016/j.fm.2019.103266

Abstract

Postharvest fungal diseases are among the main causes of fresh fruit losses. Chemical control is against claims for “natural” or “chemical-free” products. Biocontrol agents, such as antifungal proteins or their producing moulds, may serve to combat unwanted pathogens. Since the effectiveness of these bioprotective agents depends on the food substrate, their effect must be tested on fruits. The objective of this work was to study the effect of the antifungal protein PgAFP and its producer, *Penicillium chrysogenum,* against *Penicillium expansum* and *Penicillium digitatum* growth on apple and oranges respectively, and the PgAFP effect on eleven *P. expansum*, *Penicillium italicum*, and *P. digitatum* strains *in vitro*, and on patulin production on apple substrate. The sensitivity upon PgAFP was *P. digitatum* > *P. expansum* > *P. italicum*. In oranges, broadly, no inhibitory effect was obtained. PgAFP and *P. chrysogenum* did not inhibit the *P. expansum* CMP-1 growth on Golden Delicious apples, however, a successful effect was achieved on Royal Gala apples. On apple substrate, patulin production by *P. expansum* CMP-1 rose in parallel to PgAFP concentrations, linked with high reactive oxygen species levels. PgAFP cannot be proposed as a bioprotective agent on apple. However, *P. chrysogenum* is a promising agent to be used on Royal Gala apples.

Keywords: /Apple/ /Blue Mould/ /Green Mould/ /Oranges/ /*Penicillium chrysogenum/* /PgAFP/

Bai, J., Baldwin, E., Tsantili, E., Plotto, A., Sun, X., Wang, L., … Yang, W. (2019). Modified humidity clamshells to reduce moisture loss and extend storage life of small fruits⋆. Food Packaging and Shelf Life, 22, 100376. doi: 10.1016/j.fpsl.2019.100376

Abstract

Water loss is one of the major causes for the food loss and waste of small fruits, both in the retail market and at the consumer level. A modified humidity (MH) one-pound (˜454 g) clamshell was designed for small fruit packaging and was compared to a typical commercial (COM) clamshell for several small fruits held in cold (0–6 °C), refrigerated shelf (10 °C) and room (19–25 °C) temperatures, typical in the industry for shipment, storage and marketing. Water loss of litchis, sweet cherries, strawberries, blueberries, Chinese bayberries, apricots, loquats and cherry tomatoes packaged in the COM clamshells was 1.2–4.5-fold more than for MH clamshells. Quality attributes of the packaged fruits were generally better maintained in the MH clamshells, especially for those attributes susceptible to water deficit, such as shriveling, desiccation-induced browning and/or drying of pedicels in cherries, calyx of strawberries, pericarp of litchis, peel shriveling of cherry tomatoes and softening of blueberries and strawberries. The modification of the internal clamshell atmosphere was minor to moderate (mostly less than 1 kPa change, with a maximum change of 3.6 kPa which is still minor for O2, but is probably not so for CO2). MH clamshells could be problematic in some cases because it is more prone to condensation especially when raising temperature from cold storage to room temperature during marketing. Overall, the MH clamshells substantively reduced water loss, maintained fresh fruit quality and extended storage life of small fruits without excessively modifying the package atmosphere and inducing decay.

Keywords: /Small Fruit/ /Packaging/ /Modified Humidity/ /Relative Humidity/ /Water Loss/ /Decay/

HAZELNUT

Onal-Ulusoy, B., Sen, Y., & Mutlu, M. (2019). Quality changes of hazelnut kernels subjected to different cold plasmas and gamma irradiation treatments. Lwt, 116, 108549. doi: 10.1016/j.lwt.2019.108549

Abstract

In this study, physicochemical parameters of hazelnuts after atmospheric-pressure (AP:air, 3000 L/h, 655 W, 25 kHz, 1.7 min) and low-pressure (LP:air, 25 Pa, 100 W, 13.56 MHz, 30 min) cold plasmas, and gamma irradiation (GMI:10 kGy, 10 min) treatments, and untreated and treated hazelnuts after accelerated storage for 30 days(60 °C) were investigated. All treatments significantly reduced moisture (26–47%), aw (16–48%), oil (13–15%), soluble phenolic content (SPC; 26–36%) and total tocopherols (TT; 8–38%) compared to untreated hazelnut (Control-1) while no significant changes determined between treatments and Control-1 in terms of *L*a*b**, protein, total sugars (TS) and total phenolic compounds. However, TS of all treatments after storage were significantly increased (3.2–33%) while aw (7–27%) and TT (13–31%) of all treatments were significantly decreased compared to both Control-2 and before storage ($p < 0.05$). Among treatments, cold plasmas showed great potential for conservation of most tested parameters.

