

SELECTIVE DISSEMINATION OF INFORMATION As of March 2018

ALMOND

Ben Abda, J., Ben Amara, M., Bahri, N. and Abdelli, S. (2018). Effect of storage temperature and modified atmosphere packaging on quality of fresh green 'Mazetto' almonds. *Acta Horticulturae*, 1194, 921-926.

Abstract

Fresh green almonds are traditionally consumed in Tunisia during early summer. To extend the availability period, a cold storage period is needed. The aim of the present work was to study the behavior of fresh green almonds during cold storage using modified atmosphere packaging (MAP). 'Mazetto' green almonds were harvested when the kernel was completely formed. They were stored up to 120 d at 2, 6 and 10°C, with or without modified atmosphere packaging. Quality evaluation was performed after 60, 90 and 120 d; weight loss, hull and kernel dry matter, total soluble solids (TSS), proportion of kernel, decay incidence, hull and kernel scald, total phenols and flavonoids were determined. MAP significantly reduced weight loss and, increased kernel scald. Mold growth was significantly higher at 10°C and when MAP was used. A complete staining of the hull was observed for all treatments after 60 d of storage. Total phenols and flavonoids were not significantly affected by MAP during storage. Therefore, fresh 'Mazetto' green almonds could be stored up to 120 d at 6 or 2°C and MAP packaging with an acceptable total quality.

Keywords: /Cold Storage/ /Postharvest/ /Quality/ /MAP/

APPLE

Honghui Luo, Jun Song, Peter Toivonen, Yihui Gong, ... ZhaoQi Zhang. (2018). Proteomic changes in 'Ambrosia' apple fruit during cold storage and in response to delayed cooling treatment. *Postharvest Biology and Technology* 137, 66–76.

Abstract

'Ambrosia' apple is one of the emerging apple cultivars that have been gaining popularity in North America due to its superior eating quality. An effective postharvest storage regime has been established for optimal storage and quality maintenance. Unfortunately, a postharvest physiological disorder has often been reported, which shows symptoms similar to low temperature induced soft scald in 'Honeycrisp'. Therefore, a delayed cooling strategy prior to storage has been developed and implemented as a successful and economical method to prevent this disorder. In order

to reveal the molecular mechanism of soft scald development and delayed cooling in combating this low temperature induced disorder, a quantitative proteomic investigation employing stable isotope dimethylation labeling by peptides was conducted on 'Ambrosia' apples from three commercial orchards in BC, Canada. Quantitative changes in protein abundance in association with disorder development and in response to delayed cooling treatment after one and three month storage were found. Among the quantified proteins, 495 and 575 proteins were commonly presented in three biological replicates after one and three month storage; respectively. Among them, the abundance of 78 and 88 proteins were found to be significantly changed in response to delayed cooling as compared with normal cold storage for one and three months, respectively. These identified proteins were functionally annotated using MAPMAN software, which identified glycolysis, lipid metabolism, amino acids (including GABA shunt), hormone response, stress and signaling, redox and glutathione metabolism as the major pathways influenced by the delayed cooling treatment. A principal component analysis (PCA) revealed groups of proteins that play a major role in response to disorder development and a negative response to delayed cooling. In addition, an ABC transporter protein F family is correlated to the delayed cooling treatment. This study demonstrates the potential mechanism of the biological effect of delayed cooling on apple fruit at the proteomic level. It also provides in-depth insight on molecular mechanisms of the delayed cooling treatment in apples.

Keywords: /*Malus domestica*/Quantitative proteomics/Peptide demethylation/Soft scald, Physiological disorder/

Valdebenito-Sanhueza, R.M., Vargas, V.R., Pereira, J.C., Tochetto, N. and Longhi, G.H. (2018). Silicon effects in postharvest apple rots in Brazil. *Acta Horticulturae*, 1194, 215-220.

Abstract

The main postharvest apple rot diseases in Brazil are caused by *Neofabraea* sp., *Penicillium expansum* and *Botrytis cinerea*. Aiming at getting information on an alternative method of reducing losses during apple storage, the effect of treatments with sodium metasilicate pentahydrate (SM) was evaluated. In the first assay, under laboratory conditions, 'Maxi Gala' apples disinfected with chlorine and wounded (3 mm Ø) were treated with different doses of SM (0.14, 0.16 and 0.18%) and compared with a *Bacillus subtilis* treatment (0.2%). After 5 h, apples were inoculated with *Neofabraea* sp. Further trials were performed in commercial packinghouse conditions. Fungicide-free apples obtained from bins in the packinghouse were sprayed with SM (0.18%), with disinfectants or with Iprodione (0.075%) and compared to apples treated with chlorhexidine digluconate (1.225%) and with the untreated control. Under laboratory conditions, SM at 0.18% displayed a 70% control of *Neofabraea* rot and it was more efficient than *Bacillus subtilis*. In a commercial packinghouse, SM was equal to

Iprodione to control the incidence of *Neofabraea* sp., *Penicillium expansum* and *Botrytis cinerea* rots and the addition of SM to iprodione did not increase disease control.

Keywords: /Postharvest Apple Rot Diseases/

Sadar, N., Agati, G. and Zanella, A. (2018). Optical, acoustic and textural attributes in 'Braeburn' and 'Nicoter' (Kanzi®) apple resulting from different pre- and postharvest conditions. *Acta Horticulturae*, 1194, 753-760.

Abstract

In light of the hypercompetitive conditions currently ruling the apple fruit market, supplying the consumers with fruit of high quality, even after long storage, is crucial for the producer's continued existence on the market. One of the most important quality constituent of apple fruit, regardless of cultivar, is its texture, which, when unsatisfactory, overrides all other quality aspects. A suitable instrumental predictor of sensorial perception of firmness is Magness Taylor penetrometric test. One of the alternatives to this destructive test might be the acoustic measurement of firmness, calculated from the frequency of the sound emitted by fruit following a gentle tap. Additionally also fruit's spectral signature in visible light, mainly in the range of chlorophyll absorption, as well as chlorophyll fluorescence have been considered as indicators of apple fruit firmness. However, the attempts to determine the quality of fruit with these techniques have yielded conflicting results, with some studies demonstrating very strong, whilst some almost non-existent correlations with the reference standards. It is likely that different environmental, production and postharvest factors are responsible for de-coupling of the normally synchronized processes conjointly referred to as fruit ripening and quality development. The objective of the present study, done on apple fruit of two commercial cultivars ('Nicoter', 'Braeburn') with differing softening behaviour, was to observe the time-course development of the mentioned optical (I_{AD} , SFR_R), acoustic (AFS) as well as reference (MT firmness) indices resulting from different environmental, pre- and postharvest conditions. Measurements were conducted at harvest, multiple times during CA storage, and during shelf life. The results revealed clear differences between cultivars, climate conditions and cultural practices for most monitored parameters and strengths of their correlations. The general trend of MT FFF and AFS changes during CA storage was very similar. Nevertheless, AFS was not a good indicator of firmness per se. However, the initial AFS values hinted on FFF changes during SL. The only strong correlations between the different monitored parameters were obtained for the two optical indices (I_{AD} and SFR_R). Further investigations are required for the optimization of the studied non-destructive techniques for assessing fruit quality, before they can be used for practical applications.

Keywords: /Apple Maturity/ /Firmness/

Bender, R.J., Muller, I. and da S. Bender, S. (2018). After harvest, mechanical injuries on apples. *Acta Hortic.* 1194, 793-798.

Abstract

Apples endure impacts and compression forces from harvest to consumption, which may result in mechanical damages. Mechanical damages degrade fresh fruit quality and are the main source of postharvest losses. To intervene on the outcomes it is necessary to discern the forces that cause mechanical damages. In that respect, the present work intended to discriminate the impacts and compression forces occurring during packinghouse operations, throughout pallet assembly and movement with a forklift. Several trials were conducted in three commercial apple packinghouses with an instrumented sphere based on strain gauges. The procedures of pallet assembly and pallet movement were evaluated. Compression and impact forces during packing and transport of apples in boxes varied between 6 and 9 kgf (kilogram force) when the pallet was formed and up to 26 kgf when conveyed with a forklift. The base layers of the apples in the cardboard boxes on a pallet and the largest apple sizes bear the highest forces. The greater the number of boxes of a pallet the greater the forces exerted on the apples of the lowest layers in the boxes.

Keywords: /Postharvest Losses/ /Instrumented Sphere/ /Packinghouse/

APRICOT

Erbaş, D., Koyuncu, M.A. and Onursal, C.E. (2018). Effects of pre- and postharvest spermidine treatments on storage life and quality of 'Aprikoz' apricot. *Acta Hortic.* 1194, 785-792.

Abstract

Effects of pre- and postharvest spermidine treatments on storage life and quality of 'Aprikoz' apricot were investigated. For preharvest treatment, 0.1 mM spermidine and Tween-20 (0.01%) (as a surfactant) were sprayed on apricot trees as well as distilled water with Tween-20 (preharvest control group) 10 days before commercial harvest. 'Aprikoz' apricots were harvested at commercial harvest maturity from an orchard in Isparta (Turkey) and transported to the laboratory immediately. Fruits were pre-cooled (the internal temperature of fruits reduced to 2-3°C, within 6 h) by using forced air cooling at 1°C temperature. After pre-cooling, fruits were divided into two groups for postharvest application. First groups were dipped in an aqueous solution containing 0.1 mM spermidine and Tween-20 for 10 min. Second group was immersed in distilled water and Tween-20 for 10 min (postharvest control group). After postharvest treatments fruits were drained and dried with blotting paper. Then pre- or postharvest treated and non-treated fruits placed in modified atmosphere package (MAP) and stored

at 0°C and 90±5% relative humidity conditions for 40 days. The weight loss, soluble solids contents (SSC), titratable acidity (TA), fruit firmness, fruit skin color, respiration rate, ethylene production and gas composition in package and sensory evaluation (external appearance, taste and internal browning) were determined initially and at 10-day intervals. Weight loss of all treated and non-treated fruits increased over storage time. Postharvest treated fruits had the lowest weight loss compared to the other treatments. Control groups displayed the highest firmness loss and internal browning at the end of the storage period. According to the results of sensorial evaluation, apricot fruits treated with 0.1 mM dose of spermidine could be stored for 30 days with good quality in MAP conditions.

Keywords: /Cold Storage/ /Fruit Quality/ /Postharvest/

BANANA

Luyckx, A., Lechaudel, M., Hubert, O., Gros, O., Bugaud, C., Benoit, S., Leclerc, N., Salmon, F. and Brat, P. (2018). Management of post-harvest fruit quality for ecologically intensified banana cropping systems. *Acta Hort.* 1196, 79-86.

Abstract

The management of banana postharvest conditions is a pre-requisite for adapting the storage, shipping and gassing conditions to the specific physiology of individual hybrid bananas. The cultivar 'CIRAD 925', developed by CIRAD, is a good case study for adapting banana food chain conditions to accommodate the specificities of this hybrid. Indeed, the storage and ripening conditions should be adapted to this cultivar which is tolerant to the black leaf streak disease. The management of temperature and relative humidity during the maturation step is therefore a key challenge to avoid peel splitting and browning. These physiological disorders are exposed here, and associated biochemical factors are described and discussed. The cuticular wax behaviour during ripening at different relative humidities and its impact on peel splitting and browning is associated with the intensity of these disorders.

Keywords: /Banana/ /Post-harvest Quality/

Siriwardana, H., Abeywickrama, K., Kannangara, S. and Jayawardena, B. (2018). Effect of spraying with *Ocimum basilicum* oil emulsion plus passive modified atmosphere packaging on shelf life of 'Embul' banana. *Acta Hort.* 1194, 657-664.

Abstract

Effect of *Ocimum basilicum* (basil) oil spray treatment in combination with passive modified atmosphere packaging (MAP) was investigated in extending the shelf life of

'Embul' banana (*Musa acuminata*, AAB) at 12-14°C. 'Embul' banana fruits were treated with 1% (w/v) alum (sodium aluminium sulphate), 1% (w/v) alum + 0.2% (v/v) basil oil, 1% (w/v) alum + 0.4% (v/v) basil oil, 0.5 g L⁻¹ carbendazim and distilled water (control). Treated banana samples were packed in low density polyethylene bags and stored at 12-14°C. In-package gases were analysed on initial day and every seven days thereafter up to 28 days of storage. Physicochemical properties (pH, firmness, TSS, TA), sensory properties (peel colour, flesh colour, aroma, flavour, taste, overall acceptability) and crown rot disease severity were determined in ripening induced fruits after each storage period. According to the results of in-package gas analysis, oxygen (O₂) and carbon dioxide (CO₂) attained steady state conditions after 21 days in all packages containing banana samples. At the end of 28 days of storage O₂ in all packages remained between 2.7-4.0% while CO₂ varied from 3.9 to 4.3%. Further, treatment of 1% alum + 0.40% basil oil was the most effective treatment in controlling crown rot disease completely up to 28 days. Moreover, physicochemical and sensory properties of alum + 0.4% basil oil treated banana were not significantly different from the control.

Keywords: /LDPE Film/ /Crown Rot Disease/ /Cold Storage/

BELL PEPPER

Alfaro, L., Soler-Segura, R., Jacquin, C., Juan, M., Elorrieta, M.A. and Valenzuela, J.L. (2018). Yellow bell pepper fruit response to postharvest application of ultraviolet radiation. *Acta Hortic.* 1194, 815-822.

Abstract

The effects of ultraviolet-C (UV-C) radiation on postharvest quality in eight cultivars of yellow bell pepper during cold storage were investigated. Fully colored yellow bell fruits of eight cultivars ('Prometeo', 'Lores', 'Moises', 'Dorado', 'Orguste', 'Prometeo deviro', 'AR37593' and 'DRP2148') were obtained from a commercial greenhouse in Almeria (Spain). The fruits were harvested at the commercial maturity and screened for uniformity and free from physical damages and diseases. Yellow bell peppers, arranged in plastic trays in a single layer were placed 50 cm from the light source and treated with UV-C light (254 nm) at various doses. Radiation doses were varied using exposure time 0, 1, 3, 5, 10 and 20 min and the intensity of radiation was 108±10 mW cm⁻². After treatments the fruits were stored at 15°C during three weeks in order to determine the effects of radiation on several quality parameters. Weekly, a lot of fruits of each cultivar and treatment was analysed for firmness, weight loss, external appearance, colour and rots. Total soluble content (TSS) and titratable acidity (TA) were assessed at beginning and the end of experiment. No significant differences in both weight loss and firmness were detected in the fruit irradiated with UV-C and the control. UV-C illumination had no effect on the changes in fruit colour and TSS and TA. The most common decay

incidence was identified as *Rhizopus* and decay was reduced by UV-C light treatment in all cultivars compared to control fruit.

Keywords: /Ultraviolet Treatment/ /Firmness/ /Fruit Quality/

BROCCOLI

Dogan, A., Topcu, Y. and Erkan, M. (2018). UV-C illumination maintains postharvest quality of minimally processed broccoli florets under modified atmosphere packaging. *Acta Hort.* 1194, 537-544.

Abstract

The effects of different ultraviolet-C (UV-C) illumination dosages on postharvest quality of minimally processed broccoli florets were investigated. For this purpose, broccoli florets were treated with 3 different UV-C illumination dosages (4.4, 8.8 and 13.2 kJ m⁻²) and stored at 0°C temperature for 21 days under modified atmosphere packaging (MAP). UV-C treated and control samples were taken to examine some physico-chemical changes from different storage conditions with 7-day intervals. Examined physico-chemical changes included: weight loss, total soluble solids, titratable acidity, pH, color, and total phenolics of broccoli florets and CO₂ and O₂ levels in the MAP. Results showed that UV-C illumination reduced weight loss and hue angle (h°) of broccoli florets compared with the control treatment. However, there were no differences between the control and UV-C illumination dosages on titratable acidity. UV-C illuminated florets had a lower amount of soluble solids compared to that of control samples. The pH and total phenolics were constantly higher in UV-C illuminated florets than that measured on control florets. Furthermore, in the packages containing UV-C illuminated florets, O₂ levels were always lower while CO₂ levels were always higher compared to that measured in control florets.

Keywords: /Storage/ /UV-C Illumination/

CASSAVA

Babarinsa, O. A., & Oluwalana, I. B. (2018). Effect of storage of fresh cassava in sawdust on Gari processing. *Journal of Postharvest Technology*, 6:1, 57-62.

Abstract

Fresh cassava was harvested and stored for twelve weeks in sawdust with careful handling and processing method. Gari was produced from the stored cassava every two weeks throughout the period of storage. Effect of storage on gari yield, ease of peeling and peel pulp ratio was also evaluated.. The result of the analysis shows that gari yield decrease as the storage time increase but peel pulp ratio relatively increase with

increase storage time and there was no difference in the ease of peeling. The cassava stored well in the sawdust with relative humidity range of 70-80% and temperature range of 28-33°C.

Keywords: /Packaging Liners/ /Postharvest Losses/ /Quality/

CELERY

Rossi, S., Cools, K. and Terry, L.A. (2018). The influence of crop maturity and ethylene on postharvest browning in celery. *Acta Hort.* 1194, 13-18.

Abstract

Celery (*Apium graveolens* L.) is a leafy vegetable which is commonly eaten raw and appreciated by consumers for the bright green and fresh petioles. Cut-end browning is one of the most relevant postharvest “disorders” negatively affecting visual quality and it renders products unmarketable. Cut-end browning is thought to be due to the enzymatic activity of polyphenol oxidases (PPOs) which oxidase phenolic compounds to produce dark pigments on damaged tissues. Given the relevance of this postharvest problem, in the present study we investigated the influence of crop developmental stage and the plant hormone ethylene on cut-end browning in celery. The experiment was replicated across two growing seasons; early and late. The crop reached commercial maturity 19 and 12 weeks after planting respectively. The cultivar 'Monterey' was used and grown in Spain (Murcia). In each replicate trial, celery heads were trimmed every week to obtain immature, commercially mature and over-mature plants. After harvest, samples were divided into two batches to run two experiments in parallel. The first batch was stored at 20°C temperature and 55.5% relative humidity and the second was further divided into three sub-batches for postharvest treatments (continuous air, continuous ethylene and continuous air after 1-methylcyclopropene treatment) at 5°C temperature and 95% relative humidity. During the storage period (12 days) samples were periodically assessed for subjective and objective colour at both apical petiole and butt ends surfaces. Results showed that browning developed over storage in general and intensified as crop maturity increased. Conversely, ethylene did not have any significant effect on cut-end discolouration. In conclusion, findings suggest that cut-end browning seems to be more prevalent in later stages of crop maturity, whilst ethylene does not seem to be involved in its underlying mechanism.

