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ANTHURIUM

Favero, B. T., Lütken, H., Dole, J. M., & Lima, G. P. P. (2020). Anthurium andraeanum senescence in response to 6-benzylaminopurine: Vase life and biochemical aspects. *Postharvest Biology and Technology*, *161*, 111084. doi: 10.1016/j.postharvbio.2019.111084

Abstract

Plant growth regulators (PGRs) are key compounds in plant development and their exogenous use has the potential to positively influence the vase life of cut ornamentals. However, the application method can directly impact the effectiveness of PGRs. This study determined the impact of spraying or pulsing 0, 37.5, 75, 150 and 300 mg L−1 6-benzylaminopurine (BAP) on postharvest quality of cut *Anthurium andraeanum* 'Apalai' (IAC NK 130) flowers. Vase life, fresh weight (FW), soluble carbohydrate content, total phenolic content (TPC) and polyphenol oxidase (PPO) activity were determined in spathes and spadices. Spraying BAP was more effective than pulsing and extended the vase life to 17.9 d compared to 13.8 d, respectively and FW was maintained at 93 % and 76 % of initial values, respectively. Spathes treated with a BAP concentration below 150 mg L-1 showed highest soluble carbohydrate content. TPC was higher for the pulsing treatment than the spraying treatment. In spathes, TPC decreased and PPO activity increased over time with an increase of BAP concentration, showing phenolic depletion linkage to this enzyme activity. However, at BAP levels below 150 mg L-1, the activity of PPO remained low. In summary, spraying BAP at concentrations of 37.5–300 mg L-1 improved postharvest durability of *A. andreanum* 'Apalai' flower without inducing spathe blueing.

Keywords: /Fresh weight/ /Polyphenol oxidase/ /Pulsing/ /Spraying/ /Total phenolic content/

APPLE

Anese, R. D. O., Brackmann, A., Thewes, F. R., Schultz, E. E., Ludwig, V., Wendt, L. M., … Klein, B. (2020). Impact of dynamic controlled atmosphere storage and 1-methylcyclopropene treatment on quality and volatile organic compounds profile of 'Galaxy' apple. *Food Packaging and Shelf Life*, *23*, 100443. doi: 10.1016/j.fpsl.2019.100443

Abstract

There are few information about apple quality and volatile organic compounds (VOCs) profiles in fruit stored under a dynamic controlled atmosphere based on respiratory quotients (DCA-RQ). Thus, the aim of this work was to evaluate the effect of between 1-MCP with DCA-RQ, DCA based on chlorophyll fluorescence (DCA-CF), controlled atmosphere (CA) and ultralow oxygen (ULO) on the physical and chemical quality and VOCs of 'Galaxy' apples after 8 months of storage plus 7 d of shelf life. All storage conditions were performed with or without 0.625 μL L−1 of 1-MCP application. Despite of 1-MCP maintaining some quality attributes, the production of VOCs was reduced even under apples stored under DCA-RQ1.5 with it. DCA-RQ1.5 without 1-MCP maintained better VOCs than CA, ULO, DCA-RQ1.3 and DCA-CF. DCA-RQ1.5 without 1-MCP showed a similar flesh firmness compared to DCA-RQ1.5 with 1-MCP application, with high VOCs emission and flesh firmness. 1-MCP, despite of maintaining flesh firmness, has no positive effect in other attributes in apple under DCA-RQ1.3. Moreover, this regulator reduced the production of VOCs in all storage conditions.

Keywords: /Postharvest/ /*Malus domestica*/ /Oxygen/ /Physiological disorders/

Fernando, I., Fei, J., Stanley, R., & Rouillard, V. (2020). Evaluating packaging performance for bananas under simulated vibration. *Food Packaging and Shelf Life*, *23*, 100428. doi: 10.1016/j.fpsl.2019.100428

Abstract

Packaging is the primary protection of fresh produce against the environmental hazards such as vibration in the distribution process. This study evaluated the effectiveness of two types of corrugated paperboard packaging, reusable plastic crates (RPC) and vacuum tightening for their protective performance in reducing damage of bananas under simulated transport vibration. Both vibration transmissibility and the construction material of packaging influenced the mechanical damage levels in bananas with the RPCs showing the highest damage levels. The best protective performance for bananas was exhibited by one-piece corrugated paperboard cartons with additional benefits of reduced vibration transmissibility at the top-tiers. Vacuum tightening effectively reduced the vibration damage, especially in the most bottom and top tier packages, by over 70% and thus, can be considered for further reducing mechanical damage to bananas. One-piece cartons, with the possible addition of vacuum tightening or tensioned plastic wrapping, could therefore substitute the widely used two-piece carton in Australia in order to minimize mechanical damage to bananas in-transit.

Keywords: /Mechanical damage/ /Vibration/ /Simulation/ /Packaging/ /Transmissibility/ /RPC/ /Banana/

Lv, J., Zhang, M., Bai, L., Han, X., Ge, Y., Wang, W., & Li, J. (2020). Effects of 1-methylcyclopropene (1-MCP) on the expression of genes involved in the chlorophyll degradation pathway of apple fruit during storage. *Food Chemistry*, *308*, 125707. doi: 10.1016/j.foodchem.2019.125707

Abstract

The ripening of the apple (*Malus* × *domestica* Borkh.) fruit is regulated by the phytohormone ethylene, where degreening is an important physiological metabolism caused by chlorophyll (Chl) degradation. However, to date, research on how ethylene affects the Chl degradation pathway of apple peel during ripening remains scarce. In this study, the effects of ethylene on the expression of Chl catabolic genes (*CCGs*) of apple peel during ripening were studied by treating harvested commercial mature apples with 0.5 μL L−1 1-methylcyclopropene (1-MCP). The results showed that 1-MCP treatment led to a delayed climacteric peak of respiration and ethylene production, exhibiting higher Chl content and hue angle (H°) compared to untreated fruit during ripening. Lower quantities of pheophorbide a oxygenase (PAO), pheophytinase (PPH) and red Chl catabolite reductase (RCCR) were also observed in peel tissues under 1-MCP treatment during ripening. Further study with quantitative real-time polymerase chain reaction (qPCR) revealed that the expression of *CCGs*, except for *MdNYE1a*, increased at different degrees upon ripening. Meanwhile, the apples treated with 1-MCP presented a downregulated expression of *MdRCCR2*, *MdNYC1*, *MdNYC3* and *MdNOL2* and a fluctuating expression of *MdNYE1a*, *MdPPH1*, *MdPAO6*, *MdPAO8* and *MdHCAR* compared with the controls during ripening. Our results indicated the regulatory role of ethylene in the Chl degradation pathway of apple peel during ripening.

Keywords: /Apple fruit/ /Ripening/ /Chlorophyll degradation/ /Ethylene/ /Gene expression/

Poirier, B. C., Mattheis, J. P., & Rudell, D. R. (2020). Extending 'Granny Smith' apple superficial scald control following long-term ultra-low oxygen controlled atmosphere storage. *Postharvest Biology and Technology*, *161*, 111062. doi: 10.1016/j.postharvbio.2019.111062

Abstract

Superficial scald is an apple postharvest peel browning disorder that contributes to annual losses of susceptible cultivars, principally where crop protectants that control the disorder are restricted. Controlled atmosphere (CA) storage reduces or eliminates superficial scald while apples remain in storage, especially when pO2 is maintained below 1 kPa. However, symptoms often develop during the post-storage cold chain, which can last beyond a month. Diphenylamine (DPA) or 1-methylcyclopropene (1-MCP) treatment can be used to control scald, but application is required within the first weeks of cold air storage following harvest. After this period, treatments are no longer effective due to irreversible physiological changes, hereby referred to as "scald induction". As a recent report indicates, apple flesh softening can be reduced by 1-MCP treatment following ultra-low oxygen CA (ULO-CA) storage (pO2 ≤ 1.0 kPa). Here, we sought to determine if ULO-CA would also preserve the capacity to control scald with post-CA treatments. To determine this, 'Granny Smith' apples were treated with hot water and 1-MCP at harvest or following long-term (>3 months) in-house and commercial ULO-CA for two consecutive years. Different CA storage environments (2.0 kPa and 1.0 kPa O2) and delays in ULO-CA establishment were used in combinations with delayed DPA and 1-MCP treatments to reveal the scald induction timeline and how different storage practices may impact the effectiveness of post-CA scald control measures. Taken together, results indicate that scald induction is effectively delayed during ULO-CA storage and resumes upon return to air storage. 1-MCP and hot water treatments applied after four months of ULO-CA storage were equally effective at controlling scald during subsequent air storage as treatments applied at harvest. However, the efficacy of post-storage treatments relied on the rapid establishment and maintenance of ULO conditions and immediate treatment upon removal from ULO-CA storage. Scald induction resulted from cumulative oxygen exposure occurring prior to, during (pO2) and following CA storage. Conjugated trienol and acylated steryl glycoside levels at the end of ULO-CA storage reflected how much scald induction had occurred and, likewise, the efficacy of post-storage scald mitigation treatments.