Keywords: /Non-Thermal Food Processing/ /*Corylus avellana L./* /Phenolic/ /Sugar/ /Storage/

JUJUBE

Reche, J., García-Pastor, M., Valero, D., Hernández, F., Almansa, M., Legua, P., & Amorós, A. (2019). Effect of modified atmosphere packaging on the physiological and functional characteristics of Spanish jujube (Ziziphus jujuba Mill.) cv Phoenix during cold storage. Scientia Horticulturae, 258, 108743. doi: 10.1016/j.scienta.2019.108743

Abstract

Jujube fruits cv 'Phoenix' were stored in modified atmosphere packaging (MAP) using a polyester (12 μm)-polypropylene (60 μm) film at 5 °C and 90% RH during 49 days. Jujube fruits stored without packaging and in normal air and same temperature and RH served as control. The atmosphere composition at the steady state was at 35 days with 14.50 kPa O2 and 3.86 kPa CO2. The atmosphere packaging showed an almost zero amount of ethylene during all storage days. The jujubes at MAP have been very effective as they presented the same appearance throughout the 49 days of storage. On the other hand, the fruits in control showed a wrinkled and non-commercial appearance at day 21. Treatment with MAP caused a significant delay in the ripening of the fruit after harvest. It caused less weight loss, more firmer and more intense color. Improved total carotenoids, total phenols, hydrophilic-total antioxidant activity (H-TAA), lipophilic-total antioxidant activity (L-TAA). Meanwhile, the maturity index (MI) was reduced compared with control jujubes.

Keywords: /MAP/ /Ethylene/ /Respiration/ /Total Antioxidant Activity/ /Phenols/

MANGO

Vasconcelos, O. C. D. M., Guilherme José Bolzani De Campos Ferreira, Silva, J. D. C., Mederos, B. J. T., & Freitas, S. T. D. (2019). Development of an artificial fruit prototype for monitoring mango skin and flesh temperatures during storage and transportation. Postharvest Biology and Technology, 158, 110956. doi: 10.1016/j.postharvbio.2019.110956

Abstract

Postharvest losses in the mango global market may be as high as 30%, affecting the cost of production, which is passed on to the consumer. Lack of homogeneous air temperature in refrigerated containers, packages, pallets and difficulty of inserting temperature sensors in fruit are issues in addressing losses during transport. This study aimed to develop an artificial fruit with skin and flesh thermal behavior equivalent to those of ‘Tommy Atkins’ mangoes at different maturity stages, which could be used to monitor fruit temperature during storage, transportation and marketing. The materials used to simulate mango skin were white acrylonitrile butadiene styrene (ABS), crystal ABS, and poly lactic acid with wood powder (PLA Wood). Mango flesh was simulated using three agar concentrations, 5, 10 and 15%. A temperature sensor was inserted in the middle of each artificial fruit (42.5 mm deep into the agar-gel flesh) and another was inserted under the skin (1 mm deep), both in the center and equatorial region to monitor the fruit thermal behavior. Skin and flesh temperature changes were monitored during refrigerated storage with or without hydrothermal treatment. The thermal behaviors of White ABS and Crystal ABS skins were different from those of the mangoes, and it was not possible to simultaneously obtain high correlation with fruit at different maturity stages. Artificial fruit with PLA Wood skin and flesh containing 15% agar showed skin and flesh thermal behavior similar to that of mangoes at different maturity stages defined through the quality attributes skin and flesh color, soluble solids, citric acid, pH and firmness, with R^2 = 97%, coefficient of variation between 7 and 17% and P > F at 99% confidence level. Artificial fruit with PLA Wood skin and flesh containing 15% agar can be used for real-time monitoring of skin and flesh temperatures of ‘Tommy Atkins’ mangoes at different maturity stages after harvest.