Keywords: /Postharvest Browning/

CHERRY

De Paiva, E., Hernández, A., Ruiz-Moyano, S., Villalobos, M.C., Serradilla, M.J. and Córdoba, M.G. (2018). Application of microperforated films to maintain quality traits of '13S-3-13' sweet cherries. *Acta Hort.* 1194, 327-334.

Abstract

Currently, the '13S-3-13' cultivar is being recommended due to its good agronomic traits in the Jerte Valley region. However, no data are available on its behavior during long time storage. For this reason, the effectiveness of 2 biaxially oriented polypropylene (BOPP) microperforated films of different transmission rates on storage stability of '13S-3-13' sweet cherries were studied. Fruits were harvested totally at random from multiple trees and transported to the distribution centre in less than 1 h. They were then hydrocooled at a water temperature of 1°C. Sodium hypochlorite was added to the water to achieve a chlorine concentration of 100 $\mu\text{L L}^{-1}$. Then the cherries were packaged in polypropylene trays and sealed with different microperforated films: film with 16 holes (M10) and microperforated film with 3 holes (M50). As control, fruit was packaged in (BOPP) macroperforated film with five holes ($\phi=9$ mm). All treatments were stored during 50 days at 1°C and with RH of 95% in darkness. Gas concentration in trays, weight loss, firmness, total soluble solids, titratable acidity, pH, and microbial population of total mesophilic aerobic, anaerobic and psychrotrophic bacteria as well as moulds and yeasts were analyzed after 0, 7, 14, 21, 35, and 50 storage days. The results indicated that sweet cherries stored under microperforated film M50 had reduced rates of deterioration, since cherries presented higher values for firmness, and titratable acidity than control. Moreover, this microperforated film was also effective to control the growth of yeasts after 50 days of storage.

Keywords: /Postharvest Storage/ /Microperforated Films/

Dong, F., & Wang, X. (2018). Guar gum and ginseng extract coatings maintain the quality of sweet cherry. *LWT-Food Science and Technology*, 89, 117-122.

Abstract

The present study was carried out to maintain the quality of sweet cherry by using the guar gum (GG) and ginseng extract (GSE) coatings during storage at 20 °C and 70–75% RH for 8 days. Coatings with 0.15% (m/v) GG + 0.1% (m/v) calcium chloride + 0.1% (m/v) glycerol + 1% (m/v) GSE presented the best characteristics to uniformly coat sweet cherry surface. Quality (weight loss, decay percentage, firmness), respiration rate, nutrient components (total soluble solids, titratable acid, ascorbic acid, total phenols, anthocyanins) and malondialdehyde evaluations were performed. Coatings with GG-GSE controlled water loss and delayed loss of firmness and of titratable acid, ascorbic acid and total phenols, compared with untreated fruit. Overall, coatings developed in this study extend sweet cherries' shelf life for about 8 days, demonstrating

for the first time that the combination of guar gum and ginseng extract as edible coating materials has great potential in expanding the shelf life of fruits.

Keywords: /Coatings/ /Guar Gum/ /Ginseng Extract/

CITRUS FRUITS

Conesa, E., Cortell, V. and Tormo, D. (2018). Tebuconazole effect over *Penicillium* sp. control during postharvest of citrus fruit in commercial conditions. *Acta Hort.* 1194, 187-192.

Abstract

The main fungus which affects citrus fruit during its storage and marketing is *Penicillium* sp. Packing houses apply different kinds of authorized fungicides once citrus fruit reaches their facilities. The most widely used fungicide is Imazalil but its continuous use may cause an excess of residues, which may possibly be above commercial requirements, or it may lead to the development of resistance. Therefore, there is a need to seek out new plant protection products, which include Tebuconazole, in order to use them as alternatives to those commonly used. The following study was carried out to test the efficacy of a Tebuconazole formulation as a fungicide, which was used in an on-line application (1000 ppm a.i.) or mixed with wax (1000 ppm a.i.) and applied to several cultivars of citrus fruit previously inoculated with *Penicillium digitatum* and *Penicillium italicum*. This fruit was compared to fruit that had not been treated or had been treated with Imazalil. The results show that the fungicidal effect of Tebuconazole against *Penicillium* sp. was similar to Imazalil in on-line applications and when mixed with wax. Therefore, it can be concluded that Tebuconazole is a viable alternative to other plant protection products.

Keywords: /Wax/ /On-line Application/

Palou, L., Moscoso-Ramírez, P.A. and Montesinos-Herrero, C. (2018). Assessment of optimal postharvest treatment conditions to control green mold of oranges with sodium benzoate. *Acta Hort.* 1194, 221-226.

Abstract

Green mold, caused by the pathogenic fungus *Penicillium digitatum*, is the most important citrus postharvest disease in Mediterranean climate areas such as Spain. Due to health and environmental issues, alternative methods to synthetic chemical fungicides are needed to control this disease. The most effective concentration of the food additive and GRAS (generally regarded as safe) compound sodium benzoate (SB)

was 3% (w/v), as determined in in vivo primary screenings with 'Valencia' oranges. Optimal postharvest treatment conditions for maximum curative activity of SB against green mold were assessed on 'Valencia' oranges artificially inoculated with *P. digitatum* and dipped 24 h later in 3% SB aqueous solutions. Tested dip temperatures were 20, 50, 53, 58, and 62°C. Dips at each of these temperatures were performed for two or more of the following immersion times: 5, 15, 30, 60, and 150 s. Dip treatments at 50 or 53°C for 30 or 60 s resulted in reductions of green mold incidence of 60-80% on oranges incubated at 20°C for 7 days. Furthermore, SB treatment at 50°C for 60 s reduced by about 85% the incidence of green mold on 'Valencia' oranges inoculated, treated, and stored for 2 months at 5°C and 90% RH. Therefore, heated SB aqueous solutions may be an interesting additional tool for integrated control of green mold in citrus packing houses, especially for markets with zero tolerance to fungicide residues.

Keywords: /Alternative Postharvest Decay Control/

Martínez-Hernández, G.B., Gómez, P.A., Orihuel-Iranzo, B., Bretó, J., Artés-Hernández, F. and Artés, F. (2018). Innovative and sustainable postharvest treatments to control physiological disorders and decay in lemon fruit during long transport and commercialization. *Acta Hort.* 1194, 235-240.

Abstract

The effects of different sustainable postharvest treatments to control chilling injury, peteca, and *Penicillium* spp. were studied on lemon fruit (*Citrus × limon* 'Verna'). The treatments were: Citrocide® PC (0.6%), UV-C radiation (20 kJ m⁻²) and hot water dipping (55°C for 2 min), hereinafter called curing. Lemons were stored for 33 days at 2 or 7°C, which simulated a long transport period, followed by 5 days at 22°C, simulating a real commercialization period. Peteca incidence was mainly found after commercialization of those lemons previously stored at 2°C. Postharvest treatments greatly reduced peteca incidence by 90-100% without great differences among them. Chilling injury was also generally found after commercialization of lemons previously stored at 2°C. Chilling injury incidence was reduced by 35-45% after applied postharvest treatments without differences among them. *Penicillium* spp. was reduced by 40-93, 40-60 and 70-100% in lemons treated with Citrocide® PC, UV-C radiation and curing, respectively, after commercialization of those lemons previously stored 33 days at 2°C. Weight losses after transport period at 7°C (the most unfavourable conditions) were reduced by 80% after Citrocide® PC and 50-65% after UV-C radiation and curing treatments. Generally, Citrocide® PC was the treatment that better maintained visual appearance and firmness of lemons after both transport and commercialization periods. As main conclusion, all postharvest treatments greatly reduced peteca, chilling injury and *Penicillium* spp. incidence, although Citrocide® PC better reduced weight loss and maintained visual appearance and firmness of lemons during transport and commercialization.

Keywords: /Chilling Injury/

Vila, L., Landete, V., Turégano, V. and Sdiri, S. (2018). New alternatives for postharvest control of rots in citrus fruit. *Acta Hortic.* 1194, 249-256.

Abstract

The inclusion of new molecules in the postharvest of citrus fruit opens a new stage where it is possible to control almost all pathogens causers of decays and losses after harvest, with active ingredients alternatives to the traditional fungicides. The use of both Fludioxonil and Propiconazole assures, with only two active ingredients, the control of the postharvest diseases in citrus fruits during the whole season. Fludioxonil, active ingredient recently registered in the European Union for postharvest use in citrus fruits, is a wide spectrum fungicide, with low risk and belongs to the family of the fenilpirroles, presents high efficacy against *Penicillium* spp. (green and blue mold), *Alternaria* spp., *Botrytis* spp., and *Rhizopus* spp. Propiconazole, belonging to the family of the triazoles, is the unique authorized ingredient which controls and prevents, with high efficacy, the diseases caused by *Galactomyces citri-aurantii* (sour rot), also presenting efficacy against *Penicillium* spp. After inoculation, the application of 690 ppm of FDX and 600 ppm of PROP, by drench or by dip in a tank, reduced around 90% infections caused by *Penicillium* spp. and *Galactomyces citri-aurantii* and more than 85% infections caused by secondary moulds such as *Botrytis* spp. and *Rhizopus* spp. In pack-house trials the treatment efficacy was up to 95% against the mentioned moulds. The application of FDX (2880 ppm) and PROP (1200 ppm) by on-line spray, in water or in wax mix, reduced the sour rot and the green and blue moulds to more than 85% after inoculation and 95% in pack-house trials under commercial conditions.

Keywords: /Fludioxonil/ /Propiconazole/ /Oranges/

Ferdous Chowdhury, M.G., Brecht, J.K., Ritenour, M.A. and Sims, C.A. (2018). Improving postharvest quality retention of oranges during ambient storage using hot water immersion and fruit coating: the role of internal modified atmosphere. *Acta Hortic.* 1194, 313-320.

Abstract

Plants respond to sublethal stresses by upregulating their antioxidant system, which can increase resistance to subsequent stress. Respiration increases when fruit are submerged in water at warm but sublethal temperatures. While submerged, gas exchange is minimal, which can create internal modified atmospheres (MA) that may also cause tissue stress. Coatings applied to citrus fruits also can result in development of internal MA that can be either beneficial or damaging to fruit quality. The aim of this research was to determine potential hot water treatments (HWT) plus fruit coatings for oranges that stimulate the antioxidant system and create beneficial internal MA to better

maintain postharvest quality when refrigerated storage is not available. Fruit were immersed in hot water (45°C for 30 min) resulting in a desirable internal MA (5% O₂ and ~15% CO₂) then three commercial coatings (polyethylene-, carnauba-, or shellac-based) were applied using a hand spray applicator on a semi-commercial citrus packingline or left uncoated. Fruit internal atmospheres (O₂, CO₂, and C₂H₄) were measured initially then several times during 3 weeks storage at 25°C and 85% relative humidity. Among the treatments, HWT+carnauba best created near-optimum internal MA (5-10% O₂ and CO₂) and significantly reduced weight loss compared to other treatments. Coatings significantly improved peel appearance (lightness, chroma and hue), fruit firmness, and peel puncture resistance during storage. The HWT+carnauba also significantly increased antioxidant capacity during storage compared to other treatments. Sensory panalists preferred the overall quality of HWT+carnauba and HWT+no coating fruit among the treatments. They also ranked the flavor and overall quality of fruit with carnauba-based coating higher than uncoated fruit, or fruit with polyethylene or shellac coating. Shellac coating resulted in the lowest sensory rating, corresponding to elevated internal ethylene (0.2 to 0.4 versus 2 ppm) after 3 weeks, suggesting a stress response.

Keywords: /Edible Wax Coating/ /Shelf Life/

Pannitteri, C., Continella, A., Lo Cicero, L., Legua, P., D. Aquino, S., Palma, A. and La Malfa, S. (2018). Effects of postharvest storage conditions on 'Tarocco' orange fruit quality. *Acta Hort.* 1194, 873-878.

Abstract

'Tarocco Sant'Alfio' [*Citrus sinensis* (L.) Osbeck] is a late ripening sweet orange cultivar belonging to the so called blood oranges. These fruits are more and more appreciated from consumers for their high nutraceutical value due to the presence of anthocyanins in the flesh. Recently, cold treatment in sweet orange has received more attention due to its usefulness for accomplishing phytosanitary exportation rules, allowing Italian citrus fruit to be sent to Japan and the USA. In addition, cold treatments are useful for increasing pigmentation levels in the fruit. The aim of this work was to define a reliable protocol for postharvest storage of the very-late 'Tarocco Sant'Alfio' blood orange to prolong the availability of this product in the market to be used for fresh squeezed orange juice production. Fruits were subjected to three storage treatments (20 days at 1°C plus 50 days at 4°C; 70 days at 4°C; 70 days at 20°C, as control). The results indicate that cold treatments, in particular at 4°C constantly, can extend 'Tarocco Sant'Alfio' shelf life and might enhance its qualitative value determining an increase of total anthocyanin content in the flesh. The defined protocols allow prolonging market availability of such a high value product till late June with relevant benefits for the citrus industry and advantages for consumers.

Keywords: /Cold Treatment/ /Shelf Life/

Li, Y., Golding, J. B., Arcot, J., & Wills, R. B. (2018). Continuous exposure to ethylene in the storage environment adversely affects 'Afourer' mandarin fruit quality. *Food Chemistry*, 242, 585-590.

Abstract

'Afourer' mandarins were stored in air containing ethylene at 0.001, 0.01, 0.1, and 1 $\mu\text{L L}^{-1}$ at 20, 10, 5 and 0 °C and changes in a range of external and internal quality parameters were examined for up to 10 weeks in storage. At all storage temperatures, reducing ethylene concentration in the storage environment decreased the rate of respiration, visible deterioration of the calyx region, ethanol accumulation in the juice, loss of eating quality, and at chilling temperatures reduced rind pitting. The quality attributes limiting mandarin storage life differed between the different storage temperatures but retention of mandarin quality was always optimised by maintaining the lowest possible ethylene atmosphere around fruit. Thus, the primary target should be to ensure the ethylene levels are $\leq 0.01 \mu\text{L L}^{-1}$, as loss of quality was accelerated above this concentration.

Keywords: /Temperature/ /Storage/ /External Quality/

COFFEE BEANS

Worku, M., de Meulenaer, B., Duchateau, L., & Boeckx, P. (2018). Effect of altitude on biochemical composition and quality of green arabica coffee beans can be affected by shade and postharvest processing method. *Food Research International*, 105, 278-285.

Abstract

Although various studies have assessed altitude, shade and postharvest processing effects on biochemical content and quality of coffee beans, data on their interactions are scarce. The individual and interactive effects of these factors on the caffeine, chlorogenic acids (CGA) and sucrose contents as well as physical and sensory qualities of green coffee beans from large plantations in southwestern Ethiopia were evaluated. Caffeine and CGA contents decreased with increasing altitude; they respectively declined 0.12 and 1.23 $\text{g kg}^{-1} 100 \text{ m}^{-1}$. Sucrose content increased with altitude; however, the altitude effect was significant for wet-processed beans (3.02 $\text{g kg}^{-1} 100 \text{ m}^{-1}$), but not for dry-processed beans (0.36 $\text{g kg}^{-1} 100 \text{ m}^{-1}$). Similarly, sucrose content increased with altitude with much stronger effect for coffee grown without shade (2.11 $\text{g kg}^{-1} 100 \text{ m}^{-1}$) compared to coffee grown under shade (0.93 $\text{g kg}^{-1} 100 \text{ m}^{-1}$). Acidity increased with altitude when coffee was grown under shade (0.22 points 100 m^{-1}), but no significant altitude effect was observed on coffee grown without shade. Beans grown without shade showed a higher physical quality score for dry (37.2) than

for wet processing (29.1). These results generally underline the complex interaction effects between altitude and shade or postharvest processing on biochemical composition and quality of green arabica coffee beans.

Keywords: /Chlorogenic Acids/ /Postharvest Processing/

CUCUMBER

Nishizawa, T., Okada, T., Suzuki, Y., Motomura, Y. and Aikawa, T. (2018). Postharvest deformation of cucumber fruit associated with water movement and cell wall degradation. *Acta Hort.* 1194, 1217-1224.

Abstract

Changes in water content and cell wall polysaccharides associated with postharvest deformation of cucumber fruit (*Cucumis sativus* L. 'Natsu-suzumi') were investigated. When 20 cm long fruit were stored at 22°C and 90% RH, seed development was observed in the distal portion and the fruit circumference increased by 30% on day 12, whereas the fruit circumference of the middle portion decreased continuously until day 19. The increase in the fruit diameter of the swollen portion was mainly due to swelling of the placenta, whereas the decrease in that at the shrunken portion was due to shrinkage of the mesocarp. In the shrunken area, intercellular air-spaces increased in the mesocarp while no distinct change was found in the placenta. Enlargement of the cell size was observed only in the placenta of the swollen portion. In the swollen portion, both the covalently-bound pectin polymers and hemicelluloses decreased among cell wall polysaccharides. Non-pollinated fruit also deformed during storage, but the deformed portions of non-pollinated fruit differed from those of pollinated fruit. Our findings suggest that postharvest swelling of cucumber fruit occurs due to the movement of water from the mesocarp into the placental cells in relation to cell wall loosening.

Keywords: /Air Space/ /Mesocarp/ /Placenta/

FEIJOA

Urraburu, M., Aguayo, E., Zoppolo, R. and Silveira, A.C. (2018). Postharvest and functional behavior of some feijoa genetic materials. *Acta Hort.* 1194, 73-78.

Abstract

Feijoa (*Acca sellowiana* (Berg.) Burret) is one of the most popular native Uruguayan trees whose functional characteristics have attracted the interest for commercial cultivation. The aim of this work was to evaluate the postharvest behavior of six genetic

materials, identified as 95, 97, 98, 152, 153 and 154 from the Facultad de Agronomía and Instituto Nacional de Investigación Agropecuaria (INIA, Uruguay) breeding program. Fruits harvested at two maturity stages (M1: not easily picked; M2: touch picking) were stored for 0, 15 and 30 days at 5°C and 95% relative humidity (RH) plus 7 days at 18°C (shelf life). Respiration rates and ethylene emissions were measured every 3 days, while flesh firmness, weight loss and total polyphenol content were evaluated at the end of the storage period and during shelf life. The respiration rate of all the genetic materials was around 27.6 mg kg⁻¹ h⁻¹ of CO₂ during the storage period, while ethylene emission was maintained below 100 µL kg⁻¹ h⁻¹ without differences among maturity stages and genetic materials. Fruits harvested at the M1 stage were 40-60% more firm than fruits harvested at the M2 stage. Genetic materials identified as 95 and 98 had the highest firmness results, with values of 150.1 and 145.1 N (M1), 112.6 and 90.4 N (M2) at harvest and 28.8 and 17.4 N (M1) and 17.2 and 15.4 N (M2) after 30 days at 5°C + 7 days at 20°C, respectively. Average weight loss at the end of storage (30+7) was 14.7%. Fruits identified as material 152 had the highest polyphenol content with values at harvest of 2,384.5 mg GAE 100 g⁻¹ DW (M1) and 2,130.7 mg GAE 100 g⁻¹ DW (M2). At the end of the storage period (30+7), total polyphenol contents decreased between 30-70% in the M1 stage and between 20-50% in the M2 stage. Materials 95, 98 and 152 are interesting for commercial production due to their firmness retention and their functional composition.