Keywords: /*Malus domestica*/ /Physiological disorder/ /Heat treatment/ /Diphenylamine/ /1-Methylcyclopropene/

Mogollon, M., Jara, A., Contreras, C., & Zoffoli, J. (2020). Quantitative and qualitative VIS-NIR models for early determination of internal browning in 'Cripps Pink' apples during cold storage. *Postharvest Biology and Technology*, *161*, 111060. doi: 10.1016/j.postharvbio.2019.111060

Abstract

'Cripps Pink' apples are prone to develop internal browning disorder during cold storage rendering their commercialization particularly difficult after long-term storage. The purpose of this research was to predict internal browning defects quantitatively and qualitatively in apple, by a non-destructive equipment from spectra collected before the disorder develops. In order to obtain a broad expression of the disorder in severity and incidence, fruit treated and non-treated with 1-methylcyclopropene (1-MCP) were studied under three temperature regimes: T1) pre-cooled with forced air at −1 °C for 24 h and subsequently stored for 149 d at 0 °C; T2) placed directly at 0 °C and stored for 150 d; and T3) stored for 90 d at 5 °C then for 60 d at 0 °C. Every fruit was subjected to semi-transmittance spectral analysis between 100–1,100 nm at 0, 60, 90, 120 and 150 d of storage and matched with the presence and severity of internal browning. The disorder was quantified using image analysis in one half of cut fruit at the end of the 150 d plus 7 d at 20 °C (157 d) after verification that the damage was not evident in fruit stored before 120 d. Quantitative Support Vector Machine Regression (SVMR) model satisfactorily predicted the percentage of internal browning area per fruit shown after 157 d, as early as 90 d of storage with R2 ~0.70, and a root mean square error for calibration (RMSEC) and prediction (RMSEP) datasets of ~18%

and ~15% respectively. On the other hand, qualitative Partial Least Squares Discriminant Analysis (PLS-DA) model was able to predict the damaged fruit at the onset of storage (0 d) and to reach an accuracy values ~87% in calibration and test datasets, and 12% of misclassified fruit at 90 d. Quantitative and qualitative neural network models were also evaluated, reaching similar correlation coefficients, in cross validation or accuracy rate as multivariable models did, offering a novel way for modelling biological processes. This study shows different models for predicting internal browning before the disorder appears in stored apples using semi-transmittance spectra.

Keywords: /Non-destructive analysis/ /Physiological disorder/ /Prediction models/ /Neural networks/

ASPARAGUS

Huyskens-Keil, S., Eichholz-Dündar, I., Hassenberg, K., & Herppich, W. (2020). Impact of light quality (white, red, blue light and UV-C irradiation) on changes in anthocyanin content and dynamics of PAL and POD activities in apical and basal spear sections of white asparagus after harvest. *Postharvest Biology and Technology*, *161*, 111069. doi: 10.1016/j.postharvbio.2019.111069

Abstract

Postharvest quality decay of white asparagus spears is often due to red discoloration of spear tips, caused by enhanced epidermal anthocyanin synthesis and accumulation. Exposure to light of different wavelengths triggers distinct physiological processes in plants leading to changes in pigments (e.g. phenolic compounds) and their associated enzymes, among them e.g. phenylalanine ammonia-lyase [PAL, EC 4.3.1.5] and guaiacol peroxidase [POD, EC 1.11.1.7]). The presented work evaluated the impact of light quality (white, red, blue light and UV-C irradiation) on changes in anthocyanin contents and the dynamics of PAL and POD activities in different morphological spears sections (apical and basal) of harvested white 'Gijnlim' asparagus. After harvest, spears were exposed to weak white, red and blue light (30 µmol m-2 s-1) for 3 h and to UV-C irradiation (254 nm, 1 kJ m-2) for 8 min; untreated spears were used as controls. Untreated and light-treated spears were stored in darkness at 20 °C in water vapour saturated atmosphere for up to 4 d. On days 0, 2 and 4, six spears per treatment were selected, severed into basal and apical segments, and respiration rate, anthocyanin content, and PAL and POD activity determined. Light quality did not influence respiration, but section-specifically mediated changes of anthocyanin contents, and PAL and POD activities. White light triggered anthocyanin synthesis via an associated PAL increase, whereas red light and UV-C irradiation tendentiously resulted in an anthocyanin inhibition or even degradation, coinciding with changes in PAL activity, respectively. Blue light increased anthocyanin content in spear tips to the same extent as for controls. However, also other enzymes might play an important role in the light induced anthocyanin synthesis. In basal segments, PAL and POD activities were higher than in apical segments; however, light treatments affected both enzyme activities differently. In the apical, PAL activity was enhanced by white light and UV-C. In contrast, in the basal segments the different wavelength ranges did not affect PAL except for UV-C also increasing PAL activity. The activity of POD increased in tip sections throughout storage and remained high irrespective of light treatments, except for UV-C, strongly stimulating POD activity. POD was also UV-C stimulated in basal segments, whereas white, blue and red light inhibited its activity for a limited time during storage. Differentiated responses in apical and basal segments indicated distinct physiological activity, signalling chains and availability of resources from primary metabolism. PAL may be a major factor controlling lignification in the basal segments of spears, irrespective of light quality, while POD activity is significantly triggered by mainly UV-C indicating its role as an antioxidant enzyme in the physiological active spear tips.

Keywords: /Light quality/ /Anthocyanin/ /Discoloration/ /Peroxidase/ /PAL/ /Spear quality/

BANANA

Zhou, H., Yuan, B., Chen, W., Qiao, H., Yan, M., & Cao, C. (2020). Effect of monooxygenase purified from Mycobacterium JS60 combined with sodium alginate on the preservation of bananas. *Postharvest Biology and Technology*, *161*, 111079. doi: 10.1016/j.postharvbio.2019.111079

Abstract

The effect of monooxygenase combined with sodium alginate on the shelf life of bananas was studied. Monooxygenase was purified from Mycobacterium JS60 and combined with sodium alginate to form MOs@SA solution. The banana was immersed in MOs@SA for 10 min and air dried, then stored at 25 ℃, 70 % humidity for twelve days. The results indicated that the activity of the purified monooxygenase was more than 3.67 mmol kg−1 s−1. Compared with sodium alginate treatment, MOs@SA treatment extended the time of banana to get yellow for 3–4 d and banana softening, increased the accumulations of phenolics and the activities of POD and SOD. Also, the MOs@SA treatment maintained the low level of reducing sugar content, MDA content, PPO activity and ethylene production. The results showed that the shelf life of banana treated by MOs@SA coating could be extended for approximately 30 % compared to the sodium alginate treatment.

Keywords: /Monooxygenase/ /Sodium alginate/ /Mycobacterium JS60/ /Ethylene/ /Banana/

BROCCOLI

Wei, L., Liu, C., Zheng, H., & Zheng, L. (2020). Melatonin treatment affects the glucoraphanin-sulforaphane system in postharvest fresh-cut broccoli (Brassica oleracea L.). *Food Chemistry*, *307*, 125562. doi: 10.1016/j.foodchem.2019.125562

Abstract

The effect of postharvest melatonin treatment on sulforaphane production of fresh-cut broccoli at 4℃ during storage was investigated in this study. Florets treated with 100 μM melatonin exhibited higher contents of total glucosinolates and sulforaphane. Glucoraphanin content was significantly increased after melatonin treatment, and which was explained by gene analysis. Expressions of glucoraphanin biosynthesis genes including *Elong*, *CYP83A1*, *MYB28*, *UGT74B1* and *FMOGS-OX1* were up-regulated while *AOP2* was obviously decreased by melatonin treatment, leading to a higher glucoraphanin accumulation. In addition, application of melatonin enhanced the myrosinase activity and the expression level of *MYO*, benefiting the formation of sulforaphane. This study demonstrates that melatonin treatment positively affected the glucoraphanin-sulforaphane system in postharvest fresh-cut broccoli.