Keywords: /Mango/ /Hydrothermal Treatment/ /Cooling/ /Technology/

MUSHROOM

Pan, J., Ai, F., Shao, P., Chen, H., & Gao, H. (2019). Development of polyvinyl alcohol/β-cyclodextrin antimicrobial nanofibers for fresh mushroom packaging. Food Chemistry, 300, 125249. doi: 10.1016/j.foodchem.2019.125249

Abstract

Under the optimal conditions, a crosslinked electrospun polyvinyl alcohol/cinnamon essential oil/β-cyclodextrin (CPVA-CEO-β-CD) nanofibrous films for sustained release of antimicrobials were successfully prepared. Cinnamon essential oil (CEO) can be sustainably released due to CPVA-CEO-β-CD nanofibers complex delivery systems. The chemical crosslinking and physical welding achieved simultaneously by glutaraldehyde atomization fumigation, making fibers more suitable for fresh food packaging. Nanofibrous films were characterized in terms of SEM, ATR-FTIR, DSC, water contact angle analysis and antibacterial trials. ATR-FTIR and DSC data indicated that CEO was encapsulated in a β-CD cavity and they coexisted in PVA nanofibers. The water contact angle of the crosslinked PVA nanofibrous films increased with CEO and the values were always below 90°. Crosslinked nanofibers possessed fine properties in vitro antibacterial against *Staphylococcus aureus* and *Escherichia coli*. Furthermore, CPVA/β-CD/CEO nanofibrous films delayed decay of mushroom during storage, indicating their potential implementation in active food packaging.
Keywords: /Electrospinning/ /Polyvinyl Alcohol/ /Cinnamon Essential Oil/ /Antimicrobial Activity/ /Mushroom/ /Packaging/

Wang, Y., Mo, Y., Li, D., Xiang, C., Jiang, Z., & Wang, J. (2019). The main factors inducing postharvest lignification in king oyster mushrooms (*Pleurotus eryngii*): Wounding and ROS-mediated senescence. Food Chemistry, 301, 125224. doi: 10.1016/j.foodchem.2019.125224

Abstract

This study was the first investigation into the main inducers of two lignifications by examining the changes of physicochemical properties and gene expression in king oyster mushrooms, under different conditions, during 21 days of storage. The results showed that the toughness, firmness and gumminess of the no-wounding treatment decreased to approximately 75–82.5% of the initial values, and the lignin content and expression of *Pe4CL1* and *Pe4CL3* decreased by 21–40% and 22–77%, respectively, in comparison to those of the other treatments in the first lignification. These findings indicated that wounding was the main factor inducing the first lignification. The second lignification of tested mushrooms was positively correlated with reactive oxygen species (ROS)-mediated senescence, accompanied by increased malondialdehyde (MDA) content, electrolyte leakage rate and mitochondrial dysfunction, which showed that ROS-mediated senescence played an essential role in the second lignification. This study is helpful for effective strategies to reduce lignification in stored mushrooms.

Keywords: /King Oyster Mushroom/ /Postharvest Lignification/ /Wounding/ /Reactive Oxygen Species/ /Senescence/

MUSKMELON

Wang, B., Jiang, H., Bi, Y., He, X., Wang, Y., Li, Y., … Prusky, D. (2019). Preharvest multiple sprays with sodium nitroprusside promote wound healing of harvested muskmelons by activation of phenylpropanoid metabolism. Postharvest Biology and Technology, 158, 110988. doi: 10.1016/j.postharvbio.2019.110988

Abstract

Muskmelons are susceptible to mechanical damage at harvest and subsequent postharvest handling before storage. The wounds provide an easy pathway for fungi to infect, leading to postharvest decay of fruit during storage. Wound healing is considered as a positive defense process, which can restrict the invasion of pathogens. In this study, muskmelon fruit (*Cucumis melo* cv. Manao) during growth were repeatedly sprayed with 0.5 mM sodium nitroprusside (SNP, a exogenous donor of nitric oxide (NO)) or 0.1 mM 2-(4-carboxyphenyl)-4,4,5,5-tetramethylimidazoline-1-oxyl-3-oxide (c-PTIO, a scavenger of NO), to test the effect of these preharvest treatments on wound healing of harvested muskmelon fruit. The results showed that SNP sprays reduced decay incidence and disease severity of harvested muskmelons inoculated with *Trichothecium roseum*. SNP also promoted the accumulation of suberin and lignin at wound sites through increasing phenylalanine ammonia lyase (PAL) activity and stimulating the accumulation in total phenolics, flavonoids and lignin. On the contrary, c-PTIO sprays enhanced decay incidence and disease severity of wounded inoculated fruit, while decreasing PAL activity, the content of total phenolics, flavonoids and lignin and reduced the accumulation of suberin and lignin at wound sites. The present results suggest that NO released by SNP sprays promote the wound healing and prevent disease development in harvested muskmelons by inducing increase in PAL activity, the contents of phenolics, flavonoids, suberin and lignin accumulation at wound sites.