Keywords: /Postharvest of Feijoa/

FENNEL

Capotorto, Imperatrice, Maria Luisa Amodio, Maria Teresa Blanco Diaz, Maria Lucia Valeria de Chiara, Giancarlo Colelli. (2018). Effect of anti-browning solutions on quality of fresh-cut fennel during storage. *Postharvest Biology and Technology* 137, 21–30.

Abstract

Fresh-cut fennel (*Foeniculum vulgare* Mill. subsp. *vulgare* var. *azoricum* cv. Orion) is a very perishable crop due to the browning that affects the cut-surface, especially on the stem portion of the slices. The occurrence of browning is the main cause of quality loss and decrease of visual acceptance of this product. In the present work the effectiveness of different anti-browning solutions (0.5% ethanol, 1% L-ascorbic acid, 0.5% L-cysteine at pH 7, 1% citric acid and 0.5% 4-hexylresorcinol) on maintaining quality characteristics of fresh-cut fennel during 6 days at 5 °C in air conditions were investigated. Results showed that dipping in solutions of citric acid, ascorbic acid, cysteine and 4-hexylresorcinol, did not result in substantial improvement of the appearance of fresh-cut fennels cut-surfaces compared to water control. Among all applied anti-browning solutions, dipping in 1% citric acid and 0.5% 4-hexylresorcinol produced a more severe browning than control, in both stem and sheath cut-surfaces. Dipping for 2 min in 0.5% ethanol was effective in preserving visual quality of fresh-cut fennel stored

in air for six days at 5 °C, significantly reducing the browning in both stem and sheath cut-surface. In addition ethanol is a 'generally recognized as a safe' (GRAS) product and did not negatively influence the aroma of fresh-cut fennel. Based on these considerations, dipping in 0.5% ethanol for 2 min could be a useful pretreatment for extending the shelf-life of fresh-cut fennel.

Keywords: /Ethanol/ /Browning control/ /Minimally processed/ /Foeniculum vulgare/

FIGS

Villalobos, M.C., Serradilla, M.J., Ruiz-Moyano, S., Martín, A., López-Corrales, M. and Córdoba, M.G. (2018). Postharvest application of 1-methylcyclopropene (1-MCP) for preservation of 'Albacor' figs (*Ficus carica* L.). *Acta Hortic.* 1194, 853-860.

Abstract

Figs (*Ficus carica* L.) are highly appreciated in the Mediterranean diet by their attractive taste and nutritive value. Nevertheless, figs are highly perishable, even when harvested at optimal ripening time. Thus, the aim of this work was to evaluate the effect of application 1-methylcyclopropene (1-MCP) on fig fruit quality during its postharvest cold storage. To examine this, figs from 'Albacor' cultivar were stored at 0°C and 90-95% RH in darkness during 21 days after treatment with 1-MCP (2 ppm). A batch of figs without treatment stored at the same conditions was used as control (C). Percentage of disorders, fruit hardness and microbial counts were measured for each treatment on day 0 and weekly during storage up to 21 days. The highest presence of disorders, mainly visual mould growth, was detected in the control (24% fruit vs. 18% affecting the 1-MCP treated ones). In addition, figs treated with 1-MCP kept better hardness throughout cold storage (mean values of 0.65 N mm⁻¹), while hardness decreased in the control reaching final levels of 0.42 N mm⁻¹. The control figs presented higher counts for mesophilic aerobic bacteria, coliforms as well as yeasts, reaching final mean counts of 4.8, 3.0 and 3.9 log CFU g⁻¹, respectively, and interestingly 1-MCP figs presented lower levels of the former microbial counts (around 2.7, 2.1 and 2.2 log CFU g⁻¹, respectively). This effect was especially evident for mould counts, with levels of 5.8 or 2.5 log CFU g⁻¹ for the control or 1-MCP treated figs. 1-MCP kept fig quality and extended its potential storability.

Keywords: /1-methylcyclopropene (1-MCP)/ /Fruit Quality/ /Storage/

Piazzolla, F., Amodio, M.L. and Colelli, G. (2018). Effects of thermal treatments on quality of 'Petrelli' figs during storage. *Acta Hortic.* 1194, 879-888.

Abstract

'Petrelli' breba figs were exposed to treatments of 50°C for 60 (60@50C) and 30 min (30@50C), and 38°C for 24 h (24@38C), before cooling at 20°C, while untreated figs were used as control (CTRL). Treatments were applied using 90 fruits then divided in 2 groups of 45 fruits and stored at 0 and 25°C (90% RH) for 20 days. Following quality parameters were evaluated at harvest and after 3, 7, 13 and 20 days of storage: respiration, firmness, colour, appearance and browning scores, and decay incidence. Fruits stored at 25°C were only evaluated at 3 days of storage due to the high incidence of decay, indicating that heat treatment was only effective to store figs at room temperature for few days. After 3 days at 25°C fruits exposed to 30@50C showed a significantly lower decay incidence (8.1%) than all other treatments showing an incidence of 33.2 (24@38C), 35.1 (CTRL), and 65.3% (60@50C). On the contrary, fruit stored at 0°C did not show visible decay development throughout storage. Figs treated at 24@38C and at 60@50C showed a lower value of appearance score, even below the limit of marketability, while control fruits and fruits treated at 30@50C showed significantly higher values. At the end, fruits of 24@38C were scored at the limit of edibility while others showed higher values. These results were confirmed by browning scores which increased for all treatments with significantly highest values for treatment 24@38C, and lowest for control and fruit of 30@50C. In addition, treatment 24@38C also showed the highest respiration rate. In conclusion, the studied thermal treatments did not extend shelf-life of 'Petrelli' breba figs when stored at low temperature. When fruits were stored at room temperature treatment 30@50C reduced decay, but only for a few days.

Keywords: /Thermal Treatment/ /Storage/

FLOWERS

Boonyakiat, D., Poonlarp, P. and Chuamuangphan, C. (2018). Research and development on postharvest management of the Royal Project flowers. *Acta Hortic.* 1194, 587-594.

Abstract

A survey of postharvest losses of chrysanthemums, roses and hydrangeas starting from the farmers' field through the arrival at the Royal Project retail shop in Chiang Mai was conducted. The study compared the postharvest losses of each flowering plant before and after improving the postharvest handling process. For chrysanthemums, the postharvest survey of the three cultivars, namely, 'Celebrate', 'Orange Day', and 'Campus' was conducted. In case of roses, comparison of the three cultivars, 'Persia',

'Twilight' and 'Cantaloupe' was conducted, while the study of hydrangea explored the three cultivars 'Blue Color No. 031', 'White Color No. 027', and the 'Old Blue Color'. The vase life of the chrysanthemum cultivars including 'Celebrate', 'Orange Day', and 'Campus' before improving the process was 10.1, 10.5 and 9.4 days, while the improved postharvest handling prolonged the vase life to 14.2, 14.7 and 18.7 days, respectively. For the rose cultivars, 'Persia' had a regular vase life of 4.32 days before the postharvest handling was improved. With the developed handling process, the vase life for 'Persia' roses was extended to 7.7 days for dry transport and 8.5 days for wet transport. For 'Twilight' roses, the vase life was prolonged to 10.9 days and 11.2 days for flowers in dry transport and wet transport, respectively, from the normal vase life of only 3.8 days. Similarly, 'Cantaloupe' roses' vase life in dry and wet transport was extended to 8.0 and 8.4 days, respectively, as opposed to the normal life of 3.7 days before the postharvest handling was improved. Likewise, the improved postharvest handling for hydrangeas 'Blue Color No. 031' lengthened the vase life to 6.9 days and 7.3 days for those in a vase containing distilled water and in a vase with a solution of citric acid with a pH of 4, respectively, as compared to 3.07 days with traditional postharvest handling. The vase life of the hydrangea 'White Color No. 027' in a vase with distilled water, and a vase with a solution of citric acid with a pH of 3 was extended to 2.9 days and 5.1 days, respectively, while the traditional handling process could only maintain 1.8 days vase life. In case of hydrangea 'Old Blue Color', the vase life with customary postharvest handling was 3.5 days. The developed process extended the vase life for flowers in a vase containing distilled water and the one filled with a solution of citric acid with a pH of 4 to 6.5 and 5.8 days, respectively.

Keywords: /Postharvest Losses/ /Postharvest Handling/

Raquel Cavasini, Denise Laschi, Armando Reis Tavares, Giuseppina Pace Pereira Lima. 2018. Carbohydrate reserves on postharvest of lisianthus cut flowers. *Ornamental Horticulture*. 24:1, 12-18.

Abstract

Floriculture industry demands for products with high quality and durability; however, there is a lack of studies related to the postharvest physiology of cut flowers. We aimed to study phenolic contents of lisianthus (*Eustoma grandiflorum*) stems treated with ethylene inhibitors (1-Methylcyclopropene - 1-MCP and Salicylic Acid - SA) and different storage temperatures (room at 24 ± 2 °C and pre-exposure to the cold chamber at 9 ± 2 °C for 24 hours) during the post-harvest. Total soluble carbohydrate contents decreased during the experimentation, characterizing the consumption of the reserves during lisianthus post-harvest. The 1-MCP treatment slowed the decrease of total soluble carbohydrate contents. SA treatment had the lowest total soluble carbohydrate contents in both storage temperatures.

Keywords: /Postharvest/ /Cut Flowers/

GENERAL

Kyriacou, Marios C. and Youssef Roupael. (2018). Towards a new definition of quality for fresh fruits and vegetables. *Scientia Horticulturae* 234, 463-469.

Abstract

The quality of fruits and vegetables constitutes a dynamic composite of their physicochemical properties and consumer perception. Attempts at defining quality often discriminate between intrinsic characteristics inherent to the nature of the products, dictated by genotypic, agro-environmental and postharvest factors, and extrinsic characteristics influenced by socioeconomic and marketing factors which condition consumer perception of the products and formulate quality standards. The current regulatory context for fruit and vegetable quality comprises crop-specific class standards based on key visual and limited compositional criteria and lays primary emphasis on visual attributes at the expense of flavour, nutritional and functional attributes related to phytonutrient content. The potential quality of fresh fruits and vegetables in the horticultural supply chain is defined in the period preceding harvest, however the full development of quality characteristics can be optimized through the use of appropriate postharvest technology. The current review provides a discourse on the relative significance of the various factors configuring quality in fruits and vegetables, with emphasis on intrinsic factors pertaining to the preharvest period, and also on extrinsic factors shaping quality for supply chain stakeholders and consumers. Preharvest factors discussed include: 1) optimization of stage-specific production inputs, 2) biofortification through targeted plant nutrition, 3) application of accurate crop- and cultivar-specific harvest maturity indices, 4) optimized application of controlled stress conditions that increase primary and secondary metabolites and improve organoleptic and functional aspects of quality, and 5) redirection of horticultural breeding towards improving flavour in horticultural products.

Keywords: Biofortification/Functional quality/Genetic improvement/Phytochemicals/Positive stress/Postharvest/Quality standards/Sensory perception/

Valero, D. (2018). Challenges and opportunities of postharvest research. *Acta Hortic.* 1194, 631-640.

Abstract

Research trends in relation to postharvest of fruit and vegetables are marked by 'stakeholders' who demand and therefore justify the research in this field. These include consumers, agricultural producers, companies and public and private institutions. Among these, consumers constitute a fundamental pillar. A major consumer request regarding horticultural products is their low sensory quality. Furthermore, these products

must be completely safe and should provide all the healthy constituents associated with its benefits. Spanish postharvest research is being funded by the National R+D+I, by the programs of the Autonomous Communities, and by private companies themselves. The current National Plan does not address priority areas, enabling the development of research on any topic that is of interest. Coordinated projects are encouraged, enabling ambitious inter-area projects involving breeders and agronomists with food technologists, nutritionists and even molecular biologists. Postharvest research in Spain is going towards improving quality, ensuring both microbiological safety and toxicology and to optimize nutritional aspects when they reach the consumer. In addition, the development of new products and particularly new fresh-cut ready for consumption or cooking are important too. A remarkable part of postharvest research is aimed at implementing technologies or adapt already known to achieve the goal of 'fresh for longer', and the use of new tools (sensors, informatics, physico-chemical treatments considered as eco-friendly) to improve quality and safety. The use of preharvest treatments and their impact on postharvest storability has gained much attention in the recent years. Other research seeks a deep knowledge of the product biology and to understand physiological aspects that govern their metabolism during storage. Fruits and vegetables are an important source of beneficial metabolites to human health, in this sense the postharvest techniques can assist in maintaining or increasing the content of these healthy substances. The great challenge of postharvest technology is to treat the 'fresh' product properly to reach the consumer's hands with a similar quality at harvest time and if possible with better organoleptic characteristics, although there is a great distance of space (transport) or time (conservation) between the two events. In this keynote, an overview of the main results and achievements obtained by the different research groups will be provided.

Keywords: /Postharvest/ /Quality Attributes/ /Bioactive Compounds/

Bantis, Filippou, Sonia Smirnakou, Theoharis Ouzounis, Athanasios Koukounaras, ... Kalliopi Radoglou. (2018). Current status and recent achievements in the field of horticulture with the use of light-emitting diodes (LEDs). *Scientia Horticulturae* 235, 437-451.

Abstract

Light-emitting diode (LED) technology has rapidly advanced the past years and it is nowadays irrevocably linked with controlled-environment agriculture (CEA). We provide here an amalgamation of the recent research achievements in the horticulture and floriculture industry, ranging from greenhouse applications to climate rooms and vertical farming. We hope this overview bestows ample examples for researchers and growers in the selection of the appropriate LED light solution for amending crop yield, phytochemical content, nutritional value, flowering control, transplant success, pre-harvest and postharvest product quality, and production of regeneration material.

We leave the reader with some future prospects and directions that need to be taken into account in this ever-growing field.

Keywords: /Light quality/ /Greenhouse/ /Growth chamber/ /Vertical farming/
/Photomorphogenesis/ /Plant metabolism/

Pech, J.-C. (2018). The epic of postharvest biology and technology: lessons and challenges for the future. *Acta Hortic.* 1194, 1195-1204.

Abstract

The aims of the presentation are to give an overview of the most important breakthroughs in postharvest biology and technology since the early times to nowadays. The epic of postharvest teaches us that a good knowledge of the literature and the choice of good strategies have been crucial for scientific and technological advances. In recent years high throughput analytical methods of transcriptomics, proteomics and metabolomics have generated a huge amount of data whose biological significance and practical outcomes are often still awaited. However, with the help of bioinformatics, they open new perspectives for the genetic improvement of the quality and storability of fresh products.

Keywords: /Quality/ /Fruits/ /Vegetables/

Ferguson, I.B. (2018). Consumer demands and postharvest innovation: the new generation. *Acta Hortic.* 1194, 1421-1428.

Abstract

Consumer demands or traits, whether determined by market organisations and strategies, or the consumer in the home, are critical components of both crop breeding and development of postharvest technologies and practices. Traditional traits such as colour, aroma, taste, texture and appearance have become default properties. Health and nutrition, and food safety have become greater points of focus in recent years, particularly with the upsurge in minimal processing. However, there is a further tranche of market and consumer demands which is increasingly determining consumer preference. These extend beyond product properties into production and processing systems and include traceability and provenance, environmental sustainability, biodiversity, social licence, energy and water resource management, and ethics and economics of food loss and waste. Looking further ahead, there is a rapid increase in genetic and genomic information leading to genetic segregation of consumer populations in terms of health and disease states, as seen in nutritional genomics, and taste and aroma perception. These developments, current and future, will all have

multiple impacts on developments in postharvest science and technology, providing challenges as well as opportunities.

Keywords: /Food Waste/ /Food Loss/ /Bioeconomy/ /Nutritional Genomics/

Álvarez-Hernández, M.H., Artés-Hernández, F., Ávalos-Belmontes, F. et al. (2018). Current Scenario of Adsorbent Materials Used in Ethylene Scavenging Systems to Extend Fruit and Vegetable Postharvest Life. *Food Bioprocess Technol*, 11:3, 511-525.

Abstract

Fruit and vegetables are much appreciated by consumers due to their nutritional values and health-promoting compounds. However, different factors affect the postharvest life of such products, in where ethylene is a major one, even at low concentrations, besides temperature and relative humidity. Therefore, high attention has been focused on the development of effective tools to remove ethylene from the atmosphere surrounding these products during storage or in transit. Potassium permanganate scrubbers are one of the most used technologies to remove ethylene from horticultural products. To facilitate and improve the oxidation process, potassium permanganate has been supported onto inert solid materials of a small particle size. In this review, we aim to provide an outline of the most common materials used as potassium permanganate supports on postharvest treatment and their respective effects on quality aspects of various fresh produce during postharvest life. Vermiculite, activated alumina, zeolite, silica gel, activated carbon and clays are the most popular materials that have been used as a support of potassium permanganate-based ethylene scrubbers. The literature suggests that potassium permanganate supported onto silica gel or zeolite seems to be a promising tool to maintain fruit and vegetables quality attributes for long-term storage. Although vermiculite and activated alumina are the most commonly used materials to reach this goal, not promising results have been reported.

Keywords: /Shelf Life/ /Postharvest Losses/ /Scavengers/ /Active Packaging/

Kumar, R., Ghatak, A., Balodi, R., & Bhagat, A. P. (2018). Decay mechanism of postharvest pathogens and their management using non-chemical and biological approaches. *Journal of Postharvest Technology*, 6:1, 1-11.

Abstract

Ripening is a physiological process that involves numerous biochemical changes including change in sugar composition and change in pH of the fruit and vegetable tissues. These changes attract a variety of pathogens causing decay, thereby leading to losses up to 25-50% in harvested crops. The infection by the postharvest pathogens may remain quiescent during fruit or vegetable growth due to unfavourable growth

conditions for pathogen's development to pathogenesis. Owing ripening and senescence the pathogen transform to necrotrophs, activation of the pathogen is primarily due to change in pH and cause typical decay symptoms. Some pathogens have developed a mechanism for altering the pH of host environment (tissue), thereby increasing virulence. The postharvest pathogens cause acidification by producing organic acids and alkalization by ammonification of host tissues. Management of postharvest tissue-decaying pathogens is usually performed by use of fungicides but due to raised environmental concerns and residual effects of fungicides on health alternative management strategies are required. This approach should be eco-friendly; the use of plant extract and biological agents are in limited use. Thus, it should be emphasized that management of postharvest food commodity (particularly those of direct consumption like fruit) pathogens can be achieved by altering the physiological environment and use of alternative management strategies to reduce the residual effect of inorganic fungicides and other chemicals. This review deals the both of the aspects and encourages the wide use of biorational and biological approaches for management of postharvest pathogens.