Keywords: /Melatonin/ /Fresh-cut/ /Broccoli/ /Glucoraphanin/ /Sulforaphane/

Fang, H., Luo, F., Li, P., Zhou, Q., Zhou, X., Wei, B., … Ji, S. (2020). Potential of jasmonic acid (JA) in accelerating postharvest yellowing of broccoli by promoting its chlorophyll degradation. *Food Chemistry*, *309*, 125737. doi: 10.1016/j.foodchem.2019.125737

Abstract

Chlorophyll degradation is the main reason for postharvest yellowing of broccoli. To uncover the role of jasmonic acid (JA) on the degradation of chlorophyll, broccoli flowers were treated with exogenous methyl jasmonate (MeJA) and diethyldithiocarbamic acid (DIECA). We found a surge of endogenous JA content with the yellowing process, and a significant correlation between JA and chlorophyll content. MeJA treatments led to increased endogenous JA, increased allene oxide cyclase (AOC) activity, and enhanced

expression of JA synthesis genes. MeJA caused a stronger reduction in the maximum quantum yield (Fv/Fm), fluorescence decline ratio (Rfd), and total chlorophyll content, advanced the peak of pheide a oxygenase (PAO) activity, and up-regulated the expression of chlorophyll degradation genes. The DIECA treatment resulted in lower endogenous levels of JA, and AOC and 12-oxo-phytodienoic acid reductase (OPR) activity. This study revealed that the potential role of JA on broccoli yellowing is to promote the chlorophyll degradation.

Keywords: /Broccoli/ /Jasmonic acid/ /Yellowing/ /Chlorophyll/

CARROT

Pace, B., Capotorto, I., Cefola, M., Minasi, P., Montemurro, N., & Carbone, V. (2020). Evaluation of quality, phenolic and carotenoid composition of fresh-cut purple Polignano carrots stored in modified atmosphere. *Journal of Food Composition and Analysis*, *86*, 103363. doi: 10.1016/j.jfca.2019.103363

Abstract

Purple Polignano carrot is a traditional Italian landrace cultivated in the Apulia region rich in antioxidants and with a high nutritional value. On the other hand, these carrots showed a high perishability. The postharvest behaviour of fresh-cut purple Polignano carrots stored in open bags (AIR) or passive modified atmosphere (pMA) was studied, analysing the main qualitative parameters and the polyphenols and carotenoids profile. The storage in pMA allowed to preserve visual quality and respiration rate better than the storage in AIR. Polyphenols (hydroxycinnamic acids, their derivatives and anthocyanins) increased during storage of about 249 % in samples stored in pMA and of about 306 % in those stored in AIR at 4 °C during the first 4 days of storage, respect to fresh carrots. Instead, carotenoids mean content in carrots just after harvest (6.28 ± 0.48 mg kg-1 fw) did not change significantly during storage at 4 °C (both in AIR or pMA). According to our results, pMA resulted in a valid solution to cold store fresh-cut purple Polignano carrots for two weeks, preserving quality and nutritional value.
Keywords: /Fresh-cut purple carrots/ /Cold storage/ /HPLC-ITMSn/ /DPPH assay/ /Polyphenols/ /Carotenoids/ /Food analysis/ /Food composition/ /Nutritional value/

CHERRY

Li, M., Wang, Y., & Dong, Y. (2020). Pre-harvest application of harpin β protein improves fruit on-tree and storage quality attributes of 'Lapins' and 'Regina' sweet cherry (Prunus avium L.). *Scientia Horticulturae*, *263*, 109115. doi: 10.1016/j.scienta.2019.109115

Abstract

The purpose of this study was to determine the effects of pre-harvest application concentration, frequency, and timing of harpin β protein on improving quality attributes (fruit firmness (FF), size, skin color, soluble solids content (SSC), and titratable acidity (TA)), susceptibility to physiological postharvest disorders (stem browning, surface pitting, and decay), and nutrient uptake in 'Lapins' and 'Regina' sweet cherries. A single application of 1.5 mg L−1 harpin 1 week before harvest (1WBH) was effective in increasing FF, SSC, TA, and calcium (Ca) uptake of 'Lapins' cherries at harvest compared to the control fruit. Two split applications of 1.5 mg L−1 harpin at 1WBH and straw color resulted in firmer 'Lapins' cherries as a single spray, but did not further affect quality attributes. Increasing application frequency from 1 to 3 times (pit hardening, straw color, and 1WBH) effectively retained high FF and low incidences of stem browning and surface pitting in 'Lapins' cherries after 4 weeks of storage at 0 °C. For 'Regina' cherries, three applications of 1.5 mg L−1 harpin at full bloom, shuck fall, and 1WBH enhanced FF, stem pull force, and Ca uptake at harvest; surface pitting was reduced. In conclusion, 3 applications of

1.5 mg L−1 harpin β protein at pit hardening, straw color, and 1WBH improved fruit quality of ‘Lapins’ cherries, while the quality of ‘Regina’ cherries was improved by applications at full bloom, shuck fall, and 1WBH.

Keywords: /*Prunus avium*/ /Harpin β protein/ /Application timing/ /Quality attribute/ /Postharvest disorders/

CORN

Calvo-Brenes, P., & O´hare, T. (2020). Effect of freezing and cool storage on carotenoid content and quality of zeaxanthin-biofortified and standard yellow sweet-corn (Zea mays L.). *Journal of Food Composition and Analysis*, *86*, 103353. doi: 10.1016/j.jfca.2019.103353

Abstract

Influence of freezing temperature at –20 °C and −80 °C up to three months, and influence of storage at 4 °C up to fifteen days on carotenoid content and quality parameters in zeaxanthin-biofortified and commercial yellow sweet-corn were evaluated. Cobs frozen and stored at -20 °C showed a decrease in carotenoid concentration, in which carotenoids from the β-branch were mainly affected, compared to the α-branch carotenoids. Freezing temperature at −80 °C did not affect carotenoid concentration for cobs stored up to three months. Storage at 4 °C was shown to be adequate for carotenoid retention up to fifteen days, and also as a preconditioning temperature to avoid the detrimental effects of storing cobs at −20 °C. Colour and starch content were not affected by storage at 4 °C up to fifteen days, however a reduction in sugars and total soluble solids was observed.

Keywords: /Postharvest/ /Temperature/ /Freezing/ /Preconditioning/ /Zeaxanthin/ /Biofortification/ /Sweet corn/

DURIAN

Boonthanakorn, J., Daud, W., Aontee, A., & Wongs-Aree, C. (2020). Quality preservation of fresh-cut durian cv. ‘Monthong’ using micro-perforated PET/PE films. *Food Packaging and Shelf Life*, *23*, 100452. doi: 10.1016/j.fpsl.2019.100452

Abstract

In this study, retail packaging for ‘Monthong’ fresh-cut durian using micro-perforated films was developed. PET/PE laminated film was perforated using CO2 laser to obtain microholes with an average size of 113.5 μm. Ripe durian pulp was packed in a PET tray and then the two levels of micro-perforated PET/PE films, MP-1 and MP-2, and non-perforated PET/PE film (control) were heat sealed as the top lidding film. O2, CO2, and water-vapor transmission rates of MP-1 film were 285, 80, and 3.6 times higher than that of control, whereas those of MP-2 were 574, 162, and 6.4 times higher. Time and temperature simulations of export logistics of fresh-cut durian was carried out in the experiment. In MP-1 package, O2 reached a steady stage at 13 % and CO2 increased to 17 %, while in MP-2, CO2 was stable at 5 % as O2 reduced to 18 %. Most storage attributes of pulp were not different between treatments. However, in control, the pulp exhibited off-flavor after day 6. Several sulphurous and ester compounds of durian were released from the MP-2 package.

Keywords: /*Durio zibethinus* Murr./ /Ready-to-eat/ /MAP/ /Micro-perforated film/ /PET/PE laminated film/ /Volatiles released/

FRUITS AND VEGETABLES

Kumar, S., Mukherjee, A., & Dutta, J. (2020). Chitosan based nanocomposite films and coatings: Emerging antimicrobial food packaging alternatives. *Trends in Food Science & Technology*, *97*, 196–209. doi: 10.1016/j.tifs.2020.01.002

Abstract

Demand for healthy and safe food with minimal use of synthetic inputs (including synthetic preservatives) is increasing rapidly. Plastic polymers being hazardous to the environment, significant efforts have been devoted to evaluate various bio-based polymers as alternatives to synthetic plastic packaging. Chitin and its deacetylated derivative, chitosan, is primarily a by-product of crustacean, fish and seafood processing and handling. Chitosan possesses antimicrobial activities and film forming properties, making them attractive biopolymers for food packaging and food preservation applications applied through spraying, dipping, coating, or wrapping by films. This comprehensive review of contemporary research focuses on applications of chitosan and chitosan based nanocomposites in the area of food packaging and preservation. It includes different properties and functionalities of chitosan, various blends and nanocomposites of chitosan, their fabrication techniques, and applications in shelf life extension of fruits, vegetables, meat and fish products. Chitosan is an attractive alternative to synthetic plastics polymers due to its biodegradability, antimicrobial activity, and film forming properties. Incorporation of nanomaterials into chitosan based food-packaging systems can prevent the growth of spoilage and pathogenic microorganisms, improve food quality and safety, and extend shelf-life of food. It has been reported that applications of chitosan-based films or coatings or treatments have resulted in shelf life extension of fresh produce, meat products, bread, and dairy products such as cheese which has been highlighted.