Keywords: /Nitric oxide/ /Preharvest/ /Muskmelon/ /Wound Healing/ /Phenylpropanoid Metabolism/

PEANUT

Gong, A.-D., Dong, F.-Y., Hu, M.-J., Kong, X.-W., Wei, F.-F., Gong, S.-J., … Liao, Y.-C. (2019). Antifungal activity of volatile emitted from Enterobacter asburiae Vt-7 against *Aspergillus flavus* and aflatoxins in peanuts during storage. Food Control, 106, 106718. doi: 10.1016/j.foodcont.2019.106718

Abstract

The contamination of food with *Aspergillus flavus* and subsequent aflatoxins is considered as one of the most severe safety problems in the world. The application of microorganisms and the produced bio-active compounds is considered as the most promising method for controlling foodborne pathogens and mycotoxins contamination both in pre- and post-harvest. Vt-7, identified as *Enterobacter asburiae*, was able to completely inhibit the growth of *Aspergillus flavus* (AF) and other seven important fungal pathogens by the production of volatiles. Additionally, it can also significantly inhibited AF infection on peanuts in storage, down-regulated the gene expression of aflatoxin biosynthesis and eventually prevented aflatoxins production. Scanning electron microscope further proved that Vt-7 volatiles prevented conidia germination of AF on peanut surface, and severely destroyed the conidia structure. Gas chromatography – tandem mass spectrometry revealed that two abundant compounds (1-Pentanol and Phenylethyl Alcohol) were involved in the volatile profiles. They showed great antagonistic activity against AF with minimal inhibitory concentration at 200 μL/L. Therefore, *E. asburiae* Vt-7, and volatiles 1-Pentanol and Phenylethyl Alcohol were effective agents in controlling AF and aflatoxins in peanut during storage. They will provide novel strategies for the application of microbe and bio-active compounds against fungal pathogens and mycotoxins in food and grains during storage.

Keywords: /*Aspergillus flavus*/ /Aflatoxin/ /Postharvest/ /*Enterobacter asburiae*/ /Volatile/ /1-Pentanol/ /Phenylethyl alcohol/

POTATO

Liu, X., Wang, T., Lu, Y., Yang, Q., Li, Y., Deng, X., … Zheng, J. (2019). Effect of high oxygen pretreatment of whole tuber on anti-browning of fresh-cut potato slices during storage. Food Chemistry, 301, 125287. doi: 10.1016/j.foodchem.2019.125287

Abstract

The surface browning usually occurs on fresh-cut potato during storage. The effect of short-time high oxygen pretreatment on anti-browning of fresh-cut potato slices was investigated. The whole potato tubers were firstly immersed in the oxygen concentration of 21%, 60% and 80% for 20 min. Then, the potatoes were peeled, cut and stored at 4 °C for 8 days. The results showed that the short-time 80% oxygen pretreatment possessed significantly anti-browning effect by retarding the increase of polyphenol oxidase (PPO) activity and the accumulation of malondialdehyde (MDA) content, maintaining the cell integrity. Meanwhile, the 80% oxygen treatment could increase the activities of phenylalanine ammonia lyase (PAL) and peroxidase (POD), and the total phenolic content. Importantly, the 80% oxygen treatment could effectively improve the antioxidant capacity. Overall, all results suggest that the short-time high oxygen pretreatment holds great promise on anti-browning of fresh-cut potato.