Keywords: /Postharvest/ /Biocontrol/ /Decay Mechanism/

Goyal, A., & Bushra, A. (2018). Modeling and simulation of rotary dryer for wheat drying. *Journal of Postharvest Technology*, 6:1, 63-68.

Abstract

Drying of the agricultural product has been one of most effective methods to reduce postharvest losses. Different studies are conducted to evaluate the performance of a rotary drier for drying of agricultural products. Rotary dryer is capable of processing a variety of agricultural product with a large number of thermo-physical and flow properties. Rotary dryers are used for drying of grains, beans, nuts, vegetables, herbs, woody biomass, animal feeds, agricultural wastes, and by-products. During this paper, a dynamic model to simulate the dehydration process of wheat in a rotary dryer is proposed. The results are validated with the experimental data obtained. The model predicts air and product moisture and temperature depending on operating conditions of the rotary dryer.

Keywords: /Postharvest Losses/ /Rotary Dryer/

Mahajan, B. C., Tandon, R., Kapoor, S., & Sidhu, M. K. (2017). Natural coatings for shelf-life enhancement and quality maintenance of fresh fruits and vegetables-A Review. *Journal of Postharvest Technology*, 6:1, 12-26.

Abstract

The ever increasing demand for fresh fruits and vegetables challenges the researchers and industry to develop advanced methods for maintaining food quality and enhancing shelf life. The consumers around the globe demand chemical free fresh fruits and vegetables with high quality, nutritional value and extended shelf life. The application of edible films and coatings to fruits and vegetables represents an environment friendly approach to solve this problem. The use of edible coatings helps to reduce or eliminate the risk of adulteration thereby, present food in a hygienic and aesthetically attractive way. The strategy behind the use of coatings is combination of food chemistry and preservation technology. This review covers various types of edible coatings and their effects on the overall quality of whole and fresh cut fruits and vegetables providing an understanding of main functions and beneficial effects of each type of coating.

Keywords: /Natural Coating/

GRAPES

Hui Xiao, Ang Li, Meiyu Li, Ye Sun, ... Leiqing Pan. (2018). Quality assessment and discrimination of intact white and red grapes from *Vitis vinifera* L. at five ripening stages by visible and near-infrared spectroscopy. *Scientia Horticulturae*, 233, 99-107.

Abstract

The diffuse reflection visible/near-infrared (Vis/NIR, 400–1100 nm) and near-infrared (NIR, 900–2500 nm) spectrum were used to monitor the surface color (CIE $L^*a^*b^*$), total soluble solid contents (SSC) and total phenolic compounds (TP) of intact 'Manicure Finger' and 'Ugni Blanc' berries at five ripening stages (i.e., green, pre-veraison, veraison, post-veraison and ripe). The determination of quality parameters and the discrimination of five ripening stages were conducted by chemometric analysis based on full-band and selected wavelengths of Vis/NIR and NIR. The results showed that the best regression results were obtained by least squares support vector machine (LS-SVM) with the root mean squares error of prediction (RMSEP) of 5.161, 2.919, 3.275, 1.230% and 0.216 g kg⁻¹ for L^* , a^* , b^* , SSC and TP of 'Manicure Finger' in the range of 400–1100 nm, respectively; and the RMSEP of 3.049, 0.710, 2.996 and 0.150 g kg⁻¹ for L^* , a^* , b^* and TP of 'Ugni Blanc' in the range of 400–1100 nm, respectively, and the RMSEP of 1.288% for SSC in the range of 900–2500 nm. A total of 90% and 100% classification accuracies on prediction sets were reached by the total soluble solid contents based competitive adaptive reweighted sampling support vector machine discrimination analysis (SSC-based CARS SVM-DA) for 'Manicure Finger' and 'Ugni Blanc' grape berries of five ripening stages, respectively. This study provided a feasible evaluation method of quality and developing stages for grape varieties during ripening stages by Vis/NIR and NIR technology.

Keywords: /Total soluble solid contents/ /Total phenolic compounds/ /CIE L* a* b*/ /Least square-support vector machine/ /Competitive adaptive reweighted sampling/

Sortino, G., Farina, V., Gallotta, A. and Allegra, A. (2018). Effect of low SO₂ postharvest treatment on quality parameters of 'Italia' table grape during prolonged cold storage. *Acta Hort.* 1194, 695-700.

Abstract

Table grape is a non-climacteric fruit with a low rate of physiological activity, very sensitive to water loss and fungal infection (*Botrytis cinerea*) during postharvest handling and cold storage. Gray mold is the most aggressive postharvest disease, because of its ability to develop at low temperatures, for that reason, it is standard practice to fumigate with sulfur dioxide (SO₂) immediately after packing. 'Italia' table grape boxes were stored at 2°C for 4 months in a storage room with low concentrations of SO₂ (0.20%) to extend their postharvest shelf life. Every 15 days, a sample of 'Italia' table grapes boxes was moved to 20°C for 3 days for the shelf life simulation. During storage, table grapes clusters were analyzed in terms of firmness, weight loss, total soluble solids content, titratable acidity, rachis and berry decay. A sample of 'Italia' table grapes was stored at 1°C without SO₂ treatment for control. 'Italia' table grapes clusters stored at 2°C and treated with low SO₂ (0.20%) showed good postharvest performances until 3 months of cold storage in terms of firmness, weight loss, total soluble solids content and titratable acidity. Moreover, rachis and berry decays were inhibited by low SO₂ treatment.

Keywords: /Decay/ /Shelf Life/ /SO₂ Postharvest Treatment/

Petriccione, Milena, Luca Pagano, Roberto Forniti, Luigi Zampella, ... Fabio Mencarelli. (2018). Postharvest treatment with chitosan affects the antioxidant metabolism and quality of wine grape during partial dehydration. *Postharvest Biology and Technology* 137, 38–45.

Abstract

The effectiveness of postharvest chitosan treatments on qualitative traits and antioxidant biochemical system during postharvest partial dehydration of "Sagrantino" grape has been studied, compared with ozone postharvest treatment. One % and 2% chitosan coatings delayed water loss but no difference in berry color or peel resistance during partial dehydration up to 30% mass loss (m. l.), was found among samples. The reducing sugar content rose straightly from 275 g L⁻¹ (harvest), up to 445, 428, 411, and 390 g L⁻¹, in 2% chitosan, 1% chitosan, water, and ozone, respectively. Malic acid, and consequently total acidity, increased progressively in all samples with higher values in ozone- and in chitosan-treated berries. In all samples, total polyphenol content rose

already at 10% m.l., and 1% chitosan sample had the highest value. Postharvest treatments enhanced the activity of antioxidant enzymes, superoxide dismutase (SOD) and ascorbate peroxidase (APX), during partial dehydration process, whereas inhibited polyphenoloxidase (PPO) and lipoxygenase (LOX) activity, preventing polyphenol loss and avoiding membrane oxidation, as shown by lower malondialdehyde (MDA) accumulation.

Keywords: /Quality/ /Ozone/ /Antioxidant enzymes/ /Principal component analysis/

Conde, A., Soares, F., Breia, R., & Gerós, H. (2018). Postharvest dehydration induces variable changes in the primary metabolism of grape berries. *Food Research International*, 105, 261-270.

Abstract

Postharvest dehydration causes changes in texture, color, taste and nutritional value of food due to the high temperatures and long drying times required. In grape berries, a gradual dehydration process is normally utilized for raisin production and for making special wines. Here we applied a raisin industry-mimicking dehydration process for eleven days at 50 °C to intact berry clusters from cv. *Sémillon* plants, and a set of molecular, cellular and biochemical analyses were performed to study the impact of postharvest dehydration in the primary metabolism. Transcriptional analyses by real time qPCR showed that several aquaporins (VvTIP1;2 and VvSIP1) and sugar transporters (VvHT1, VvSWEET11, VvSWEET15, VvTMT1, VvSUC12) genes were strongly upregulated. Moreover, the study of key enzymes of osmolytes metabolism, including mannitol dehydrogenase (VvMTD) and sorbitol dehydrogenase (VvSDH), at gene expression and protein activity level, together with the transcriptional analysis of the polyol transporter gene VvPLT1, showed an enhanced polyol biosynthesis capacity, which was supported by the detection of sorbitol in dehydrated grapes only. The metabolism of organic acids was also modulated, by the induction of transcriptional and biochemical activity modifications in malate dehydrogenases and malic enzymes that led to organic acid degradation, as demonstrated by HPLC analysis. Taken together, this study showed that primary metabolism of harvested berries was severely influenced in response to dehydration treatments towards lower organic acid and higher sorbitol concentrations, while sugar transporter and aquaporin genes were significantly upregulated.

Keywords: /Postharvest Dehydration/

GRAPEFRUIT

Zhengjun Shi, Fang Wang, Yanyuan Lu, Jia Deng. (2018). Combination of chitosan and salicylic acid to control postharvest green mold caused by *Penicillium digitatum* in grapefruit fruit. *Scientia Horticulturae*, 233, 54-60.

Abstract

Green mold caused by *Penicillium digitatum* is critical diseases for grapefruit fruit. In this study, the alone or combined effects of chitosan and salicylic acid on the control of green mold decay in grapefruit fruits were investigated. The results showed that combination of chitosan with SA treatment provided a more effective control of green mold than alone applying chitosan or SA. chitosan plus SA significantly reduced lesion diameter, disease incidence, while the content of endogenous SA much higher than those in treatment alone or control fruit. The combined treatment enhanced the chitinase, β -1,3-glucanase, peroxidase, phenylalanine ammonia-lyase and polyphenoloxidase activities and stimulated the synthesis of total phenolic compounds content. Moreover, the applications of alone or combined did not impair fruit postharvest quality such as firmness, weight loss and TA, while increased ascorbic acid and total soluble solids contents in grapefruit fruits. These result suggest that the use of chitosan combined SA treatment was effective in activating disease resistance against green mold, and providing a longer storage life with acceptable postharvest quality in grapefruit fruit.

Keyword: /Chitosan/ /Salicylic acid/ /Green mold/ /Grapefruit fruit/ /Postharvest disease/ Induced resistance/

GUAVA

González-Reza, R.M., Pérez-Olivier, M.S., Miranda-Linares, V. and Zambrano-Zaragoza, M.L. (2018). Effect of solid lipid nanoparticles coating on shelf life of refrigerated fresh-cut guava. *Acta Hortic.* 1194, 553-560.

Abstract

The objective of this work was to study the effect of applying coatings with solid lipid nanoparticles (SLN) on shelf life of fresh-cut guava. The SLN were prepared by hot homogenization method employing candeuba wax as solid lipid to obtain a submicronic size system. The film-forming dispersion contained xanthan gum as SLN support. The film-forming dispersion was evaluated by its particle size (PS), polydispersion index (PDI) and zeta potential (ζ). The film-forming dispersions were prepared with 3 g L⁻¹ of xanthan gum, 5 g L⁻¹ of glycerol as plasticizer and SLN at different concentrations. The SLN concentrations tested were 5 and 10 g L⁻¹. The guavas packaged were stored by 22 days at 7°C and 85% of RH. The coatings were applied by dipping and the changes in pH, soluble solid content, firmness and browning index were measured. The differences between treatment were analyzed by ANOVA and Tukey test ($\alpha=0.05$). The

particle size of the SLN was of 245 nm, IPD of 0.16 and ζ of -35 mV, indicative of a stable system. The changes in pH (3.5-4.5) and SSC (10-11) did not show a statistically significant effect ($p \leq 0.05$) as function of SLN concentration. The firmness (5-15 N) and browning index (50-80 on a 0 to 100 scale) presented effect with respect to the SLN concentration and storage time ($p \leq 0.05$). The best results were by samples coated with the film-forming dispersion with 5 g L⁻¹ of SLN. The use of coatings with solid lipid nanoparticles reduced the browning index and firmness loss of guava showing that SLN have a high potential for use in fresh cut fruit preservation.

Keywords: /Edible Coating/ /Nanoparticles/ /Xanthan Gum Film/ /MAP Packaging/

Alba-Jiménez, J.E., Vázquez-Barrios, M.E., Rivera-Pastrana, D.M., Escalona, V. and Mercado-Silva, E. (2018). Effect of postharvest calcium treatments on firmness of guava fruit. *Acta Hort.* 1194, 823-830

Abstract

The effects of different chelated glycine calcium solutions on the quality and firmness fruit of guava fruit (*Psidium guajava* L.) were studied. Five sets of 45 fruits of 'Media China' guava were submerged in different solutions of Glycine-calcium (Ca-Metalosate®) (0, 0.02, 0.08 and 0.14 M) at vacuum (3.3 kPa) during 10 min, and then stored 20 days at 10°C. Fruit samples were analyzed every five days. The firmness (F), weight loss (WL), visual quality (VQ), total soluble solids (TSS), titrable acidity (TA), and electrolyte leakage (EL) were measured. At the end of storage, TSS, TA and EL did not show significant differences between treatments but the fruit treated with 0.08 M Glycine-Ca presented the highest firmness (3.09±1.18 N) and VQ as well as the lowest WL (9.69%), while control fruit showed the lowest firmness (1.68±1.3 N). The ripening process was not affected by the treatment suggesting that the application of postharvest calcium could maintain firmness and quality of guava fruits.

Keywords: /Postharvest/ /Firmness/ /Visual Quality/ /Chelated Calcium/

Silva, W. B., Silva, G. M. C., Santana, D. B., Salvador, A. R., Medeiros, D. B., Belghith, I., ... & Misobutsi, G. P. (2018). Chitosan delays ripening and ROS production in guava (*Psidium guajava* L.) fruit. *Food Chemistry*, 242, 232-238.

Abstract

Guava is a typically tropical fruit highly perishable with a short shelf-life due to intense metabolic activity after harvested. In attempt to minimize the problems related to the postharvest, we evaluated the physiochemical characteristics and antioxidant system in guava fruits under chitosan coating at concentrations of 1%, 2%, and 3% stored at 25 °C during 96 h. The chitosan suppressed the respiratory rate, fresh weight loss,

firmness and skin color with delay in the degradation of chlorophyll. In the treatment with 2% and 3% of chitosan in the solid soluble content and ascorbic acid were reduced; retarded the loss of titratable acidity during 96 h after treatment. These treatment induced significant decreases in the phenylalanine ammonia-lyase activity and significantly increases of peroxidase Activity. Our results suggest that chitosan effectively prolongs the quality attributes in guava fruits after harvesting due to increases in the antioxidant processes, delaying the ripening during room temperature of storage.

Keywords: /Antioxidant/ /Chitosan/ /Quality/ /Ripening/

LEAFY GREEN VEGETABLES

Caleb, O., Rux, G., Geyer, M., Herppich, W. and Mahajan, P. (2018). Impact of water rinsing and packaging of leafy green vegetables on the development of off-odour and shift in volatile profile. *Acta Hort.* 1194, 275-282.

Abstract

Postharvest challenges associated with packaged leafy green vegetables include tissue softening (loss of turgor), accelerated browning of cut edges, and the development of strong off-odours. This study investigated the effect of water rinsing prior to packaging on the change in volatile distribution and degreening of leafy green vegetables. Perforation-mediated modified atmosphere packaging (MAP) system was applied using a flow wrap design format (polypropylene film 30 µm thickness) with total package volume of 1.9 L. Number of perforations were MAP-0: without perforation; MAP-2: 2 micro-perforations; and control: 21 macro-perforations industry practice as control. Packaged samples (125 g) were stored at 4°C, 80% RH for 4 days and thereafter moved to 20°C, 65% RH for 3 days (to mimic the supply chain and retail conditions). Changes in headspace gas composition, sensory attributes and volatile composition were evaluated at regular intervals during the storage period. Headspace gas composition was significantly influenced by the different packaging systems. Degreening of samples was delayed under MAP-2; however, this process was enhanced after the break in cold chain. A total of 35 volatile organic compounds (VOCs) were tentatively identified via gas chromatography-mass spectrometry, consisting of 19 primary (detected on fresh samples prior to storage) and 15 secondary (detected on samples during storage) VOCs. Volatile profiles obtained were significantly influenced by water rinsing and the packaging system. Accumulation of secondary VOCs and development of strong off-odour was higher for washed samples in comparison to dry samples. Perceived development off-odour based on sensory evaluation was observed to be consistent with the accumulation of ethyl esters, benzaldehyde, benzene acetaldehyde, and benzyl alcohol volatile organic compounds.

Keywords: /Storage Quality/

Geyer, M., Rux, G., Caleb, O. and Mahajan, P. (2018). Effect of perforation-mediated modified atmosphere packaging system on the quality of rucola. *Acta Hort.* 1194, 649-656.

Abstract

Rucola is an important leafy green salad normally sold in plastic trays wrapped with macro-perforated polypropylene film. Such film does not allow to atmosphere modification inside the package resulting in loss of freshness and green chlorophyll pigments. The aim of this study was to optimize the packaging system for fresh rucola under short-term (6 days) and long-term (7 days) cold chains maintained between 4 to 20°C. Washed and unwashed rucola were packed using different packaging systems: packages without perforations (MAP-0); optimized 2 micro-perforations of 0.5 mm diameter (MAP-2); and 21 macro-perforations with 5 mm diameter (control). In control packages, the gas composition stayed close to air and browning of cut edges, water loss, and loss of turgor pressure was most severe. MAP-0 led to anoxia and fermentative off-odor was perceived by day 3 of storage, therefore, it should be avoided. In MAP-2, equilibrium modified atmosphere of 2-3% O₂ and 10-12% CO₂ was achieved and respiration rate of rucola was halved compared to other packages. Additionally, it maintained the freshness, delayed senescence and slowed down the breakdown of chlorophyll pigments. Washed rucola increased the development of off-odor across all the packaging treatments and should not be practiced, while unwashed samples better maintained the overall quality attributes.

Keywords: /Packaging/ /Modified Atmosphere/ /Micro-perforations/

Al Ubeed, H. M. S., Wills, R. B. H., Bowyer, M. C., & Golding, J. B. (2018). Comparison of hydrogen sulphide with 1-methylcyclopropene (1-MCP) to inhibit senescence of the leafy vegetable, pak choy. *Postharvest Biology and Technology*, 137, 129-133.