Keywords: /Food preservation/ /Shelf-life/ /Fruit and vegetable/ /Fish and meat/ /Natural antimicrobial/ /Nanoparticle/

GINGER

Li, H., Wu, L., Tang, N., Liu, R., Jin, Z., Liu, Y., & Li, Z. (2020). Analysis of transcriptome and phytohormone profiles reveal novel insight into ginger (Zingiber officinale Rose) in response to postharvest dehydration stress. *Postharvest Biology and Technology*, *161*, 111087. doi: 10.1016/j.postharvbio.2019.111087

Abstract

Dehydration stress is one of the severe postharvest problems of ginger. To better understand the molecular regulatory mechanism in ginger in response to postharvest dehydration stress, RNA-seq and phytohormone profiles analysis were performed in ginger rhizomes after 0 h, 2 h, 12 h, 24 h of postharvest water stress (with loss of 0 %, 1.7 %, 4.7 %, and 9.4 % of initial weight), respectively. The results indicated that postharvest dehydration stress contributes significantly to a loss of nutritious quality and storability in ginger rhizomes. Both the levels of abscisic acid (ABA) and salicylic acid (SA) markedly increased, however, auxin (indol-acetic acid, IAA), cytokinin (*tans*-zeatin, *t*Z), and gibberellin (GA1 and GA3) significantly decreased in ginger rhizomes under dehydration stress. Transcriptome analysis revealed a total of 1415, 2726, and 6641 genes were differently expressed after 2 h, 12 h, and 24 h of water-loss stress treatment compared with that in 0 h of ginger rhizomes, respectively. Additionally, 518 DEGs share similar expression patterns during 24 h of dehydration stress. These genes are mainly enriched in plant hormone signaling, phenylpropanoid biosynthesis, phenylalanine metabolism, fatty acid elongation, starch and sugar metabolism, and carotenoid biosynthesis. In addition, expression levels of MYB genes sharply increased in ginger rhizomes in response to water loss, which may function in regulation of lignin biosynthesis. These findings suggest that postharvest dehydration tolerance of ginger

rhizomes may be mainly related to antagonistic regulation of endogenous phytohormones biosynthetic pathway and signaling, MYB transcription factors mediated lignin metabolism, antioxidant enzyme regulatory oxidative balance, and maintenance of energy supply. Our results provide new insights into the molecular mechanism of ginger in response to postharvest dehydration which are of agricultural importance.

Keywords: /*Zingiber officinale* Rose/ /Postharvest dehydration stress/ /Transcriptome analysis/ /Phytohormone profiles/ /Molecular mechanism/

GREEN BEAN

Li, Y., Cai, Y., Liang, Y., Ji, P., & Xu, L. (2020). Assessment of antifungal activities of a biocontrol bacterium BA17 for managing postharvest gray mold of green bean caused by Botrytis cinerea. *Postharvest Biology and Technology*, *161*, 111086. doi: 10.1016/j.postharvbio.2019.111086

Abstract

Gray mold incited by *Botrytis cinerea* is one of the most important postharvest fungal diseases of green bean that causes significant loss in the production, processing, storage, and transportation of green bean worldwide. Management of the disease relies on chemical fungicides that have detrimental effects on the environment and human health. In this study, a bacterial strain BA17, identified as *Bacillus amyloliquefaciens*, exhibited strong antifungal effect against *B. cinerea*. Filtrate of BA17 liquid culture, when applied at 1 %, 5 % and 10 %, reduced spore germination, spore production and mycelial growth of *B. cinerea* significantly. Mycelium treated by BA17 filtrate appeared swelling and dehydrated malformation, protoplasm aggregation, and mitochondria became bigger and more numerous with defective cell walls. Assessment of activities of intrasporic and extrasporic antagonistic substances of BA17 indicated that active substances were primarily produced outside the bacterial cell. The active substances produced by BA17 were sensitive to heat, had optimum efficacy at pH 8.0, and were relatively resistant to ultraviolet irradiation. Inhibitory effect of BA17 was not significantly different when stored at 4 or 25 °C for 120 d. BA17 filtrate, when applied at 10 %, reduced gray mold on green beans by more than 90 % in repeated experiments. It also provided significant preservative effects on green beans by reducing decay rate and rust spots and maintaining better hardness and color. The biocontrol agent BA17 has great potential for control of postharvest gray mold on green bean and improvement of green bean quality in practical production.

Keywords: /Antifungal mechanism/ /*Bacillus amyloliquefaciens*/ /*Botrytis cinerea*/ /Gray mold/ /Green bean/

GUAVA

Arroyo, B. J., Bezerra, A. C., Oliveira, L. L., Arroyo, S. J., Melo, E. A. D., & Santos, A. M. P. (2020). Antimicrobial active edible coating of alginate and chitosan add ZnO nanoparticles applied in guavas (Psidium guajava L.). *Food Chemistry*, *309*, 125566. doi: 10.1016/j.foodchem.2019.125566

Abstract

Nanostructured coatings made with chitosan (100%Q), alginate (100%A) and blends of 50%Q–50%A; 90%Q–10%A and 90%A–10%Q, were added with (1%v/vgel) of nanoZnO and applied to guavas (*Psidium guajava* L.). After the coating application, fruits were stored for 15 days at 21 ± 1 °C and 80 ± 2% RH. To determine the effect on ripening process, fruits were submitted to water loss, texture, color, rot index, and physic-chemical assays. The results showed that coatings are able to prevent rot appearance in every sample, corroborating with the antibacterial action of nanoZnO. Coatings made with alginate and

90%A did not delay the maturation process, however, chitosan matrices (100%Q or 90%Q) protected fruits against excessive mass loss and retarded physic-chemical changes related to maturation. The experiment or study showed that it is possible to extend guava shelf life with ZnO nanostructured coatings with 100%Q or 90%Q–10%A for up to twenty days versus seven days of uncoated fruits.
Keywords: /Edible coating/ /Polymer blends/ /Bioactive packaging/ /Nanoparticles (NPs)/ /Nano/ /ZnO/

LOQUAT

Hadjipieri, M., Christofi, M., Goulas, V., & Manganaris, G. (2020). The impact of genotype and harvesting day on qualitative attributes, postharvest performance and bioactive content of loquat fruit. *Scientia Horticulturae*, *263*, 108891. doi: 10.1016/j.scienta.2019.108891

Abstract

Due to scalar on-tree ripening, harvest of loquat fruit is successive, spanning for several weeks, depending on the cultivar considered and the cultivation practices applied. Notably, early harvested fruit receive appreciably high prices on the market. The aim of the current study was to dissect the effect of harvesting day on mechanical properties, postharvest performance and phytochemical attributes (free and bound phenolic compounds and antioxidant capacity) of the predominant loquat cultivars grown in Cyprus (cvs. 'Karantoki' and 'Morphitiki'). Determination of the aforementioned attributes at harvest (H) and after additional maintenance at room temperature for 3 days (H+3) for four successive harvesting dates (H1-4) were determined. Flesh firmness was slightly higher in early-harvested compared to late-harvested fruit, while slight or no differences after shelf life period for both cultivars were monitored. 'Karantoki' fruits manifested higher values of ripening index (SSC/TA) than 'Morphitiki'; such values were higher with the progress of harvest date due to a significant decrease of titratable acidity. 'Morphitiki' fruits were generally characterized by higher phenolic content, along with higher antioxidant capacity. No evident differences were registered between the harvest date and the shelf life period for both cultivars regarding free phenolic content. This study also highlights the significance of bound phenolics that contribute to the phenolic fraction of loquat fruit by 21.6–37.5%, depending on the cultivar and storage condition applied. Overall, the current study sheds light in the unexploited area of phytochemical properties of loquat fruits derived from successive harvesting dates.

Keywords: /*Eriobotrya japonica*/ /Harvest/ /Phytochemicals/ /Free phenolics/ /Bound phenolics/ /Antioxidant capacity/

MANDARIN

Baswal, A., Dhaliwal, H., Singh, Z., Mahajan, B., & Gill, K. (2020). Postharvest application of methyl jasmonate, 1-methylcyclopropene and salicylic acid extends the cold storage life and maintains the quality of 'Kinnow' mandarin (Citrus nobilis L. X C. deliciosa L.) fruit. *Postharvest Biology and Technology*, *161*, 111064. doi: 10.1016/j.postharvbio.2019.111064

Abstract

The objective of the present investigation was to evaluate the effects of different concentrations of 1-methylcyclopropene (1-MCP; 0.5, 1.0 and 1.5 µL L-1), methyl jasmonate (MeJa; 0.001, 0.002 and 0.003 µmol L-1) and salicylic acid (SA; 0.001, 0.002 and 0.003 µmol L-1) on cold storage life and fruit quality of 'Kinnow' mandarin for up to 75 d. Weight loss, spoilage loss, firmness, juice percentage, soluble solids content, titratable acidity, pectin content, total carotenoids and ascorbic acid content, organoleptic sensory attributes, pectin methylesterase and cellulase activity were determined. MeJa (0.001 µmol L-1), 1-MCP (1.5 µL L-1) and SA (0.002 µmol L-1) were the most effective in decreasing the weight loss, spoilage, firmness, juice content, and were retarding the activities of pectin methylesterase and cellulase

compared to control. Treated fruit also had higher contents of ascorbic acid, pectin, total carotenoids and sensory attributes for 75 d of cold storage. In conclusion postharvest treatment of 'Kinnow' mandarin with MeJa (0.001 µmol L-1), 1-MCP (1.5 µL L-1) fumigation and SA (0.002 µmol L-1) extended cold storage life and maintained quality.