Keywords: /High Oxygen Pretreatment/ /Enzymatic Browning/ /Fresh-cut Potato/

ROCKET LEAVES

Pereira, M., Amaro, A., Oliveira, A., & Pintado, M. (2019). Bioactive compounds in ready-to-eat rocket leaves as affected by oxygen partial pressure and storage time: A kinetic modelling. Postharvest Biology and Technology, 158, 110985. doi: 10.1016/j.postharvbio.2019.110985

Abstract

Storage techniques, such as low temperature and modified atmosphere packaging, are efficient in keeping visual quality of ready-to-eat (RTE) products such as processed leafy vegetables throughout the supply chain, but studies on appearance often neglect the effect of different storage conditions on their nutritional properties. The effects of initial O2 partial pressure (20, 10, 5 and 2.5 kPa O2) in packages and storage time (14 d) on RTE rocket leaves on the bioactive compounds, phenolics, ascorbic acid, and antioxidant activity were determined. Kinetic models were applied to allow the assessment and prediction of the influence of initial partial pressure on nutritional composition. The results show that lowering package initial O2 partial pressure from 20 kPa to 5–10 kPa reduced the respiration rate by 53 and 38%, respectively. However, antioxidant activity and ascorbic acid content showed most effects with an initial O2 of 5 kPa. The kinetic parameters are relevant to help predict phytochemical changes during storage under different package O2 partial pressures. To obtain an overall quality, the application of intermediate atmospheres would be beneficial.

Keywords: /Antioxidant Activity/ /*Diplotaxis tenuifolia*/ /Kinetics/ /Modified Atmosphere Packaging/ /Phenolic Compounds/

SWEET CHERRY

Wang, F., Zhang, X., Yang, Q., & Zhao, Q. (2019). Exogenous melatonin delays postharvest fruit senescence and maintains the quality of sweet cherries. Food Chemistry, 301, 125311. doi: 10.1016/j.foodchem.2019.125311

Abstract

We assessed the effects of postharvest exogenous melatonin (50,100 and 150 μmol L−1) on the senescence and quality of sweet cherries during storage at 0 ± 0.5 °C. Melatonin treatment decreased decay incidence, respiration rate, and weight loss. It delayed the degradation of firmness, lightness, saturation, hue angle, titratable acidity, and total soluble solids content, thus maintaining better fruit quality. Melatonin treatment inhibited increases in $O2^{\bullet -}$, H2O2, malondialdehyde content, and relative membrane permeability, while maintaining higher endogenous melatonin levels and increasing superoxide dismutase and catalase activity. Additionally, melatonin treatment enhanced the activity of antioxidant enzymes, increased the levels of ascorbic acid, and reduced glutathione levels, which are related to the ascorbate–glutathione cycle, as well as increasing the AsA:DHA and GSH:GSSG ratios. Delayed senescence in sweet cherries after exogenous melatonin treatment may be associated with high endogenous melatonin levels and increased antioxidant activity and content.

Keywords: /Sweet Cherry/ /Melatonin/ /Senescence/ /Antioxidant Enzyme/ /Antioxidant Compounds/

Serradilla, M. J., Falagán, N., Bohmer, B., Terry, L. A., & Alamar, M. C. (2019). The role of ethylene and 1-MCP in early-season sweet cherry 'Burlat' storage life. Scientia Horticulturae, 258, 108787. doi: 10.1016/j.scienta.2019.108787

Abstract

Sweet cherries (*Prunus avium* L.) are highly appreciated because of their bioactive compound content and attractive organoleptic characteristics; however, they are very perishable. The aim of this work was to investigate whether ethylene and its antagonist 1-MCP affect the postharvest quality of an early-season sweet cherry cultivar, allowing storage life extension. 'Burlat' sweet cherries were subjected to three treatments at 1 °C for one month: i) control (air); ii) continuous ethylene supplementation (10 μL L−1); and iii) 1-Methylcyclopropene (1-MCP; 1 μL L−1 for 24 h) followed by air. The incidence of postharvest physiological disorders, the evolution of physical and functional quality traits, and fruit senescence were evaluated at 0, 7, 14, 21, and 30 days. Results showed that sweet cherries were sensitive to both ethylene and 1-MCP treatments. Continuous ethylene exposure reduced abscisic acid accumulation, resulting in higher weight and firmness loss. Moreover, ethylene application decreased titratable acidity through storage, indicating an effect on sweet cherry senescence. No significant differences among treatments were found for soluble solids content and individual sugars. Conversely, 1-MCP preserved firmness during the first 7 days of storage, while reduced the incidence of physiological disorders at the end of storage life. Furthermore, 1-MCP delayed the accumulation of cyanidin-3-*O*-glucoside for 7 days compared to control and ethylene treated cherries. Taken together these results highlight the potential use of 1-MCP to extend the postharevst life of early season sweet cherry fruit

Keywords: /*Prunus avium*/ /Fruit Quality/ /Disorders/ /Polyphenols/ /Sugars/ /Abscisic acid/