Abstract

Postharvest fumigation with hydrogen sulphide (H₂S) can inhibit senescence of a range of fruit and vegetables. It has been suggested that the mode of action of hydrogen sulphide is through inhibiting either the endogenous production and/or the action of ethylene. This study compared the effect of fumigation with 250 µL L⁻¹ hydrogen sulphide and 10 µL L⁻¹ 1-methylcyclopropene (1-MCP) on a range of factors associated with senescence of the leafy vegetable, pak choy stored at 10 °C and ventilated with ethylene-free air or air containing 0.1 µL L⁻¹ ethylene. When pak choy was stored in an ethylene-free atmosphere, hydrogen sulphide and 1-MCP were equally effective in inhibiting the loss of green colour, respiration, ion leakage and endogenous ethylene

production. However, for containers ventilated with ethylene, 1-MCP was more effective in inhibiting loss of green colour, respiration and ethylene production than hydrogen sulphide. Sequential fumigation with 1-MCP followed by hydrogen sulphide showed no difference in any quality factor to produce fumigated with 1-MCP. The study concluded that (i) the mode of action of hydrogen sulphide included inhibiting the action of ethylene and (ii) for pak choy, 1-MCP was a more effective fumigation treatment than hydrogen sulphide.

Keywords: /1-MCP/ /Senescence/

Gogo, E. O., Förster, N., Dannehl, D., Frommherz, L., Trierweiler, B., Opiyo, A. M., & Huyskens-Keil, S. (2018). Postharvest UV-C application to improve health promoting secondary plant compound pattern in vegetable amaranth. *Innovative Food Science & Emerging Technologies* 45, 426-437.

Abstract

Vegetable amaranth (*Amaranthus cruentus* L.) is gaining importance among the African indigenous leafy vegetables (AIVs) in the diets of many households in Africa. However, improper processing, handling, and storage of AIVs often result in faster deterioration thus high quantitative and qualitative losses with reduced availability of these highly nutritive and health promoting plants. Targeted application of UV-C has been shown to induce beneficial physiological responses of crops after harvest. The present study was conducted to evaluate the effects of postharvest UV-C application on health promoting secondary plant compounds of vegetable amaranth cv. Madiira. Eight weeks after planting, leaves were harvested and treated with UV-C (254 nm) at either 1.7 kJ m⁻² or 3.4 kJ m⁻² while untreated leaves served as control. The leaves were kept up to 4 d and 14 d at 20 °C (65% RH) and 5 °C (85% RH), respectively. Characteristic health promoting plant compounds, such as vitamin E, carotenoids, flavonoids, phenolic acids, as well as glutathione peroxidase (GPOX) activity and antioxidant capacity (TEAC) and their correlations were analyzed. Results showed that the accumulation of secondary metabolites was dependent on UV-C dosage, storage temperature and duration. Vitamin E, carotenoids (e.g. lycopene, β-carotene and lutein), flavonoids (e.g. quercetin and kaempferol derivatives), phenolic acids (e.g. ferulic, coumaric and caffeic acid derivatives) as well as GPOX activity and TEAC increased in UV-C treated vegetable amaranth leaves compared with the untreated samples. Furthermore, there was a relationship in most studied secondary compounds and TEAC. The UV-C effects at both storage conditions were comparable for most studied compounds while storage duration variedly affected the compounds studied. The increase in the studied secondary plant compounds is attributed to their plant defense mechanism against oxidative damage of plant tissues by UV-C irradiation. This could be an important strategy in reducing the loss of secondary plant compounds, hence maintaining nutritional and health promoting properties of AIVs during postharvest supply chain.

Keywords: /Indigenous Leafy Vegetables/ /UV Irradiation/ /Bioactive Compounds/
/Postharvest Quality/ /Postharvest losses/

LETTUCE

Katarzyna Kowalczyk, Leszek Sieczko, Vasilij Goltsev, Hazem M. Kalaji, ... Magdalena D. Cetner. (2018). Relationship between chlorophyll fluorescence parameters and quality of the fresh and stored lettuce (*Lactuca sativa* L.). *Scientia Horticulturae*, 235, 70-77.

Abstract

Quality of lettuce relates to growing conditions, cultivar and storage conditions. There is a need to introduce in the plant production a forecast system for abiotic stresses to enable recognizing early changes of the plant quality before visual changes occur, based on non-destructive measurement methods. The objective of this study was to evaluate the relationship between photochemical processes dynamics and quality parameters of the lettuce. The results will be useful to assess the quality and storage ability of the lettuce and to determine chlorophyll fluorescence parameters, which could well characterize early changes of quality during plant production and storage. Two cultivars of lettuce were investigated 'Omega' F1 - butterhead lettuce type, and 'Aficion' F1 - 'Batavia' type, which were grown in three hydroponic systems: in mineral wool slabs, coconut fibre, and NFT (nutrient film technique). The harvested plants were tested after 3 d and after 6 d of storage. The results of this study showed that lettuce of 'Aficion' F1 and 'Omega' F1 cvs. differ significantly in yield, quality and different ChlF parameters. 'Aficion' F1 of 'Batavia' type was characterized by higher dry mass, soluble solids, Chl a, Chl b and carotenoid contents than the 'Omega' F1 plants. Only 'Omega' cultivar showed reaction to the growing medium used. The influence of storage period on both cultivars was similar. Storage for 3 d period particularly affected decreasing of SPAD index, and the chlorophyll fluorescence parameters such as PI total, Area, Fo, Fm, Fv, Reo / CSo and increasing of ABS / RC, kP / ABS × kF and kN / ABS × kF. In general, 'Aficion' plants photosynthetic apparatus was significantly less modified during the storage. The level of degradation of the plant tissues during storage has a different effect on structure and reactions in photosynthetic light phase parameters in leaves. The analysis of the photoinduced chlorophyll fluorescence rise allows to monitor the damage dynamics in thylakoid membranes and connect them with the quality parameters of plant tissue.

Keywords: /Growing substrate/ /Abiotic stress/ /Diagnostic methods/ /Quality parameters/ /SPAD

Murray, K., Aldossari, H., Wu, F., & Warriner, K. (2018). Dynamic changes in free-chlorine levels within a commercial post-harvest wash and prevention of cross-contamination between shredded lettuce batches. *Food Control* 85, 127-134.

Abstract

The dynamic changes in free-chlorine levels within a commercial shredded lettuce washing process and implications for preventing cross-contamination by human pathogens during processing has been determined. The commercial lettuce processing line incorporated a pre-wash in Wash Tank 1 followed by a biocidal wash in Wash Tank 2. Within the commercial wash process, the free-chlorine concentration fluctuated in a cyclic pattern (ranging from 4 to 27 ppm) in Wash Tank 1 but was depleted within Wash Tank 2 (low as 0.1 ppm). Despite the variation in free-chlorine levels the Oxidation Reduction Potential of the wash tanks remained stable and consequently there was no significant correlation to free-chlorine levels and ORP ($r^2 = 0.37$). From analysis of the spent wash water it was found the Chemical Oxygen Demand (COD) was significantly higher in Wash Tank 1 (>5000 mg/l) compared to Wash Tank 2 (800–1001 mg/l). Significantly, both wash tanks operated below the chlorine demand that partly explained the inability to maintain constant free-chlorine levels. In laboratory studies, the spent wash water (containing disinfection byproducts) from the Wash Tanks supported inactivation of *Salmonella* (>3 log cfu reduction), *Listeria monocytogenes* (>4 log cfu reduction) and *Escherichia coli* O157:H7 (1–3 log cfu reduction). By adding chlorine beyond the chlorine breakpoint it was possible to achieve >4 log cfu reduction of the aforementioned pathogens, in addition to minimizing cross-contamination events between batches. The study has illustrated that commercial wash tanks for leafy greens operate below the chlorine breakpoint and hence maintaining specific free chlorine levels would be an unsuitable monitoring metric. Although disinfection byproducts contributed to antimicrobial capacity of the wash tank water it would be challenging to designate a specific limit of free-chlorine for purpose of process monitoring.

Keywords: /Postharvest Wash/ /Chlorine/ /Disinfection Byproducts/

Adator, E. H., Cheng, M., Holley, R., McAllister, T., & Narvaez-Bravo, C. (2018). Ability of Shiga toxigenic *Escherichia coli* to survive within dry-surface biofilms and transfer to fresh lettuce. *International journal of food microbiology*, 269, 52-59.

Abstract

Biofilms are known to play important roles in bacterial survival and persistence in food-processing environments. This study aimed to determine the ability of the top 7 STEC serotypes to form biofilms on polystyrene (POL) and stainless steel (SS) plates and to quantify their survival and transfer from dry-surface biofilms to lettuce pieces. The ability of 14 STEC strains to form biofilms on these two materials at different exposure times and temperatures was assessed using crystal violet, Congo red and

SEM. At 10 °C all serotypes were weak biofilm producers on both surfaces. In contrast, serotypes O45-040, O45-445, O103-102, O103-670 and O157-R508 were strong biofilm producers at 25 °C. Strains O103-102, O103-670, O111-CFS, O111-053 and O157:H7-R508 were expressers of curli. Under scanning electron microscopy, strains O103-670, O111-CFS, O157-R508, and O121-083 formed more discernible multilayer, mature biofilms on SS coupons. Regardless of the surface (POL/SS), all STEC strains were able to transfer viable cells onto fresh lettuce within a short contact time (2 min) to varying degrees (up to 6.35 log cfu/g). On POL, viable cell of almost all serotypes exhibited decreased detachment ($p = 0.001$) over 6 days; while after 30 days on SS, serotypes O45-040, O103-102, O103-670, O111-053, O111-CFS, O121-083, O145-231 O157:H7-R508 and O157:H7-122 were transferred to lettuce. After enrichment, all 14 STEC strains were recovered from dry-surface biofilms on POL and SS plates after 30 days. Results demonstrated that the top 7 STEC remained viable within dry-surface biofilms for at least 30 days, transferring to lettuce within 2 min of exposure and acting as a source of adulteration.

Keywords: /Biofilm/ /Lettuce Contamination/ /Postharvest Losses/

LITCHI

Farina, V., Gentile, C., Sortino, G., Gianguzzi, G., D'Asaro, A., Saletta, F., Piva, G., Inglese, P. and Liguori, G. (2018). Effects of gellan-based coating application on litchi fruit quality traits. *Acta Hortic.* 1194, 335-342.

Abstract

The use of gellan-based coating formulation on litchi (*Litchi chinensis* Sonn. 'Wai Chee') fruit was investigated in order to determine its ability to improve color conservation and to maintain the overall quality. Fruits were treated with gellan-based coating (0.5% w/v) and glycerol (3% w/v) after dipping in ascorbic acid (1.5% w/v) and then stored at 5°C and 90% relative humidity for 15 days. Changes in peel color, soluble solid content, titratable acidity, weight loss, antioxidant activity and phenolic content, were measured. Formulations containing gellan-based coating exhibited slightly improved water barrier properties and showed their active role in maintaining color characteristics and overall quality as compared to the uncoated samples.

Keywords: /Gellan-based Coating/

LOQUAT

Mostafa, Y.S. and Sultan, M.Z. (2018). Calcium chloride combined with antioxidants increases keeping quality and limits postharvest decay of loquat fruit. *Acta Hortic.* 1194, 157-164.

Abstract

Postharvest losses in loquat (*Eriobotria japonica* Lindl.) fruit can result from mechanical damage, browning or fungi infection. The effects of dipping fruit in calcium chloride (CaCl_2) alone or combined with salicylic acid (SA), ascorbic acid (AA) and citric acid (CA) on decay, browning and quality deterioration has been studied. Fruit treated with water (control), 4% CaCl_2 , 4% CaCl_2 + 5 mM salicylic acid (SA), 4% CaCl_2 + 11 mM ascorbic acid (AA), and 4% CaCl_2 + 5 mM citric acid (CA) were packed in commercial perforated (4% ventilation) polyethylene boxes (punnets) and stored at $18\pm 2^\circ\text{C}$ and 55% RH. Fruit skin color, external browning index (EBI), decay, fruit firmness, weight loss, soluble solids content, titratable acidity, ascorbic acid and total phenols were evaluated. The results showed that CaCl_2 alone or combined with antioxidants (especially SA) significantly maintained higher levels of hue angle (h°), reduced both EBI and decay incidence and slowed the weight loss and softening of treated fruits compared to the control. The results suggested that loquat fruit quality can be maintained and shelf life extended up to 18 days at ambient temperature after postharvest dipping in CaCl_2 + SA.

Keywords: /Postharvest of Loquat/ /Browning/ /Antioxidants/

MANGO

Vázquez-Celestino, D., Barba de la Rosa, A.P., González de la Vara, L.E., Vázquez-Barrios, M.E. and Mercado-Silva, E. (2018). Possible role of plasmatic membrane into softening process of 'Manila' mango (*Mangifera indica* L.). *Acta Hortic.* 1194, 439-444.

Abstract

Mexico is the first exporter of mango (*Mangifera indica*) of different cultivars and postharvest behaviors, such as fast loss of firmness. This factor is one of the most critical quality attributes influencing the shelf life and consumer appeal. 'Manila' mango, with high sensory quality, shows a fast softening during postharvest that limits its shelf life. In addition to the general idea that softening results from the enzymatic degradation of cell wall polysaccharides, recent studies suggest that softening is a multifactorial process, among which the integrity/functionality of the plasma membrane plays an important role. In previous work in our research group, we evaluated the effect of postharvest treatments to prevent the softening and with these results establish a model to study the softening process under two opposite conditions, firm and soft fruit. We found that wax coating was the best treatment to delay the softening process and this treatment was used to establish the model of study. The aim of this study was to understand the role of plasma membrane integrity during the softening process of 'Manila' mango. A sample of 108 fruits harvested at 75% maturity was treated with and

without wax coating. Fruits were stored for 9 d at 20°C. The results showed a clear relationship between weight loss and firmness but the electrolyte leakage, lipid peroxidation and PLD activity (26.77-28.93%, $4.69e^{-6}$ - $3.08e^{-6}$ $\mu\text{m cm}^{-1}$ and $5.46e^{-4}$ - $4.67e^{-4}$ μm of choline for control and wax coating, respectively) did not show a clear evidence of deterioration of the plasma membrane, because there was no significant difference between treatments. These findings suggest that the hydric relations in fruits play an important role in the softening process.

Keywords: /Waxing/ /Membrane Integrity/

Wannabussapawich, Bussarin and Kanogwan Seraypheap. (2018). Effects of putrescine treatment on the quality attributes and antioxidant activities of 'Nam Dok Mai No.4' mango fruit during storage. *Scientia Horticulturae* 233, 22-28.

Abstract

This research is aimed at investigating the benefits of the exogenous application of putrescine on the postharvest quality and antioxidant activities of 'Nam Dok Mai No.4' mango. Mangoes harvested at commercial maturity were dipped into 1, 2, and 4 mmol/L putrescine (PUT) for 20 min while distilled water was used as the control. Treated fruit were stored at 14 °C for 9 days and then transferred to storage at 25 °C for 9 days. The 2 mmol/L PUT proved to be the most effective in keeping mango fruit quality intact during fruit ripening. Fruit hardness and titratable acidity (TA) were observed to be higher in treated fruit. The PUT treatment also caused a reduction in weight loss and soluble solids content (SSC). Moreover, 2 mmol/L PUT treated fruit exhibited the maximum superoxide dismutase (SOD), catalase (CAT), guaiacol peroxidase (GPOX), ascorbate peroxidase (APX) and glutathione reductase (GR) activities and total antioxidant contents of fruit during storage. These findings suggest that exogenous application of 2 mmol/L PUT could be an effective treatment for prolonging the storage life and enhancing antioxidant activities of 'Nam Dok Mai No.4' mango after harvest.

Keywords: /Ripening/ /Postharvest/ /Polyamine/ /Reactive oxygen species/

Peerasak, C., Boonsong, S. and Nantha, P. (2018). Optimization of chitosan and gum arabic coating formulations to physicochemical properties of fresh-cut mango. *Acta Hortic.* 1194, 527-536.

Abstract

Fresh-cut mango has a short shelf life storage, which both markets and consumers would like to be longer. Response surface methodology (RSM) was applied to determine the effect of chitosan (0.25-0.5% w/v) and gum arabic (1.0-5.0% w/v) to the physicochemical properties of fresh-cut mangoes to optimize the suitability of edible

coating. 80% mature mangoes were dipped in 200 mg L⁻¹ ethephon for ripening stage and kept at room temperature for 3 days. In the processing, ripe mangoes were washed with 100 mg L⁻¹ peroxyacetic acids and dipped in warm water at 50°C for 5 min. Then the whole fruits were manually peeled with a ceramic sharp knife and cut into 2×2×2 cm³ cubes. Fresh-cut mangoes were coated with the chitosan and gum arabic edible coating in various formulations, placed in polypropylene plastic boxes and covered with nylon/LDPE bags before being stored at 5°C for 5 days. Weight loss, firmness, the total color difference (DE), ascorbic acid content, polyphenol oxidase and phenylalanine ammonia lyase activity were measured as response variables in the experiment. The results showed that the response variable was highly fitted to the regression coefficients (R²) from 0.816 to 0.968 for weight loss, firmness, total color difference, ascorbic acid content, and polyphenol oxidase activity. The optimum concentration of chitosan and gum arabic were predicted to be 0.50 and 4.51%, respectively. Under this optimum condition, there was no significant difference between the predicted and the experimental values. Thus, RSM was an effective tool for identifying optimized coating formulations.

Keywords: /Fruit Quality/ /Room Storage/ /Coating/

Romero-Cano, P.E., Mercado-Silva, E., Vázquez-Barrios, M.E, Zambrano-Zaragoza, M.L., Rivera-Pastrana, D.M. and Arvizu-Medrano, M.S. (2018). Effect of particle size of edible coatings made from carboxymethyl cellulose/starch on the quality of minimally processed mango (*Mangifera indica* L. 'Ataulfo'). *Acta Hortic.* 1194, 561-568.