Keywords: /Mandarin/ /1-MCP/ /MeJa/ /SA/ /postharvest quality/

MANGO

Xing, Y., Yang, H., Guo, X., Bi, X., Liu, X., Xu, Q., … Zheng, Y. (2020). Effect of chitosan/Nano-TiO2 composite coatings on the postharvest quality and physicochemical characteristics of mango fruits. *Scientia Horticulturae*, *263*, 109135. doi: 10.1016/j.scienta.2019.109135

Abstract

The chitosan nano-coating film used during the storage and preservation of fruits and vegetables is attracting increasing attention. In this investigation, the chitosan/titanium dioxide nanocomposite (nano-TiO2) coating was prepared using chitosan as the primary film-forming material and nano-TiO2 modified by sodium laurate. More importantly, the effects of the chitosan monolayer treatment and chitosan/nano-TiO2 composite coating on the postharvest physiology and storage of mangoes were investigated. Scanning electron microscopy (SEM) images were used to examine the composite membranes containing different concentrations of nano-TiO2. The results showed that the mass fractions of the chitosan and nano-TiO2 in the chitosan/nano-TiO2 composite film were 1 % and 0.03 %, respectively. The decay index of the composite coated fruits was 14.49 % lower than the control group (CK), and the breathing peak appeared 5 d later. The composite membrane enhanced the firmness of the mangoes, which was 5.9 kg/cm2 higher that of than uncoated fruits. The total soluble solid content (TSS) was 6.53 % lower than in CK. Furthermore, the peroxidase (POD) and polyphenol oxidase (PPO) activity of the composite coated fruits, as well as the total phenol and flavonoid content was also higher than in CK, while the malonaldehyde (MDA) content was lower than that in CK. These results indicated that the chitosan/nano-TiO2 composite coating could maintain the nutrient composition of mangoes while playing a significant role in preserving the quality of fruit at 13 °C.

Keywords: /Chitosan/ /Nano titanium dioxide/ /Mango/ /Quality/

MELON

Wu, Z., Tu, M., Yang, X., Xu, J., & Yu, Z. (2020). Effect of cutting and storage temperature on sucrose and organic acids metabolism in postharvest melon fruit. *Postharvest Biology and Technology*, *161*, 111081. doi: 10.1016/j.postharvbio.2019.111081

Abstract

In order to reveal the molecular information of soluble sugars and organic acids both in stored fresh-cut and whole melon fruits, the enzymes and genes involved in the metabolism of sucrose and organic acids in melon fruit (cv. Xizhoumi-17) were investigated. Cutting of fruit and storage temperature significantly affected the content of sugars, citric acid (CA) and malic acid (MA), and the change was controlled by enzymes involved in the metabolism of sucrose and organic acids. Fresh-cut melon had higher content of hexose (fructose and glucose) and organic acids when stored at 15 °C for a short period of time, and this was correlated with higher activities of acid invertase (AI), neutral invertase (NI), sucrose synthase-cleavage (SS-c), phosphoenolpyruvate carboxylase (PEPC), citrate synthase (CS), aconitase (ACO), malate dehydrogenase (MDH) and malic enzyme (ME) and lower activity of isocitrate dehydrogenase (IDH). These patterns were due to the up-regulation of *CmAI1/2*, *CmNI3*, *CmPEPC3*,

CmCS1, *CmACO1/2*, *CmMDH1/3* and *CmME3/4* and down-regulation of *CmIDH1* in fresh-cut melon. Compared with fresh-cut melon stored at 15 °C, lower temperature (5 °C) significantly extended the shelf life and reduced the quality loss as indicated by higher content of sucrose, CA and MA in fresh-cut fruit stored at 5 °C. These differences resulted from the up-regulation of *CmPEPC2/3* and down-regulation of *CmAI1/2*, *CmNI3*, *CmCS1*, *CmACO1/2* and *CmME3/4* during the storage period.

Keywords: /Fresh-cut melon/ /Sucrose/ /Organic acid/ /Metabolism/ /Temperature/

MUSHROOM

Salamat, R., Ghassemzadeh, H. R., Ranjbar, F., Jalali, A., Mahajan, P., Herppich, W. B., & Mellmann, J. (2020). The effect of additional packaging barrier, air moment and cooling rate on quality parameters of button mushroom (Agaricus bisporus). *Food Packaging and Shelf Life*, *23*, 100448. doi: 10.1016/j.fpsl.2019.100448

Abstract

Button mushroom (*Agaricus bisporus*) has very short shelf life and its quality attributes are considerably influenced by postharvest handling. Temperature management and modified atmosphere packaging are extensively used to prolong shelf life of fruits and vegetables. In this study, the effects of cooling rate and modified atmosphere packaging on apparent quality characteristics and texture of mushroom were investigated. Different cooling rates were obtained by forced-air cooling at different cooling air temperatures, namely, 2, 6 and 10 °C. The results showed that cooling rates considerably affected the quality of mushrooms. However, modified atmosphere packaging did not necessarily improve the quality retention of mushrooms. Just in case mushrooms were cooled by forced-air cooling, utilization of modified atmosphere packaging could be of benefit. For samples, forced-air cooled at 2 °C and stored under modified atmosphere conditions, total water loss was less than 5 %, firmness remained almost unchanged (10.18 N), and changes in color and in browning index were significantly smaller than that of all other treatments during storage (10 d). Therefore, application of forced-air cooling, followed by modified atmosphere packaging and storage in refrigerated conditions is recommended as an integrated postharvest technology to preserve mushroom quality.

Keywords: /Browning index (BI)/ /Firmness/ /Mass loss/ /Modified atmosphere packaging (MAP)/ /Mushroom/ /Precooling/

Lyn, F. H., Adilah, Z. M., Nor-Khaizura, M., Jamilah, B., & Hanani, Z. N. (2020). Application of modified atmosphere and active packaging for oyster mushroom (Pleurotus ostreatus). *Food Packaging and Shelf Life*, *23*, 100451. doi: 10.1016/j.fpsl.2019.100451

Abstract

This research investigated the effect of combining modified atmosphere packaging with bilayer active packaging (MAP + BL) on the shelf life of oyster mushroom (*Pleurotus ostreatus*). The BL active packaging consisted of gelatin with pomegranate peel powder (PPP) coated on the polyethylene (PE) film (gelatin + PPP/PE). Pouches of single layer (SL) of PE were used for MAP without active function (MAP + SL). Three different conditions of MAP were used i.e. high oxygen packaging (HOP), medium oxygen packaging (MOP) and low oxygen packaging (LOP). Mushrooms packaged with atmospheric air (ATM) were used as control. The mushroom packed in MOP with an active layer successfully increased the shelf-life of mushrooms up to 11 days as compared to the control (3 days). Generally, mushroom in MAP + BL presented better results in all analyses as compared to MAP + SL. Oyster mushrooms packaged in MOP + BL showed the lowest weight loss as only 0.60 % decrease in weight was recorded throughout the storage time. Despite the lowest ($p < 0.05$) aerobic bacterial count for sample in

LOP + BL, mushroom packaged in MOP + BL scored the highest for the overall acceptability of the packaged mushrooms. This study promotes the new prospect of combining MAP with active packaging to prolong the shelf life of oyster mushrooms.