Abstract

Mexico is the seventh largest producer worldwide and the first exporter of whole mango. However, mango exporters have not been able to take advantage of new markets such as minimally processed product (MMP). There is a lack appropriate technology to maintain the quality of the fresh-cut mango during its storage (15 days at 5°C). The drained intracellular fluids and firmness loss diminish the visual quality and promote the microbial growth, therefore being the main problems for fresh-cut mango. The use of edible coatings (EC) in submicron systems could extend the shelf life of MMP. The aim of this work was to determine the effect of emulsion coatings of carboxymethylcellulose (CMC), starch and α -tocopherol with different particle sizes on quality product. Mango cubes were dipped in the coatings, drained, packed in plastic containers and stored for 16 days at 5°C, physicochemical, microbiological, biochemical and sensory analysis were performed periodically during storage. The particle size of the emulsion was 1203 nm and -17 mV of zeta potential, while the nanoemulsion was 194 nm and -8 mV of zeta potential, indicating stable systems. No significant differences were observed in total soluble solids, acidity and pH but the phenolic content increased during storage time. The PAL activity did not change during storage time and PPO showed the highest activity after 16 days of storage. The content of mesophilic aerobic bacteria increased significantly after 12 days showing a load of ≥ 5.4 log (CFU g⁻¹). The

mangoes coated with nanoemulsion had the best sensory quality and the SEM observation showed a better distribution of the nanoemulsion over fruit. The use of nanotechnology in EC can improve their functional properties and the quality products.

Keywords: /Nanoemulsion/ /Carboxymethylcellulose/

Calderón-Castro, A., Vega-García, M. O., de Jesús Zazueta-Morales, J., Fitch-Vargas, P. R., Carrillo-López, A., Gutiérrez-Dorado, R., ... & Aguilar-Palazuelos, E. (2018). Effect of extrusion process on the functional properties of high amylose corn starch edible films and its application in mango (*Mangifera indica* L.) cv. Tommy Atkins. *Journal of food science and technology*, 55:3, 905-914.

Abstract

Starch is an attractive raw material as ingredient for edible film manufacture because of its low cost, abundant availability, renewability, and biodegradability. Nevertheless, starch based films exhibit several disadvantages such as brittleness and poor mechanical and barrier properties, which restrict its application for food packaging. The use of the extrusion technology as a pretreatment of the casting technique to change the starch structure in order to obtain edible films, may constitute an alternative to generate coatings with good functional properties and maintain longer the postharvest quality and shelf life of fruits. For this reason, the objective of this study was to optimize the conditions of an extrusion process to obtain a formulation of modified starch to elaborate edible films with good functional properties using the casting technique and assess the effect during the storage when applied on a model fruit. The best conditions of the extrusion process and concentration of plasticizers were obtained using response surface methodology. From optimization study, it was found that appropriate conditions to obtain starch edible films with the best mechanical and barrier properties were an extrusion temperature of 100 °C and a screw speed of 120 rpm, while the glycerol content was 16.73%. Also, once applied in fruit, the loss of quality attributes was diminished.

Keywords: /Casting Technique/ /Postharvest Quality/

OKRA

Silva, T.P., Silva, F.C., Neves, L.L.M. and Finger, F.L. (2018). Heat treatment prevents the appearance of chilling symptoms in okra. *Acta Hort.* 1194, 463-468.

Abstract

The aim of this study was to determine the efficiency of hot water treatment to prevent chilling induced browning in okra (*Abelmoschus esculentus*). Okra fruit 'Amarelinho' and 'Mammoth Spineless' were immersed in hot water at 40°C for 15 or 30 min, or left untreated (control). Afterwards, the fruit were stored at 10°C simulating

shipping conditions. Visual analysis, total chlorophyll content and the content of phenolic compounds were evaluated. In addition, the relationship between the activity of catalase and the appearance of chilling injury, as well as the relationship between peroxidase and polyphenoloxidase with enzymatic tissue browning were determined. The longest shelf-life period was achieved when the fruit were treated for 30 min at 40°C. Total pericarp chlorophyll decreased linearly with the length of storage and with the increase of heat treatment in both cultivars. Longer period of storage led to greater concentration of total phenolic compounds in the fruits of both cultivars. The appearance of chilling injury symptoms was not coincident with increase in catalase activity. No relationship was found between the increase in skin browning and polyphenol oxidase and peroxidase activity. Based on the results, skin browning seems to develop by non-enzymatic reactions.

Keywords: /Heat Treatment/ /Chilling Symptoms/

ORANGES

García-Martín, Juan Francisco, Manuel Olmo, José María García. (2018). Effect of ozone treatment on postharvest disease and quality of different citrus varieties at laboratory and at industrial facility. *Postharvest Biology and Technology* 137, 77–85.

Abstract

The effects of continuous and intermittent (simulating a day-night cycle) exposure to ozone enriched atmosphere (from 1.6 to 60 mg kg⁻¹) at 5 °C for 28 d and subsequent shelf life at 20 °C for 15 d on six citrus varieties (two mandarins: Fortune and Ortanique; and four oranges: Navelate, Lanelate, Salustiana and Valencia) were investigated. In vitro and in vivo growth of *Penicillium digitatum* and *Penicillium italicum* was first assessed. Based on the results obtained, continuous 60 mg kg⁻¹ ozone and intermittent 1.6 mg kg⁻¹ ozone were selected for industrial trials, and decay and oleocellosis incidence, colour, firmness, weight losses and juice (content, soluble solids, pH, titratable acidity and vitamin C) were analysed. Results showed that the application of ozone was not detrimental to fruit quality. Furthermore, the application of both continuous and intermittent ozone delayed decay and oleocellosis incidence and slowed down the development of the colouring process, while reducing firmness and weight losses. For industrial applications, the advantage of using ozone 12 h d⁻¹, simulating a day-night cycle, is that workers would not be exposed to ozone inside the cold storage room during the day shift.

Keywords: /Mandarins/ /Oranges/ /*Penicillium digitatum*/ /*Penicillium italicum*/ /Shelf life/

Saberi, Bahareh, John B. Golding, José R. Marques, Penta Pristijono, ... Costas E. Stathopoulos. (2018). Application of biocomposite edible coatings based on pea starch and guar gum on quality, storability and shelf life of 'Valencia' oranges. *Postharvest Biology and Technology*, 137, 9–20.

Abstract

Novel edible composite coatings based on pea starch and guar gum (PSGG), PSGG blended with lipid mixture containing the hydrophobic compounds shellac and oleic acid (PSGG-Sh), and a layer-by-layer (LBL) approach (PSGG as an internal layer and shellac as an external layer), were investigated and compared with a commercial wax (CW) and uncoated fruit on postharvest quality of 'Valencia' oranges held for up to four weeks at 20 °C and 5 °C with an additional storage for 7 d at 20 °C. The incorporation of lipid compounds into the PSGG coatings (PSGG-Sh) generally resulted in the best performance in reducing fruit respiration rate, ethylene production, weight and firmness loss, peel pitting, and fruit decay rate of the coated oranges. Fruit coated with PSGG-Sh and a single layer PSGG coatings generally resulted in higher scores for overall flavor and freshness after four weeks at 5 °C followed by one week at 20 °C than uncoated fruit, as assessed by a sensory panel. Although the LBL coating reduced weight loss and respiration rate with improved firmness retention to a greater extent than the single layer PSGG coating, the bilayer coating also resulted in higher levels of ethanol causing increased perception of off-flavors. Overall results suggested that PSGG-based edible coatings could be a beneficial substitute to common commercial waxes for maintaining quality and storability, as well as extending shelf life of citrus fruit and potentially other fresh horticultural produce.

Keywords: /Biocomposite edible coating/ /Citrus/ /Pea starch/ /Guar gum/ /Postharvest quality/

PEACH

Falagán, N., Artés, F. and Aguayo, E. (2018). Antimicrobial properties of edible coatings enriched with natural additives on fresh-cut peaches. *Acta Hort.* 1194, 519-526.

Abstract

The effect of alginate-based edible coating (EC) as carrier of natural antimicrobial agents on fresh-cut 'Flordastar' peaches was studied. Firmness, sensory properties, microbial counts, total phenols and antioxidant capacity were evaluated. After washing the whole peaches were cut into wedges and four treatments were considered: 1) control, non-treated; 2) wedges were dipped in an alginate-based EC (1 g L⁻¹); 3) and 4) wedges were dipped in the mentioned EC plus natural antimicrobial agents as vanillin (1 g L⁻¹) or trans-cinnamic acid (150 mg L⁻¹), respectively. After these treatments, fresh-cut

peaches were packed under air condition and stored at 5°C for 8 days and 90% RH. Firmness of peaches treated with EC enriched with vanillin and trans-cinnamic acid decreased around 10% of initial values of 12 N, while the control peaches lost nearly 20% of their firmness. Sensory evaluation was more favorable to treated wedges which achieved better scores in texture, visual appearance and browning. The application of vanillin and trans-cinnamic acid increased the taste assessments. These natural additives inhibited the psychrophilic, mold and yeast growth during the 8-day shelf-life. No pathogenic bacteria were detected in any treatments. Regarding total phenol content, the initial concentration reached was of 131.74±3.95 mg gallic acid equivalents in 100 mg f.w. At the end of shelf-life the control wedges lost nearly 25% of this content while treated samples showed a maximum of 5% loss. This result was also observed in the antioxidant capacity response, which presented a similar trend. Definitely, the combination of alginate-base EC and natural antimicrobial agents preserved quality characteristics of fresh-cut peaches, either from sensorial, microbiological or functional points of view.

Keywords: /Shelf Life/ /Edible Coatings/

PEARS

Nascimento, F.V., Almeida, G.K., Silva, S.J.N. and Bender, R.J. (2018). Coatings based on chitosan and carnauba wax for postharvest use on 'Rocha' pears. *Acta Hortic.* 1194, 283-288.

Abstract

Coatings applied to fruit after harvesting stand as alternatives to prolong shelf life. Chitosan postharvest treatments are becoming more customary because of its already recognized fungicidal effects. Carnauba wax is a well-known fruit coating that prevents dehydration and imparts glossiness. Chitosan and carnauba wax films were applied to fresh 'Rocha' pears to evaluate the effects on fruit quality. The following blends were applied manually: T1) control (without any coating); T2) 2% (v/v) chitosan; T3) 2% chitosan + 2% (v/v) glycerol; T4) lipid phase (15%) carnauba emulsion. Then the pears were stored at 0±1°C and 90% RH for 30, 60, 90 or 120 days. After cold storage plus 5 additional days at room temperature the pears were evaluated for weight losses, flesh firmness, epidermal color and internal quality. Epidermal color as indicated by L*a*b* values was not altered by fruit coatings. Weight losses increased and fruit firmness diminished along the evaluation period and coating with the carnauba emulsion and chitosan 2% presented the lowest values. Therefore, chitosan and carnauba coatings should be further studied as potential postharvest treatment to maintain 'Rocha' pear quality under conventional cold storage conditions.

Keywords: /Cold Storage/ /Edible Films/

PERSIMMON

Sakurai, N., Suzuki, T. and Niikawa, T. (2018). Evaluation of crisp texture of persimmon flesh by an acoustic vibration method. *Acta Hortic.* 1195, 189-196.

Abstract

'Taishu' persimmon (*Diospyros kaki*) fruit was introduced to the Japanese market 20 years ago to increase consumption, especially among the younger generation, who prefer fruit with a crisp texture. Fruit firmness, however, did not correspond to crispness scores by a sensory test. Therefore, accurate evaluation of the perceived crisp texture is a prerequisite for research on maintaining high crispness during shipping and storage. Persimmon flesh texture was evaluated using an acoustic measurement of crispness (AMC) method. A wedge-type probe (5 mm diameter) was inserted at 22 mm s⁻¹ into a two cm thick disc of flesh excised from the equatorial plane of the fruit. Vibration of the probe on insertion was detected by a piezoelectric sensor directly attached to the bottom of the probe. Voltage signals from the sensor were amplified for computer analysis. The voltage signals were passed through a half-octave band-pass filter and allotted to 19 bands by a custom-made program. Texture index (TI) was defined as: $TI_i = (f_i^2/n) \times \Sigma(V^2)$, where f_i is a frequency of i^{th} of 19 bands, V is an output voltage from the sensor and n is the data number. TI is physically equivalent to kinetic energy density of probe vibration. Sensory tests showed that the crispness score of the flesh decreased when the fruit was stored at room temperature. TI of 2240 to 25600 Hz decreased during storage. Combined use of 0.06 mm thick polyethylene (PE) film and 1-methylcyclopropane (1-MCP) maintained high crispness scores by sensory test and high TI values above 6400 Hz for 12 days. Changes in sensory score and TI values were very similar under different storage conditions ($r=0.736$ to 0.861). These results suggest that the AMC method objectively evaluates the crispness texture of 'Taishu' persimmon fruit and a combined use of PE film and 1-MCP extends the storage life by maintaining the crisp texture.

Keywords: /Crisp Texture of Persimmon/

Miranda, M. and del Pino, A. (2018). Public-private research linkage in pre-harvest and post-harvest technologies to lead the commercial development of the 'Rojo Brillante' Persimon[®] cultivar. *Acta Hortic.* 1195, 197-202.

Abstract

The 'Rojo Brillante' persimmon cultivar has undergone exponential growth over the last two decades, and this has been accompanied by intense promotion from the growers' associations in the Ribera del Xuquer area of Valencia, Spain, where the

cultivar originated. The aforementioned growers' associations joined Anecoop in order to pool a larger share of this fruit's total yield and put together marketing and research activities to further develop the Persimon® trademark. Different questions have arisen which have had to be addressed during the development of the Persimon® brand. These have mainly focused on post-harvest and pre-harvest processes, and meeting market and consumers' quality standards. One important objective was to extend the harvest period by means of pre-harvest treatments whilst a second major objective centred on improving the procedure for astringency removal. The occurrence of residual astringency and the internal browning of pulp have been solved by improved handling on the packing line and the reduction of chilling injuries during cold storage has been a key factor in extending the marketing period of the 'Rojo Brillante'. Part of the success in solving these problems lies in the close relationship and joint efforts made by all the stakeholders involved, from producers through to market agents. This cooperation has consisted of major R&D investment in packinghouses and laboratories, in human resources via a network of technicians, and joint programmes with public research centres. However, there are still several physiological disorders that need to be solved in the near future. Again, the solution will come from broad-based cooperation between stakeholders and public research centres.

Keywords: /Post-harvest Technology/ /'Rojo Brillante' Persimon/

Palou, L. and Taberner, V. (2018). Evaluation of short postharvest gaseous treatments for inhibition of *Alternaria* black spot of persimmon 'Rojo Brillante'. *Acta Hortic.* 1195, 243-250.

Abstract

Persimmon (*Diospyros kaki* Thunb.) is an expanding crop in Spain. The most important production area is València (about 90% of total planted area) and astringent 'Rojo Brillante' is by far the most planted cultivar. An increasingly important factor limiting storability of persimmon is postharvest decay due to *Alternaria* black spot (ABS) caused by the pathogen *Alternaria alternata*. As in other EU countries, no chemical fungicides are currently approved in Spain for postharvest treatment of persimmon and alternative antifungal treatments are required. The availability of commercial facilities in persimmon packinghouses for fruit deastringency through CO₂ treatments opens the door for potential application of antifungal gaseous treatments. 'Rojo Brillante' persimmons were artificially wound-inoculated with *A. alternata* and exposed 24 h later for 48 h to air at 20°C (ambient atmosphere, control), air at 35°C, 95 kPa CO₂ at 20 or 35°C, or 30 kPa O₂ + 70 kPa CO₂ at 20 or 35°C, all at 90% RH. Incidence (% of infected wounds) and severity (lesion size) of ABS were evaluated after 3, 5, and 10 days of incubation at 20°C and 80% RH. Another lot of treated fruit was cold-stored at 1°C and 90% RH for up to 82 days and fruit quality attributes such as weight loss (WL), firmness, maturity index (MI), and peel color index (CI) were also determined on non-inoculated but treated fruit. After 10 days of incubation at 20°C, none of the gaseous treatments

applied at 20 or 35°C significantly reduced ABS incidence and ABS severity was even higher on some gas-treated persimmons than on control fruit. After 40 days at 1°C, ABS incidence was reduced by 30 to 40% on fruit treated with 95 kPa CO₂ at both temperatures, but these reductions were not significant after 82 days. ABS severity on cold-stored fruit was also greater on gas-treated persimmons than on control fruit. In general, gas-treated and cold-stored persimmons, especially those treated with 95 kPa CO₂, showed lower CI, higher MI and greater firmness than control fruit.

Keywords: /Post-harvest Gaseous Treatment/ /Post-harvest Decay Control/

Novillo, P., Besada, C., Bermejo, A., Navarro, P. and Salvador, A. (2018). Effect of deastringency treatment on carotenoid compounds of persimmon fruit. *Acta Hort.* 1194, 709-712.

Abstract

Nowadays, consumers demand fresh fruits high in bioactive compounds because of their growing concern for health. Carotenoids are important bioactive compounds present in persimmon fruit and the content of these compounds depends on the cultivar. Before marketing fruit from astringent persimmon cultivars are routinely submitted to astringency removal treatments; however, the effect of this process on flesh carotenoids has not yet been studied in depth. This work aimed to evaluate the effect of the deastringency treatment based on high CO₂ concentration on carotenoids content of persimmon fruit. To this end, total and individual carotenoids were determined in four astringent cultivars ('Aizumishirazu-A', 'Hachiya', 'Giombo' and 'Rojo Brillante') at harvest and after fruit submitted to CO₂-deastringency treatment (95% CO₂, 24 h, 20°C, 90% RH). Our results corroborated that the total carotenoids content depends on the cultivar, the highest content at harvest being detected in 'Hachiya' and 'Aizumishirazu-A'. The main carotenoids present in the flesh of persimmons were β -cryptoxanthin, lutein, violoxanthin, zeaxanthin, and β -carotene; in the four studied cultivars, β -cryptoxanthin was the predominant carotenoid. The CO₂-deastringency treatment did not affect the total carotenoids content of 'Rojo Brillante' and 'Hachiya'. However, CO₂ treatment resulted in increased carotenoids content in 'Aizumishirazu-A' and 'Giombo', and lutein and β -cryptoxanthin were the carotenoids that most markedly increased after astringency removal.

Keywords: /Deastringency Treatment/

Taberner, V., Sanchís, E., Mateos, M., Palou, L. and Pérez-Gago, M.B. (2018). Pectin-based edible coatings formulated with pomegranate peel extracts and other antibrowning agents to extend shelf life of fresh-cut 'Rojo Brillante' persimmon. *Acta Hort.* 1194, 887-894.

Abstract

The antioxidant activity and the effects on the physico-chemical and sensory quality of fresh-cut 'Rojo Brillante' persimmon of a pectin-based edible coating formulated with a pomegranate peel extract or other antibrowning agents were compared. Treatments consisted of the pectin-based coating amended with the following anti-browning agents: (1) 15 g kg⁻¹ calcium ascorbate (CaAsc); (2) 10 g kg⁻¹ citric acid (CA) plus 15 g kg⁻¹ CaAsc; (3) 15 g kg⁻¹ aqueous pomegranate peel extract (PG) and (4) 15 g kg⁻¹ PG plus 15 g kg⁻¹ CaAsc. Persimmon slices were dipped in the pectin-based edible coatings or in water (control), packed with macro-perforated film to maintain the ambient atmosphere within the package, and stored at 5°C and 95% RH for up to 9 days. Colour, polyphenol oxidase (PPO) activity, firmness and sensorial quality (visual, overall flavour, off-flavour and firmness) were measured after 2, 5, 7 and 9 days of storage. Coated samples presented lower a* values than control samples, the coatings being amended with PG the most effective to maintain L* during storage, which indicated an effective browning inhibition on fresh-cut persimmon. Only the coatings containing 15 g kg⁻¹ CaAsc significantly reduced PPO activity compared to uncoated samples during 5 days of storage at 5°C. Pectin-based coatings formulated with PG alone or in combination with CaAsc significantly reduced firmness loss of persimmon slices during 5 days of storage at 5°C with respect to control samples. At the end of the storage period, overall flavour was evaluated as excellent for all treatments and fruit were considered neither soft nor firm. Overall, only persimmon slices treated with the coating containing PG and CaAsc were evaluated above the limit of marketability after 7 days of storage.

Keywords: /Antioxidant Edible Coatings/ /Minimally Processed Persimmon/ /Quality/ /Natural Extracts/

PINEAPPLE

Luengwilai, Kietsuda, Diane M. Beckles, Ute Roessner, Daniel A. Dias, ... Jingtair Siriphanich. (2018). Identification of physiological changes and key metabolites coincident with postharvest internal browning of pineapple (*Ananas comosus* L.) fruit. *Postharvest Biology and Technology*, 137, 56–65.

Abstract

Chilling causes biochemical and physiological dysfunction in pineapple fruit, evidently as internal browning (IB). Here, putative biomarkers of the early responses to chilling stress, prior to the appearance of IB, were investigated using a combination of GC–MS profiling and physiological and biochemical assay. Two cultivars – one tolerant and one susceptible – were used, and attention was made to tissue sampling from the early reversible to late irreversible phase of chilling injury. At these stages, electrolyte

leakage and the levels of phenolic compounds were not altered even after prolonged chilling stress; however, changes in ascorbic acid levels and antioxidant activity coincided with IB occurrence. These data suggest that antioxidant capacity and ascorbic acid are the measurable and 'early' responses to IB. The GC–MS metabolite profiling data of chilled pineapple fruit presented here is the first reported. The tolerant pineapple showed greater shifts in metabolism and accumulated higher levels of amino acids and organic acids, especially, valine, cysteine, aspartate and galacturonate. In contrast, the lactic acid content of susceptible cultivar was higher upon chilled storage.

Keywords: /Postharvest chilling injury/ /Internal browning/ /Metabolite profiling/

Sabater-Vilar, M., Suñé-Colell, E., Castro-Chinchilla, J. and Sáenz-Murillo, M.V. (2018). Reduction of postharvest rotting with an ethylene absorbent: a case study with pineapple. *Acta Hortic.* 1194, 721-728.

Abstract

Peduncle mould caused by *Penicillium* sp. in export pineapple is a major postharvest problem in Costa Rica and causes significant economic losses. The accumulation of ethylene in the cooling rooms and transport containers may be a risk factor for fungal growth. Ethylene exposure has been shown to enhance fungal development in other non-climacteric fruit such as strawberry and citrus. This paper assessed the use of a potassium permanganate ethylene absorbent (Bi-On[®], Bioconservacion SA, Spain) in reducing rotting of waxed and unwaxed 'Gold Extra Sweet' pineapple held under export conditions of 25 days at 7.5°C and 85-90% RH with and without aerobic inoculation with *Penicillium* inoculation. The obtained results show that the inclusion of the potassium permanganate absorbent into the storage room significantly reduced ($p < 0.05$) the incidence of peduncle mould after the cold storage followed by shelf-life simulation of 3 days at 18°C and 85-90% RH. There was no significant effect of waxing nor aerial inoculation with *Penicillium purpurogenum* spores on the incidence of rotting. It is concluded that ethylene absorption is an effective method to reduce peduncle rot in stored pineapple without applying fungicides to the fruit.

Keywords: /Postharvest Rotting/ /Ethylene/ /Senescence/

PLUMS AND PRUNES

Martínez-Romero, D., Paladines, D., Valverde, M., Guillén, F., Zapata, P.J. and Valero, D. (2018). Rosehip oil added to Aloe vera gel as postharvest coating of 'Songría' plums and 'President' prunes. *Acta Hortic.* 1194, 321-326.

Abstract

In this study, the effect of two postharvest coatings, Aloe vera at 33% alone or with rosehip oil at 2%, and control (distilled water) was analyzed in two cultivars of plum, *Prunus salicina* 'Songría' and *Prunus domestica* 'President'. Fruit were stored for 28 days at 2°C and 2 days at 20°C and RH of 95% in darkness. Both plums showed a similar behavior in both treatments, both at physiological level (respiration rate and ethylene emission) or at physical and sensory level (firmness, color peel and maturity index). Overall, the coatings were able to delay most of the parameters related to fruit ripening fruits, mainly ethylene production and respiration rate. In addition, treatments maintained a better appearance of the fruit as indicated by lower losses of color, firmness and weight during storage. These results were better when to rosehip oil was incorporated in Aloe gel and fruits were exposed at 20°C. Therefore, the use of these natural compounds could be an effective alternative as postharvest coating to maintain qualitative properties of plums.

Keywords: /Edible Coating/ /Rosehip Oil/

Castillo, S., Giménez, M.J., Valero, D., Valverde, J.M., Guillén, F. and Serrano, M. (2018). Effect of postharvest treatments with salicylates on 'Royal Rosa' plum quality attributes. *Acta Hortic.* 1194, 839-844.

Abstract

The aim of this work was to evaluate the effect of salicylic acid (SA) and acetyl salicylic acid (ASA) applied as postharvest treatments on the evolution of fruit plum quality properties during cold storage. Treatments were performed by dipping the fruits on 1 mM SA or ASA for 10 min. After treatments the fruits were allowed to dry at room temperature and thereafter stored at 2°C and a relative humidity (RH) of 85% for 40 days. Samples were taken after 20 and 40 days of cold storage and then stored for an additional day at 20°C before performing analytical determinations. Parameters related to fruit quality, such as colour, firmness, total soluble solids (TSS) and total acidify (TA) were maintained at higher levels in SA and ASA-treated plums, as compared to controls. These effects are attributed to a delay in the postharvest ripening process, due to a drastic inhibition in the ethylene production rate as a consequence of the treatments. Thus, SA or ASA treatments could be considered as safe and environmentally friendly tools with potential practical application to maintain the plum fruit quality properties and increase the time of storage with high quality attributes.

Keywords: /Storage/ /Ripening/

Pan, H., Wang, L., Wang, R., Xie, F., & Cao, J. (2018). Modifications of cell wall pectin in chilling-injured 'Friar' plum fruit subjected to intermediate storage temperatures. *Food Chemistry*, 242, 538-547.

Abstract

'Friar' plum (*Prunus salicina* Lindl.) fruit were stored at low (0 °C), intermediate (5 and 15 °C) and ambient temperature (25 °C). Flesh translucency was evidenced as the main chilling injury (CI) symptom and the CI developed rapidly at 5 and 15 °C but suppressed at 0 °C. Modifications of cell wall pectin in 'Friar' plums were investigated during storage. Sodium carbonate-soluble pectin (SSP) was found to be predominant in the fruit but it decreased more rapidly at 5 and 15 °C than 0 °C. Nevertheless, SSP possessed abundant galactose, arabinose and rhamnose at 5 and 15 °C. Nanostructural observations indicated that the detachment and degradation of linear backbone chains in SSP molecules were enhanced at 5 and 15 °C. Therefore, the development of CI of 'Friar' plums at intermediate temperatures was associated with the modifications of SSP in the cell wall pectin of the fruit subjected to chilling stress.

Keyword: /Chilling Injury/ /Flesh Translucency/

POMEGRANATE

Babalar, Mesbah, Farhad Pirzad, Mohammad Ali Askari Sarcheshmeh, Alireza Talaei, Hossein Lessani. (2018). Arginine treatment attenuates chilling injury of pomegranate fruit during cold storage by enhancing antioxidant system activity. *Postharvest Biology and Technology*, 137, 31–37.

Abstract

In this study, the impacts of arginine treatment at 0, 0.5, 1 and 2 mM applied by preharvest spray in combination with postharvest immersion, on postharvest chilling injury and nutraceutical properties of pomegranate fruit during storage at 4 ± 0.5 °C for 120 d was investigated. Pomegranate fruit treated with arginine at 1 mM, displayed significantly lower chilling injury symptom manifested by external husk browning. Lower husk browning in pomegranate fruit treated with arginine, caused by lower husk H₂O₂ accumulation, was partially due to higher antioxidant enzymes, superoxide dismutase (SOD), catalase (CAT) and ascorbate peroxidase (APX) activities, leading to higher membrane integrity revealed by lower electrolyte leakage and malondialdehyde (MDA) accumulation. Also, lower husk browning in pomegranate fruit treated with arginine resulted from higher husk phenylalanine ammonia-lyase (PAL)/polyphenol oxidase (PPO) enzymes activity ratio. Moreover, pomegranate fruit treated with arginine displayed higher arils DPPH scavenging capacity, due to higher arils total phenols and anthocyanins accumulation. Also, higher arils PAL/PPO enzymes activity ratio together with lower arils H₂O₂ accumulation was partially due to higher antioxidant enzymes, SOD, CAT and APX activities which are crucial for higher arils DPPH scavenging capacity. In addition, higher arils ascorbic acid content in pomegranate fruit treated with arginine may be attributed to higher glutathione reductase (GR)/APX system activity or

higher anthocyanin accumulation. The results of this study suggest that arginine treatment can be used as promising technology not only for attenuating chilling injury but also for maintaining nutraceutical properties of pomegranate fruit partially by promoting antioxidant system activity.

Keywords: /Antioxidant enzymes/ /DPPH scavenging capacity/ /Husk browning/ / Nutraceutical properties/ /Postharvest/

Candir, Elli, Ahmet Erhan Ozdemir, Mehmet Can Aksoy. (2018). Effects of chitosan coating and modified atmosphere packaging on postharvest quality and bioactive compounds of pomegranate fruit cv. 'Hicaznar.' *Scientia Horticulturae*, 235, 235-243.

Abstract

The objective of this study is to determine effects of chitosan (CH) coating and modified atmosphere packaging (MAP) on postharvest quality and bioactive compounds of 'Hicaznar' pomegranate fruit. Pomegranates were subjected to CH treatment (0% or 1%) and packaged with or without MAP bags. Following treatments, pomegranates were kept at 6 ± 0.5 °C and $90 \pm 5\%$ relative humidity for 6 months. After 2, 4 or 6 months of storage, fruit were removed from cold storage and kept at 20 °C for 7 days to simulate a shelf life period. The untreated fruit was served as a control treatment. CH, MAP and CH + MAP treatments maintained better husk color, titratable acidity (TA) and ascorbic acid (AsA) content, compared to control treatment. CH + MAP and MAP treatments significantly reduced weight loss and husk scald. CH coating alone was the most effective treatment to control fungal decay during cold storage and its effect continued during the shelf life period. The arils of CH-coated fruit were deep red and had highest antioxidant activity, total monomeric anthocyanin (TMA) and total phenolic (TP) content. After 6 months of storage plus shelf life period, control and CH coated fruit became unmarketable while MAP and CH + MAP treated fruit were still marketable. The best results were obtained from CH + MAP treatment for controlling husk scald, decay and weight loss of 'Hicaznar' pomegranate fruits with maintaining visual quality and initial red aril color intensity for 6 months of cold storage plus shelf life.

Keywords: /Pomegranate/ /MAP, Chitosan/ /Quality/ /Bioactive compounds/ /Storage/ / Shelf life/

Schele, M., Huidobro, C., Monsalve, L., Simpson, R., Fuentes, L. and Valdenegro, M. (2018). Biochemical and functional changes in pomegranate fruit (*Punica granatum*) during cold storage. *Acta Hort.* 1194, 445-450.

Abstract

Pomegranate (*Punica granatum*) is a fruit that can be affected by chilling injury. This disorder affects the organoleptic quality of the fruit. A commercial attribute of this fruit is its high content of antioxidants, of which 92% are anthocyanins and tannins. The present investigation tries to determine how certain quality parameters and the antioxidant capacity of pomegranate fruits are affected after being stored for a long period at low temperatures. The novelty is to study the possible influence of ethylene on changes in their functional capacity as defence mechanism to cold, and also to evaluate the effect of different postharvest treatments to prevent chilling injury in this fruit. Different treatments were applied to pomegranates fruits stored in a cold chamber at 2°C, taking samples of all treatments after 20, 60, 100 and 120 days of storage. The following treatments were applied: exogenous ethylene (0.5, 1 and 1.5 $\mu\text{L L}^{-1}$); one competitive inhibitor of ethylene action: 1-methylcyclopropene (1-MCP; 1 $\mu\text{L L}^{-1}$); passive modified packaging in X-Tend bags; a combined treatment (1MCP-X-Tend bags); macro-perforated bags (control treatment) and one group maintained as control at room temperature. At each sampling day, different quality parameters like firmness, colour, acidity and electrolyte leakage, among others, were measured. In addition, the concentration of anthocyanins and tannins were measured. The results indicated that treatment at low temperatures caused an increase in the concentration of anthocyanins in both peel and arils. In the case of peel, an increase of up to 12 times the initial concentration of anthocyanins in the fruits treated with ethylene was observed. For the tannins, a non-significant variation was observed. Although more studies are needed, early results give evidence that in the case of pomegranates, it is possible to increase the concentration of certain antioxidants like anthocyanins after subjecting the fruit to a cold storage or a treatment with ethylene.

Keywords: /Chilling Injury/ /Cold Storage/

POST-HARVEST DISEASES

Kamel, M., Cortesi, P. and Saracchi, M. (2018). The influence of potassium alum, sodium bicarbonate, and chlorine treatments on banana's crown rot disease progress. *Acta Hort.* 1196, 247-254.

Abstract

Crown rot is a post-harvest fungal disease causing significant negative impact on fruit quality. The infection mainly occurs by different etiological agents at harvest time but the symptoms appear 10-14 days later, usually after overseas transportation. The use of synthetic fungicides to control this disease is frequently restricted and regulated in banana farming, therefore it is necessary to find safe alternatives to fungicides that can reduce the incidence under acceptable threshold levels. The effect of potassium alum, sodium bicarbonate and chlorine on crown rot disease progress was assessed on organic bananas against some pathogen strains. Mycelium and conidia of strains

belonging to the main fungal species identified as etiological agents of crown rot in the Dominican Republic were assessed in vitro for germination and growth against different concentrations of the substances to report their activity as fungicidal/fungistatic on artificial media and crown tissues. Results obtained correspond to those reported in disease incidence, whereby the alum mainly acts as fungistatic, the chlorine was fungicidal, and sodium bicarbonate didn't demonstrate any effect on conidia germination at the tested concentration. In packing stations, 240 hands of normally harvested green bananas were used immediately after the second washing bath in three separate treatments: 1) alum as normally adopted in packing stations, 2) 5 g L⁻¹ of sodium bicarbonate in water, and 3) 3 ppm chlorine in water. The results showed significant differences between the different treatments. Sodium bicarbonate improved the infections causing highest disease incidence of 81%, followed by alum with 23% in comparison to the control that showed 19% of symptomatic bananas. In contrast, no symptomatic fruits were present among bananas treated with chlorine.

Keywords: /Post-harvest Disease/ /Protective Treatment/ /Crown Tissue/

Vicent, A., Mira, J.L. and Bassimba, D.D.M. (2018). Fungal diseases of persimmon in semi-arid areas: adaptive strategies and future risks. *Acta Hort.* 1195, 127-132.

Abstract

In east-central Spain, the persimmon-growing area has increased considerably as a result of the popularization of the cultivar 'Rojo Brillante' and the implementation of the postharvest deastringency treatment, which has opened new export markets. Circular leaf spot disease, caused by *Mycosphaerella nawae*, was first described in Japan and is prevalent in Korea. Both areas have a humid subtropical-type climate, with a summer-rainfall pattern and high annual precipitation. In contrast, the climate in the Mediterranean Basin is characterised by dry summers and low annual precipitation, so persimmons can only be grown with irrigation. Epidemiological studies of circular leaf spot in Spain indicated that all infections were caused by ascospores formed in the leaf litter. Ascospores were released mainly in April and May, much earlier than in Korea, and relatively low numbers in June were able to induce severe symptoms on trap plants. Most infections coincided with rains, but the disease was observed also on trap plants exposed to less than 1 mm of precipitation and even in the absence of rain. These results revealed that *M. nawae* managed to adapt to semi-arid conditions mainly by changing the period of inoculum production to coincide with rains and susceptible host availability. Postharvest black spot of persimmon, caused by *Alternaria alternata*, is also responsible of serious yield losses in the Mediterranean Basin. Studies conducted in Spain indicated that the different inoculum sources were broadly distributed in affected orchards and *A. alternata* conidia were highly tolerant to dry periods. Consequently, airborne inoculum was available throughout the growing season. Latent infections in persimmon fruit were more frequent during the three-month period prior to harvest. Finally, the risk of introduction of exotic fungal diseases of persimmon in

semi-arid areas is discussed considering the unforeseen epidemic of circular leaf spot in Spain, which highlights the limitations of climate suitability analyses, especially when based only on limited disease distribution records.

Keywords: /Postharvest Deastringency Treatment/

Siddique, S.S., Hardy, G.E.St.J. and Bayliss, K.L. (2018). Advanced technologies for controlling postharvest diseases of fruit. *Acta Hort.* 1194, 193-200.

Abstract

According to the Food and Agricultural Organization, more than 800 million people still suffer from hunger, yet one third of food produced (equivalent to \$ 1 trillion USD in value) is either lost or wasted globally each year. Postharvest losses are considered a major component of food loss and waste in the food supply chain, from raw production (total harvest) to food consumed. Losses occur due to improper handling, storage, transport, preservation techniques and infection by microorganisms, and can reach up to 45% in fresh fruits and vegetables. Postharvest diseases, particularly of perishable food crops, are predominately caused by fungal pathogens. Management practices for controlling such pathogens include physical, chemical and biological methods in addition to newer technologies such as UV radiation, nano-technology and plasma treatments. Fungicides are the most common management option due to the consistency of results, however, there is increasing demand by consumers for less chemical use, and chemical-free produce can attract premium prices for growers. New technologies are required to reduce postharvest disease losses, without exposing consumers to hazardous chemical residues. This paper reports a novel, non-chemical method for treating postharvest diseases that shows much promise - cold plasma. Our experiments indicate that this method does not have any phytotoxic effects on avocado fruit, but can inhibit pathogens in vitro following an exposure time of 3 min.