Keywords: /Bilayer films/ /Modified atmosphere packaging (MAP)/ /Oyster mushroom/ /Pomegranate (*Punica granatum*)/ /Fish gelatin/

PEACH

Ranjan, S., Chandrasekaran, R., Paliyath, G., Lim, L.-T., & Subramanian, J. (2020). Effect of hexanal loaded electrospun fiber in fruit packaging to enhance the post harvest quality of peach. *Food Packaging and Shelf Life*, *23*, 100447. doi: 10.1016/j.fpsl.2019.100447

Abstract

Hexanal is a naturally occurring bioactive volatile compound which extends post-harvest shelf life of fruits and vegetables by preserving the cell membrane from degradation. The aim of this study is to encapsulate hexanal in a polymer and activate its release in presence of relative humidity replicating the fruit packaging environment. Fiber loaded with hexanal was prepared using different ratios of zein-poly(ethylene oxide) (PEO) polymer solution containing hexanal (1:2:5 and 1:5:5) on weight basis. Sustained diffusion of hexanal vapor from electrospun fiber was achieved and confirmed using gas chromatography. Characterization of fibers using Fourier transform infrared spectroscopy and scanning electron microscopy confirmed the incorporation of hexanal into the fiber and the changes in the morphology of fiber in relation to the relative humidity. Hexanal loaded fibers were used in the packaging of peaches and its shelf life parameters were evaluated. The results showed that increasing the relative humidity in the packaging environment triggered the release of hexanal from the fiber. Physical and morphological study of the fiber revealed that the integrity of the fiber did not change for 20 days at room temperature when stored at 0 % RH. The application of hexanal loaded fiber on the peach showed that the shelf life of fruits was extended by 4 days and the fiber prepared from the ratio 1:2:5 w/w of hexanal, zein and PEO showed better efficacy in shelf life extension of peach as compared with fiber prepared from the 1:5:5 w/w of hexanal, zein and PEO polymer solution.

Keywords: /Hexanal/ /Zein/ /Poly(ethylene oxide)/ /Electrospinning/ /Post-Harvest/

Zhang, L., Kou, X., Huang, X., Li, G., Liu, J., & Ye, J. (2020). Peach-gum: A promising alternative for retarding the ripening and senescence in postharvest peach fruit. *Postharvest Biology and Technology*, *161*, 111088. doi: 10.1016/j.postharvbio.2019.111088

Abstract

To evaluate the potential of peach-gum coating in retarding postharvest fruit ripening and softening, the effects of peach-gum treatment on storage performance and transcriptomes of peach fruit were studied during cold storage. Compared to the controls (CK), treatment with all tested concentrations (1 %, 5 %, and 10 %, v/v) of peach-gum repressed ethylene production and fruit softening, and to some extent, prevented weight loss. Peach-gum treatment did not alter malic acid, citric acid, quinic acid, glucose, fructose, or sucrose content, but it repressed the reduction in sorbitol. Transcriptomic analysis revealed that the expression of numerous genes related to fruit softening and cell wall degradation were repressed by peach-gum treatment, in accordance with the delayed softening observed. Meanwhile, the expression of senescence-associated genes, chitinase genes, and pathogenesis-related genes that were up-regulated during cold storage, were also inhibited by peach-gum treatment. Among the genes differentially expressed between peach-gum-treated and control fruit, genes involved in indole-3-acetic acid (IAA) transport and auxin response were relatively statistically overrepresented. A total of 90

transcription factors belonging to 26 families were differentially expressed. 21 of 23 zinc finger proteins from the four TF families, C2H2, C3H, CO, and Dof, were up-regulated in peach-gum-treated fruit. Additionally, abscisic acid and IAA content were markedly lower in peach-gum-treated fruit than in control fruit. Taken together, our study demonstrated that peach-gum can potentially serve as a new edible coating to preserve peach fruit. These results establish the basis for the future development of improved peach-gum-based edible coatings, by incorporating other effective compounds, and provide valuable information for further investigation of the regulatory mechanisms underlying fruit ripening and senescence in peaches.

Keywords: /Peach-gum/ /Coating/ /Postharvest/ /Retard/ /Peach/ /RipeningTranscriptome/

Yang, C., Duan, W., Xie, K., Ren, C., Zhu, C., Chen, K., & Zhang, B. (2020). Effect of salicylic acid treatment on sensory quality, flavor-related chemicals and gene expression in peach fruit after cold storage. *Postharvest Biology and Technology*, *161*, 111089. doi: 10.1016/j.postharvbio.2019.111089

Abstract

Salicylic acid (SA) has been used in reducing chilling injury of horticultural crops caused by postharvest cold storage. However, the effect of SA on fruit flavor quality in response to chilling needs to be further investigated. In the present study, SA treated peach fruit (*Prunus persica* L. Batsch., cv. Hujingmilu) were stored at 0 °C for 7, 14, 21 and 28 d followed by a subsequent shelf-life at 20 °C, respectively. SA treatment (1 mM) alleviated development of flesh browning and maintained softening ability of peach fruit after cold storage. Electronic nose (e-nose) and electronic tongue (e-tongue) analysis showed separation of SA treated fruit and controls based on discriminant factor analysis (DFA) plots, particular for peaches during 3 d shelf-life after 28 d cold storage (C28dS3). Reduced content of fruity note volatile esters and lactones was observed for peach fruit with extended cold storage, SA treatment maintained significant higher volatiles than controls. Transcript levels of genes derived from volatile ester biosynthesis pathway, including lipoxygenase *PpLOX1*, hyperoxide lyase *PpHPL1*, alcohol dehydrase *PpADH1* and alcohol acyltransferase *PpAAT1*, were analyzed using real-time quantitative PCR. For SA-treated peach fruit after cold storage, significant higher transcript levels was detected for the *PpLOX1* which encodes the first enzymatic step of the pathway. Regarding soluble sugars, high sucrose content and low content of fructose and glucose was observed for SA-treated peach fruit. Gene expression analysis revealed higher transcript abundance of sucrose synthase *PpSUS4*, neutral invertase *PpNINV8* and tonoplast monosaccharide transporter *PpTMT2* in peach fruit treated with SA. No significant differences in contents were observed for citric acid, malic acid and quinic acid between SA-treated samples and controls. This study showed that SA treatment alleviated the cold storage-induced reduction of a number of volatiles and sugars, and thereby maintained flavor quality of peach fruit during shelf-life after cold storage.

Keywords: /Chilling injury/ /Esters/ /Lactones/ /Lipoxygenase/ /Organic acids/ /Sugars/

PEARS

Siddiq, R., Auras, R., Siddiq, M., Dolan, K. D., & Harte, B. (2020). Effect of modified atmosphere packaging (MAP) and NatureSeal® treatment on the physico-chemical, microbiological, and sensory quality of fresh-cut d'Anjou pears. *Food Packaging and Shelf Life*, *23*, 100454. doi: 10.1016/j.fpsl.2019.100454

Abstract

Modified atmosphere packaging (MAP) is used to preserve the quality and shelf life of fruits and vegetables. The present study was undertaken with the objective of applying MAP in combination with 2

% NatureSeal and evaluating the following quality attributes during 21-d storage at 4 °C: headspace CO2 and O2, color, total soluble solids (TSS), pH, titratable acidity (TA), bacteria and yeast plus mold loads. Sensory quality was assessed after 10 days. The headspace CO2 level in MAP samples increased significantly, reaching 35.3 % at the end of storage; while O2 decreased significantly. Color values were affected by MAP, with no changes in Hunter *L* and *a* values, which decreased and increased, respectively, only in the control. Whereas, *a* values increased for both the control and MAP, but the increases were significantly higher in the control from day 7 to 21. MAP also preserved the sensory quality of fresh-cut pears evaluated on day-10.

Keywords: /Fresh-cut pears/ /MAP/ /Anti-browning treatment/ /Headspaces gases/ /Color/ /Microbial load/ /Sensory evaluation/

Jung, J., Deng, Z., & Zhao, Y. (2020). Mechanisms and performance of cellulose nanocrystals Pickering emulsion chitosan coatings for reducing ethylene production and physiological disorders in postharvest 'Bartlett' pears (Pyrus communis L.) during cold storage. *Food Chemistry*, *309*, 125693. doi: 10.1016/j.foodchem.2019.125693

Abstract

Pickering emulsion coating (CNCP-CH) composed of oleic acid (OA, 1, 2, and 3%, w/w), cellulose nanocrystal (CNC, 0.1, 0.3, and 0.5%, w/w), and 2% chitosan (CH) was optimized for high emulsion stability. It was found that OA concentration played a significant role in emulsion stability. Increasing OA from 1 to 3% reduced emulsion stability ~43%, indicated by the thickness of the separated cream layer in the emulsion. 'Bartlett' pears (*Pyrus communis* L.) coated by CNCP-CH containing 1% OA showed significantly reduced ethylene production than that coated with 2% and 3% OA at 1-month of accelerated cold storage at 1.7 °C. The superficial scald on pear peels was only observed on fruit coated by CNCP-CH with 3% OA, but not that with 1% or 2% OA. Therefore, CNCP-CH coating with 1% OA, 0.1% CNC, and 2% CH was suggested for delaying ripening and superficial scald of 'Bartlett' pears during the long-term cold storage.

Keywords: /Pickering emulsion/ /Cellulose nanocrystal/ /Chitosan coating/ /'Bartlett' pears/ /Long-term cold storage/

PEONY (CUTFLOWER)

Jahnke, N. J., Dole, J. M., Livingston, D. P., & Bergmann, B. A. (2020). Impacts of carbohydrate pulses and short-term sub-zero temperatures on vase life and quality of cut Paeonia lactiflora Pall. hybrids. *Postharvest Biology and Technology*, *161*, 111083. doi: 10.1016/j.postharvbio.2019.111083

Abstract

Flower quality of cut *Paeonia lactiflora* (peony) Pall. hybrids are best preserved between 0 and 1 °C. However, cut flower traits such as vase life and flower size often decline following 4 or more weeks of storage. While the use of sub-zero temperatures is avoided in the cut flower industry due to fears of freeze injury, sub-zero temperatures may allow extended storage of cut flowers. Peonies are a candidate for sub-zero storage due to their natural cold tolerance, exposure to spring freezes before harvest, and limited seasonal availability. Three cultivars: Karl Rosenfield, Monsieur Jules Elie, and Sarah Bernhardt were used to evaluate freeze tolerance of cut peonies by holding cut stems at three temperatures: 0, −2, −4 °C for 5 h. Pre-cold treatment pulses consisting of 24 h in either 100 g·L−1 sucrose, 100 g·L−1 fructose, or tap water did not improve total vase life, summation of the time spent as a bud and time open. Total vase life was 10.5, 7.1, and 9.3 d for 'Karl Rosenfield', 'Monsieur Jules Elie', and 'Sarah Bernhardt',

respectively. Sucrose-pulsed stems of ‘Karl Rosenfield’ and ‘Sarah Bernhardt’ had the lowest total vase life. Pulses and cold-treatments decreased bud time for ‘Karl Rosenfield’ and ‘Monsieur Jules Elie’ by 2–3 d and 0.5–1 d, respectively. Petals were the only tissue to develop water-soaked spotting (freeze injury) following 5 h at -4 °C. Stems kept dry (not pulsed) prior to cold treatment were uninjured. Fructose-pulsed stems of ‘Karl Rosenfield’ and ‘Monsieur Jules Elie’ had the highest injury ratings when held at -4 °C. Carbohydrate-pulsing did not influence injury ratings on ‘Sarah Bernhardt’. Supercooling and multiple freeze events were observed with infrared video in all tissues when held at -4 °C. Typically, ice nucleation started at the base of the cut stems and propagated throughout the stem, leaves, and bud within 3–5 min of initiation. Stems that were not pulsed remained in a supercooled state longer than those that were pulsed. These findings indicate that storage temperatures between 0 and -2 °C may be a good option for longer periods of dry storage for peonies and other cold tolerant cut flower species.

Keywords: /FructoseIce nucleation/ /Infrared thermography/ /Peony/ /Sucrose/

POMEGRANATE

Hasheminejad, N., & Khodaiyan, F. (2020). The effect of clove essential oil loaded chitosan nanoparticles on the shelf life and quality of pomegranate arils. *Food Chemistry*, *309*, 125520. doi: 10.1016/j.foodchem.2019.125520

Abstract

The effect of four different coating dispersions including chitosan, clove essential oil, chitosan nanoparticles and clove essential oil loaded chitosan nanoparticles (CEO-ChNPs or encapsulated oil) was investigated on shelf life and quality of minimally processed pomegranate arils during storage at 5 °C. Among tested dispersions, CEO-ChNPs extended aril shelf life for 54 days while uncoated arils became unusable at day 18 due to the incidence of fungal decay. At the end of storage, CEO-ChNPs could significantly maintain microbial quality, weight, total soluble solid, titratable acidity, pH, total phenol and total anthocyanin content, as well as antioxidant activity and sensory quality in pomegranate arils coated with CEO-ChNPs compared to uncoated arils, however only some of mentioned parameters maintained significantly in arils coated with other dispersions ($P < 0.05$). According to these results, CEO-ChNPs were the most effective coating for extending shelf life and controlling undesirable microbial, physicochemical and sensory alterations of pomegranate arils.

Keywords: /Nano-encapsulation/ /Clove essential oil/ /Chitosan nanoparticles/ /Antifungal surface coating/ /Minimally processed or ready to eat pomegranate arils/ /Shelf life extension/

POTATO

Jiang, H., Wang, Y., Li, C., Wang, B., Ma, L., Ren, Y., … Prusky, D. (2020). The effect of benzo-(1,2,3)-thiadiazole-7-carbothioic acid S-methyl ester (BTH) treatment on regulation of reactive oxygen species metabolism involved in wound healing of potato tubers during postharvest. *Food Chemistry*, *309*, 125608. doi: 10.1016/j.foodchem.2019.125608

Abstract

Benzo-(1,2,3)-thiadiazole-7-carbothioic acid *S*-methyl ester (BTH) can improve wound healing of potato tubers; however, how the chemical regulates reactive oxygen species (ROS) generation and scavenging during wound healing is not completely understood. BTH at 100 mg·L−1 regulated changes in ROS generation and scavenging in healing tissues of potato tubers. A higher H2O2 content was presented in healing tissues of potato tubers, while cell membrane permeability and malondialdehyde content declined due to BTH treatment. Additionally, the activities and transcript level of enzymes related with ROS

generation, including NADPH oxidase, peroxidase and polyamine oxidase, as well as enzymes involved in ROS scavenging, such as superoxide dismutase, catalase, ascorbate peroxidase, and glutathione reductase, were significantly enhanced by BTH treatment. It is suggested that ROS metabolism might play a crucial role in wound healing of potato tubers mediated by BTH during postharvest.

Keywords: /Potato tuber/ /Wound-healing/ /Reactive oxygen species (ROS) metabolism/ /Benzo-(1,2,3)-thiadiazole-7-carbothioic acid S-methyl ester (BTH)/

ROSE

Khatami, F., Najafi, F., Yari, F., & Khavari-Nejad, R. A. (2020). Expression of etr1-1 gene in transgenic Rosa hybrida L. increased postharvest longevity through reduced ethylene biosynthesis and perception. *Scientia Horticulturae*, *263*, 109103. doi: 10.1016/j.scienta.2019.109103

Abstract

The present research aimed to scrutinize the role of *Arabidopsis etr1-1* gene in ethylene sensitivity of two cut roses, namely the *etr1-1* mutated transgenic (TR) and wild type lines of *Rosa hybrida* L. cv. Vendetta. The cut roses were treated either by exogenous 1.2 μg L−1 ethylene or 80 mg L−1 gibberellic acid (GA3) at commercial bud stage. The postharvest longevity, contents of peroxide and phenolics, ethylene production, and expression of ethylene signal transduction genes (*RhETR1,2,3,4,5* and *RhCTR1,2*) were measured in both treated and control samples of the wild type and TR lines at both bud and half-open stages. The TR rose lines were not fully insensitive to ethylene and only showed less ethylene induced oxidative stress and flower senescence. The GA3-treated TR lines showed the highest vase life (22 d) mainly because of increasing the contents of total phenols and decreasing the ethylene synthesis. The cut roses showed a significant expression of *RhETR2,4,5* genes upon GA3 treatment and the expression of *RhETR1,3* and *RhCTR1,2* genes upon ethylene exposure. The *ert1-1* mutation of the rose decreased both endogenous ethylene biosynthesis and perception.

Keywords: /Ethylene sensitivity/ /Gene expression/ /Gibberellins/ /Postharvest longevity/ /*Rosa hybrida L.*/ /Transgenic rose/

STRAWBERRY

Yang, M., Ban, Z., Luo, Z., Li, J., Lu, H., Li, D., … Li, L. (2020). Impact of elevated O2 and CO2 atmospheres on chemical attributes and quality of strawberry (Fragaria × ananassa Duch.) during storage. Food Chemistry, 307, 125550. doi: 10.1016/j.foodchem.2019.125550

Abstract

Modified atmosphere has widely been evident to contribute to fruit quality maintenance, however the correlation among these quality traits was less known. To explore main factors of elevated atmosphere and reduce the detection indexes, we exposed strawberry to either high O2 (80% O2 + 20% N2) or CO2 (20% CO2 + 20% O2 + 60% N2) atmosphere and compared quality characteristics. It was demonstrated that both atmospheres well maintained the fruit firmness, alleviated weight loss and decay rate. Elevated O2 maintained the polyphenolic contents and cell integrity by significantly decreasing superoxide and hydrogen peroxide levels. PCA analysis implied that HO treatment mainly affected oxygen metabolism while HCO affected carbon metabolism more. Significantly positive correlation was observed between weight loss, anthocyanin content and decay rate in elevated O2 and control groups. This study provided new insights into correlation and difference between impact of elevated O2 and CO2 to postharvest preservation.

Keywords: /Strawberry/ /Elevated atmosphere/ /Quality/ /Correlation analysis/

SOFT KALE

Boerzhijin, S., Makino, Y., Hirai, M. Y., Sotome, I., & Yoshimura, M. (2020). Effect of perforation-mediated modified atmosphere packaging on the quality and bioactive compounds of soft kale (Brassica oleracea L. convar. acephala (DC) Alef. var. sabellica L.) during storage. *Food Packaging and Shelf Life*, *23*, 100427. doi: 10.1016/j.fpsl.2019.100427

Abstract

Perforation-mediated modified atmosphere packaging of soft kale (*Brassica oleracea* L. convar. *acephala* (DC) *Alef.* var. *sabellica* L.) was investigated to maintain freshness at 10 °C for 12 d. Kale was sealed in micro-perforated pouches with different oxygen transmission rates (OTRs: mL m–2 d–1 atm–1) at 1.66 × 106, 3.0 × 103 or 64. Headspace atmospheres (O2/CO2) of pouches at OTR 1.66 × 106, 3.0 × 103 and 64 were 21 %/0 % (normoxia), 1.9~7.4 %/8.5~9.6 % (modified atmosphere) and 0 %/> 20 % (hypoxia), respectively. Hue angles (degree of green color) of leaves in the OTR 3.0 × 103 and 64 pouches were significantly higher than that in the OTR 1.66 × 106 pouch. However, carotenoid and ascorbic acid concentrations in the leaf in the OTR 3.0 × 103 pouch was significantly higher than that in the OTR 64 pouch. The modified atmosphere created in the OTR 3.0 × 103 pouch was suitable for maintaining external (green color) and internal (bioactive compounds) qualities of soft kale.

Keywords: /Leaf vegetables/ /Ethylene/ /Ascorbic acid/ /Chlorophylls/ /Carotenoids/ /Polyphenols/

TOMATO

Agudelo-Rodríguez, G., Moncayo-Martínez, D., & Castellanos, D. A. (2020). Evaluation of a predictive model to configure an active packaging with moisture adsorption for fresh tomato. *Food Packaging and Shelf Life*, *23*, 100458. doi: 10.1016/j.fpsl.2019.100458

Abstract

In this study, a model for the simulation of moisture exchange in a perforated active packaging system was applied in the preservation of fresh tomato (*Solanum lycopersicum* Mill.). In the proposed model, the effect of temperature and relative humidity on the moisture transfer and adsorption through the active packages was considered and included. To evaluate the prediction capacity of the model and its utility to configure the active packaging system, 245 ± 30 g of fresh 'chonto' tomatoes were packaged in perforated rigid polyethylene terephthalate (PET) clamshells at 10 °C for 17 days. Three configurations of the adsorber were evaluated according to simulations previously performed: 100 % of the adsorber required to avoid condensation during the entire storage time (18.2 g), 50 % of the required adsorber (9.1 g) and packages without adsorber. A sodium polyacrylate (SPA) and cotton mixture was used as a moisture adsorber in 'sachets' with a proportion of 70 % SPA (w/w). It was possible to adequately simulate and represent the evolution in the amount of water adsorbed by the adsorber and the weight loss of the packaged samples (R2 = 0.96–0.97). Likewise, it was also possible to avoid condensation during the time of evaluation for the packages with 100 % of the adsorber required (18.2 g). During the evaluation, the quality properties of the packaged tomato were not affected, except for the fruit weight and firmness loss. This is a commitment that must be made to guarantee the non-condensation of water within the active system.

Keywords: /Modeling and simulation/ /Prediction/ /Sodium polyacrylate/ /Transpiration/ /*Solanum lycopersicum* Mill/

Sadeghi, K., Kasi, G., Ketsuk, P., Thanakkasaranee, S., Khan, S. B., & Seo, J. (2020). A polymeric chlorine dioxide self-releasing sheet to prolong postharvest life of cherry tomatoes. *Postharvest Biology and Technology*, *161*, 111040. doi: 10.1016/j.postharvbio.2019.111040

Abstract

Chlorine dioxide (ClO2) as an effective sanitizer is widely used in postharvest handling. Because of its generation challenge such as equipment requirement for on-site production and ClO2 generator, application of ClO2 gas in retail is not currently feasible. In this study, a novel polymeric ClO2 self-releasing sheet was prepared using a solution casting method. As such, sodium chlorite (NaClO2) can react with the citric acid in the polymer matrix in the presence of moisture. Poly (ether-block-amide) as the backbone of the sheet was utilized to provide a hydrophilic system and generate ClO2 gas. In addition, polyvinyl alcohol was used as a barrier layer to control the releasing level and increase the hydrophilicity. The new developed self-releasing sheet released sufficient ClO2 concentration to inactivate microbial growth and maintain the quality of cherry tomatoes during actual storage tests. Overall, the self-releasing sheet containing lower content of NaClO2 exhibited better postharvest parameters. The new developed ClO2 self-releasing sheet is not just limited to postharvest handling and cherry tomatoes; it could also be used for wider applications such as medical sterilization or industrial sanitization.

Keywords: /Self-releasing sheet/ /Chlorine dioxide/ /Postharvest life/ /Polymeric system/

Kasampalis, D. S., Tsouvaltzis, P., & Siomos, A. S. (2020). Chlorophyll fluorescence, non-photochemical quenching and light harvesting complex as alternatives to color measurement, in classifying tomato fruit according to their maturity stage at harvest and in monitoring postharvest ripening during storage. *Postharvest Biology and Technology*, *161*, 111036. doi: 10.1016/j.postharvbio.2019.111036

Abstract

Tomato fruit classification and postharvest ripening monitoring based on maturity stage of fruit at the time of harvest are necessary, in order to guarantee the highest possible quality and marketability of the final ripe product. The aim of this study was to investigate if three non-destructive innovative and convenient protocols, in terms of rapidness, accuracy and expense, can be exploited in the discrimination of the maturity stage of tomato fruit and in the assessment of the pericarp's pigments content, as well as in the monitoring of the postharvest ripening of tomato fruit during storage. These protocols included the measurement chlorophyll fluorescence (OJIP), the non-photochemical quenching of photosystem (NPQ) and the light harvesting complex (LHC). The efficiency of these methods was compared to that of the colorimeter, which is widely used for such purposes. According to the results, specific parameters of all the three protocols can classify the tomato fruit according to their maturity stage, as efficiently as the hue angle parameter of the color measurements. Additionally, certain parameters of these protocols were identified that can monitor the tomato fruit ripening during storage more reliably even compared to the colorimeter parameters, while also being strongly correlated with the tomato fruit pericarp pigments' content. Among the three protocols, the OJIP is the most accurate one which also excels in generating data faster than the rest. Moreover, the 'fix area' parameter of the OJIP protocol retains the efficiency to discriminate fruit during 16 days of storage according to their initial ripening stage at harvest, even when all tomatoes turn red, in contrast to hue angle parameter, which was less efficient in distinguishing the different initial maturity stages, beyond the 8th day of storage. Models based on 'fix area' parameter better reflect the actual ripening process of fruit per maturity stage than the ones based on hue angle data.

Keywords: /Chlorophyll fluorescence/ /Non-Destructive/ /Color/ /Maturity stage/ /Storage/ /Ripening/

WALNUT

Ma, Y., Li, P., Watkins, C. B., Ye, N., Jing, N., Ma, H., & Zhang, T. (2020). Chlorine dioxide and sodium diacetate treatments in controlled atmospheres retard mold incidence and maintain quality of fresh walnuts during cold storage. *Postharvest Biology and Technology*, *161*, 111063. doi: 10.1016/j.postharvbio.2019.111063

Abstract

Fresh walnuts deteriorate and develop mold rapidly during cold storage. The effects of chlorine dioxide (ClO2) and sodium diacetate (SDA) in controlled atmosphere (CA) storage on deterioration of fresh walnuts have been investigated. 'Xifu No.1′ fresh walnuts were treated with air (Control), air +200 mg kg−1 sodium diacetate (SDA), air +50 mg L−1 chlorine dioxide (ClO2), 2 % O2 + 25 % CO2 (CA), CA + SDA and CA + ClO2 and then stored at 0 ± 1 °C for 135 d. Mold incidence, nutrient quality, oil quality and physiological indices of the walnuts were analyzed. The results showed that CA, CA + SDA, CA + ClO2 treatments delayed the development of mold, increased POD activity while decreasing PPO activity, and maintained quality of fresh walnuts in comparison to air treatments. CA + SDA and CA + ClO2 maintained higher melatonin content and lower peroxide and carbonyl values of fresh walnuts than CA treatment alone, but no difference in mold incidence were detected between CA and CA + SDA treatments. Overall, CA + ClO2 was the optimal treatment and kept quality of fresh walnuts for 135d at 0 ± 1 °C, with the lowest mold incidence (5 %), the highest firmness and contents of fat and melatonin, as well as the maximum POD activity.

Keywords: /Fresh walnuts/ /CA storage/ /Antimicrobial agents/ /Mold/ /Phenolic metabolism/ /Storage/