Keywords: /Non-chemical/ /Postharvest Diseases/

POTATO

Pristijono, P., Bowyer, M.C., Scarlett, C.J., Vuong, Q.V., Stathopoulos, C.E. and Golding, J.B. (2018). Effect of UV-C irradiation on sprouting of potatoes in storage. *Acta Hort.* 1194, 475-478.

Abstract

Postharvest UV-C irradiation has been shown to alter the postharvest quality of some horticulture crops. In these preliminary experiments, freshly harvested potatoes

(*Solanum tuberosum* 'Innovator') were exposed to UV-C light at five different intensities (0.0, 3.4, 7.1, 10.5 and 13.6 kJ m⁻²). After treatment, potatoes were stored in the dark in air at 20°C and 80% RH for up to 40 days. During storage the potatoes were assessed for the number and length of each sprout at 10 day interval and at the end of 40 days storage, all sprouts were weighed individually. UV-C irradiation significantly affected the number of sprouts. In the first 20 days of storage, the number of sprouts in irradiated potatoes was significantly lower than untreated tubers, however, this effect diminished during storage. UV-C irradiation also affected the sprout length where irradiated potatoes had significantly shorter sprouts than untreated potatoes during storage of 20 days. Similarly this effect diminished over the storage time. The individual weight of the different sprouts was not significantly different between untreated and irradiated tubers. These results indicate promise for UV-C as a potential postharvest treatment to reduce the incidence of sprouting in potato tubers stored in air at 20°C.

Keywords: /UV-C light/ /Postharvest Quality/

SEJE

García-Jiménez, A., Cucaita, N., Gutiérrez-Bravo, R.H., Hernández, M.S. and Fernández-Trujillo, J.P. (2018). The harvest maturity stage as a critical factor for postharvest quality of seje fruit. *Acta Hortic.* 1194, 67-72.

Abstract

Seje (*Oenocarpus bataua*) is an emergent fruit from the Amazon because it is adapted to growing in poor soils but is also rich in excellent quality oil, similar to olive oil, with high quality proteins. Seje fruit is widely used in the Amazon basin and is very important in the diets of the indigenous populations. In the Atrato river basin (Chocó bio-geographical region, Colombia), seje is a dominant palm in the seasonally flooded forests and forms dense, extensive populations. The inhabitants of this region recognize the usefulness of the palm and occasionally use the mature fruit to prepare drinks or to extract oil. The growth and ripening process was established in seje fruit in order to determine the changes of potential maturity indices during development and ripening. The moisture percentage and total acidity decreased slowly from fruit set until week 11. The fat content remained constant at a value of 3 mL 100 g⁻¹ on a dry weight basis (dw) until week 24, increasing thereafter to values of 6 mL 100 g⁻¹ dw at week 50, particularly due to higher levels of unsaturated fatty acids (oleic + linoleic 80%). The electrical resistance in the seje fruit was not useful for monitoring fruit ripening. The seje fruit did not develop flavonoids, saponins or alkaloids during the study period; terpenoids or carotenoid compounds were detected up to week 5. Seje fruit must reach 80% of full maturity on the palm in order to ensure quality and maximum concentrations of fat.

Keywords: /Harvest Maturity Stage/ /Factor for Postharvest Quality/

SQUASH

Megías, Z., Manzano, S., Martínez, C., García, A., Aguado, E., Garrido, D., Reboloso, M.M., Valenzuela, J.L. and Jamilena, M. (2018). Breeding for postharvest cold tolerance in zucchini squash. *Acta Hortic.* 1194, 357-362.

Abstract

Tolerance to postharvest chilling injury (PCI) is an extremely important trait in current zucchini breeding programs, especially for productions that are export-orientated and require therefore refrigerated transport and storage. In the search for new sources of tolerance to PCI, we have screened more than 100 accessions of *Cucurbita pepo*, which had elongated fruit and belonged to morphotypes Zucchini, Vegetable Marrow and Coccozelle. The fruit of the 20 most promising accessions and 5 commercial hybrids was stored for 7 and 14 days at 4°C, and evaluated mainly for PCI, but also for fruit weight loss, and ethylene production. We found that the fruit from commercial hybrids and most of the accessions was very sensitive to cold storage, losing its marketable value after 7 days of storage at 4°C. The fruit of three accessions, CpCAL003, CpCAL051 and CpCAL053, however, showed the lowest PCI index and fruit weight loss in two successive trials, indicating that they were highly tolerant to PCI. We tested the inheritance of PCI tolerance in CpCAL003, and the potential use of this in zucchini breeding programs, by crossing the identified tolerant accession with the cold sensitive CpCAL112, and by evaluating the F₁ and F₂ progenies, as well as the two backcrossing populations BC₁ and BC₂. The results indicate that the PCI tolerance of CpCAL003 is not a monogenic Mendelian trait, but rather a complex polygenic quantitative trait. The lower PCI and fruit weight loss in the fruit of some segregating plants in F₂, BC₁ and BC₂ indicated, however, that this trait could be selected and introgressed in modern hybrid cultivars of zucchini. Moreover, we found that the production of cold-induced ethylene was correlated with PCI and fruit weight loss not only in the different analyzed accessions, but also in the segregating populations (F₂, BC₁ and BC₂), demonstrating that ethylene production can be used as a marker for the selection of PCI tolerance in the present-day zucchini breeding programs.

Keywords: /Postharvest Chilling Injury/

García, A., Manzano, S., Megías, Z., Aguado, E., Martínez, C., Garrido, D., Reboloso, M.M., Valenzuela, J.L. and Jamilena, M. (2018). Use of mutant platforms to discover novel postharvest fruit-quality traits in *Cucurbita pepo*. *Acta Hortic.* 1194, 367-374.

Abstract

Mutant platforms represent a great technological advantage for increasing genetic variability in vegetable crops, thereby improving the identification and selection

of new allelic variants and traits for vegetable breeding programs. At the University of Almeria, we have generated a *Cucurbita pepo* EMS mutant collection composed of about 3,800 M₂ families. To explore the genetic variability of this platform, we are developing massive plant-phenotyping protocols for different traits, including, among others: sex expression, fruit and seed set and development, accumulation of bioactive compounds and resistance to plant pathogens. In this paper we present two screening approaches for the identification of mutants, both of which could improve the postharvest fruit quality of zucchini. Since postharvest chilling injury (PCI) in this species is known to be associated with an induced biosynthesis of both ethylene and oxidative stress metabolites, the mutant collection was screened for both ethylene insensitivity and tolerance to oxidative stress. By using the triple-response assay in etiolated seedlings, we developed a massive screening that allowed the detection of four ethylene-insensitive mutant families. Ethylene-insensitive mutants were found to be affected in sexual expression, fruit set and parthenocarpy, and are also expected to be tolerant to postharvest chilling injury (PCI). A massive phenotyping method has been also developed in order to select oxidative-stress-tolerant mutants. The method was first developed in 10 commercial cultivars by germinating seeds in the presence of hydrogen peroxide (H₂O₂) and the catalase inhibitor aminotriazole (AT). Given that the developed protocol distinguished varieties based on their response to oxidative stress, it has been used to screen the *C. pepo* mutant collection. The identified cultivars and mutants that are more tolerant to oxidative stress during germination and as seedlings are also expected to be more tolerant to abiotic stresses, including PCI tolerance during fruit storage.

Keywords: /Chilling Injury/

STRAWBERRY

Gude, K., Rivard, C.L., Chiebao, H.P., Swaney-Stueve, M. and Pliakoni, E.D. (2018). Preharvest effects on postharvest quality of spring-planted, day-neutral strawberries in high tunnels. *Acta Hortic.* 1194, 91-98.

Abstract

Intensive specialty crop production within high tunnel systems in the Central US has greatly expanded. This production system, along with spring-planted day-neutral strawberries, could provide growers with early and late-season income. We identified which spring-planted, day-neutral strawberry cultivars grown in a high tunnel system perform optimally in regards to yield, quality, storage life, and consumer preferences, while investigating the effect of evaporative cooling on above parameters. The experiment was conducted at Kansas State University Olathe Horticulture Research and Extension Center in 2014. Six commercially-available cultivars were evaluated

('Albion', 'Evie 2', 'Monterey', 'Portola', 'San Andreas', and 'Seascape'). Fruit (90-100% red), was harvested twice weekly and four harvests were evaluated for postharvest quality throughout the season. Strawberries were stored at 3°C for 8 days. Physical and organoleptic quality were evaluated every other day, and nutritional quality was evaluated the day of harvest. Consumer analysis determined overall likeness (9-pt hedonic scale) based on color, flavor, texture, and sweetness. Visual quality, on a scale from 5 (excellent) to 1 (very poor), respiration rate, and water loss was monitored everyday throughout storage. Our results indicate 'Portola', 'Evie 2', and 'Seascape' had significantly high yields ($p < 0.0001$) at 0.603, 0.526, and 0.476 kg plant⁻¹, respectively. 'Portola', 'San Andreas', 'Monterey', and 'Seascape' maintained better visual quality throughout storage life ($p = 0.01$). In support, moisture loss (%) of 'Portola', 'San Andreas', and 'Monterey' was significantly low throughout storage life ($p < 0.001$), with significantly high respiration rate of 'Seascape'. The physical quality of all cultivars was maintained throughout storage life, with the exception of 'Seascape' and 'Evie 2'. Consumer research indicated significantly high overall liking of 'Monterey' and 'Albion' ($p < 0.001$), confirming physical and organoleptic analysis. Little difference was observed among evaporative cooling plots. Our results indicated that growing day-neutral strawberries in a high tunnel in Kansas has potential for success based on yield and quality.

Keywords: /Evaporative Cooling/

Falah, M.A.F., Yuliastuti, P. and Khuriyati, N. (2018). Quality and shelf-life improvement of fresh strawberry (*Fragaria* sp. 'Holibrite') using Aloe vera coating during storage in a tropical environment. *Acta Hortic.* 1194, 665-672.

Abstract

Fresh strawberry (*Fragaria* sp. 'Holibrite') sharply decrease their quality and also have a short shelf-life in a tropical environment conditions. The coating method using Aloe vera was applied to strawberry fruit to preserve their quality and increase their shelf life. Aloe vera is used as a biopolymer coating to cover strawberry fruit skin with standard formulation as gel coating. Different maturity levels of strawberry fruits were used and the quality parameters of fresh strawberry assayed were weight loss percentage, skin texture, water content, titratable acidity, vitamin C and total soluble solid content. Storage temperatures were set at 4°C with RH 62% and 10°C with RH 68% and then compared with the sample at room temperature as control for tropical environment. All quality parameters of strawberry fruit coated using Aloe vera could be kept stable at controlled temperature storage. Moreover, the shelf life of strawberry fruit under controlled storage temperatures was longer than those at tropical environment conditions. Aloe vera coating can preserve quality conditions and increase shelf life of strawberry fruit in a tropical controlled storage temperature and at room temperature.

Keywords: /Aloe vera coating/ /Shelf Life/

Guerreiro, A., Gago, C., Miguel, G., Faleiro, M.L., Panagopoulos, T. and Antunes, M.D. (2018). Potential of strawberry tree fruit (*Arbutus unedo* L.) for fresh consumption and its behavior through storage. *Acta Hortic.* 1194, 941-946.

Abstract

Strawberry tree fruit (*Arbutus unedo* L.) has been used mainly for alcoholic drinks (brandy) and marmalades. The consumption of the fruit as fresh is limited despite their good appearance and flavor. The objective of our work was to evaluate the quality of strawberry tree fruit for fresh consumption and storage. Harvested fruit were stored at 0, 3 and 6°C to study their physic-chemical behavior through storage. Also, some edible coatings made of alginate and enriched with honey and essential oils were used to further improve the storage life. Results showed good quality attributes evaluated by a sensory panel and fruit showed to be rich in antioxidants and vitamin C. Fruit exhibited a climacteric pattern of ethylene production between 3 and 7 days of storage. Temperature of 0°C was the best to preserve most general and nutritional fruit quality parameters. Application of edible coatings improved the storage life with the Al+Cit+Eug treatment, giving the best results.

Keywords: /Postharvest/ /Edible Coatings/ /Microbial Spoilage/

TOMATOES

González-Casado, Sandra, Olga Martín-Belloso, Pedro Elez-Martínez, Robert Soliva-Fortuny. (2018). Enhancing the carotenoid content of tomato fruit with pulsed electric field treatments: Effects on respiratory activity and quality attributes. *Postharvest Biology and Technology*, 137, 113–118.

Abstract

Pulsed electric field (PEF) may be used to elicit the accumulation of carotenoids in plant tissues. The stress-adaptive response to PEF is dependent on the treatments conditions and could lead to undesirable effects on the final quality of tomato fruit. This study was aimed at assessing the changes in the respiratory activity and the main quality attributes of tomato fruit when PEF treatments were used to elicit an increased concentration in their carotenoids content. Whole tomatoes (cv. Raf) were subjected to different electric field strengths (40, 120 and 200 kV m⁻¹) and number of pulses (5, 18 and 30 pulses). After being treated, the fruit were immediately stored at 4 °C for 24 h. Total carotenoids and lycopene concentrations were enhanced by 50% and 53%, respectively, after applying 30 pulses at 200 kV m⁻¹ (2.31 kJ kg⁻¹). Concurrently, a significant improvement in lipophilic antioxidant capacity was observed. At such

treatment conditions, a deceleration in the and , a drop in the ethylene production and the induction of acetaldehyde synthesis were observed, as an evidence of the stress injury caused to tomato tissues. In addition, several quality attributes of tomato were significantly affected. Tomatoes subjected to 200 kV m⁻¹ exhibited the greatest values of total soluble solids and pH, as well as a marked reddening and softening of the fruit. Results suggest that selected PEF conditions could be proposed as a pre-processing treatment to produce tomato-based products with enhanced carotenoid contents.

Keywords: /Pulsed electric fields/ /Antioxidant capacity/ /Carotenoids/ /Quality attributes/ /Respiratory activity/ /Tomato/

Scott, G., M. Dickinson, G. Shama, M. Rugar. (2018). A comparison of the molecular mechanisms underpinning high-intensity, pulsed polychromatic light and low-intensity UV-C hormesis in tomato fruit. *Postharvest Biology and Technology*, 137, 46–55.

Abstract

Postharvest treatment of tomato fruit with high-intensity, pulsed polychromatic light (HIPPL) has previously been shown to induce delayed ripening and disease resistance comparable to that of low-intensity UV-C (LIUV). Little, however, is known of the mechanisms underpinning postharvest HIPPL hormesis in tomato fruit. Expression of genes involved in plant hormone biosynthesis, defence, secondary metabolism and ripening were monitored 24 h post treatment (24 HPT), 10 d post treatment (10 DPT) and 12 h post inoculation with *Botrytis cinerea* (12 HPI). All genes monitored were constitutively expressed and changes in expression profiles following treatment were highly similar for both HIPPL and LIUV treatments. Expression of pathogenesis-related proteins P4, β -1,3,-Glucanase and Chitinase 9 and a jasmonate biosynthesis enzyme (OPR3), were significantly upregulated at 10 DPT and 12 HPI. Both treatments significantly downregulated the expression of polygalacturonase and flavonol synthase at 10 DPT and 12 HPI. Ethylene biosynthesis enzyme ACO1 and β -carotene hydroxylase were significantly upregulated at 24 HPT, and phenylalanine ammonia-lyase (PAL) was significantly upregulated at 12 HPI. Both HIPPL and LIUV treatments stimulate defence responses that are mediated by salicylic acid, jasmonic acid and ethylene. This may lead to broad range resistance against both necrotrophic and biotrophic pathogens as well as abiotic stresses and herbivorous pests. Following inoculation with *B. cinerea* only PAL showed indication of a gene priming response for HIPPL- and LIUV-treated fruit.

Keywords: /Hormesis/ /*Solanum lycopersicum*/ /Pulsed light/ /Gene expression/ /Polychromatic light/

Ran Li, Daqi Fu, Benzong Zhu, Yunbo Luo, Hongliang Zhu. (2018) CRISPR/Cas9-mediated mutagenesis of lncRNA1459 alters tomato fruit ripening. *The Plant Journal* 94:3, 513-524.

Abstract

With the development of high-throughput sequencing, many long non-coding RNAs (lncRNAs) have been found to play important roles in diverse biological processes. However, the biological functions of most plant lncRNAs are still unknown. We have previously discovered a tomato ripening-related lncRNA, lncRNA1459. Here, we cloned the full-length lncRNA1459, giving two transcript isoforms. In addition, lncRNA1459 exhibited a specific location in the nucleus. Furthermore, in order to fully identify the function of lncRNA1459 in tomato ripening, loss-of-function mutants of lncRNA1459 were developed using clustered regularly interspaced short palindromic repeats (CRISPR)/-associated protein 9 (Cas9)-induced genome editing technology. Compared with wild-type fruits, the tomato ripening process was significantly repressed in lncRNA1459 mutants. Ethylene production and lycopene accumulation were largely repressed in lncRNA1459 mutants. Additionally, genes related to ethylene and carotenoid biosynthesis were distinctly downregulated in lncRNA1459 mutants compared with wild-type fruits. Moreover, expression of numerous ripening-related genes was changed significantly when lncRNA1459 was knocked out. Expression of potential tomato ripening-related lncRNAs was also specifically changed after knocking out lncRNA1459. Taken together, these results provide insight into the role of lncRNA1459 in tomato fruit ripening.

Keyword: /tomato/ /fruit ripening/ /lncRNA/ /CRISPR/Cas9/ /full-length/ /subcellular location/

Rodsamran, P., Sothornvit, R., Palou, L. and Pérez-Gago, M.B. (2018). Effect of polysaccharide-based edible coatings incorporated with sodium benzoate on the control of postharvest black spot of organic cherry tomatoes caused by *Alternaria alternata*. *Acta Hort.* 1194, 241-248.

Abstract

Edible composite coatings based on hydroxypropyl methylcellulose (HPMC), commercial carboxymethylcellulose (CMC), CMC from rice stubble (CMCr) or sodium alginate (SA)-lipid were prepared with or without 2% (w/w) of the food preservative sodium benzoate (SB) and evaluated against postharvest black spot caused by the pathogen *Alternaria alternata* on artificially inoculated organic cherry tomatoes during either incubation at 20°C for up to 13 days or storage at 5°C for up to 19 days followed by a shelf life period of 3 days at 20°C. Disease incidence and severity (lesion diameter) were determined during storage and the 'area under the disease progress stairs' (AUDPS) was calculated. The addition of SB did not reduce disease incidence during

incubation at 20°C. However, it significantly reduced black spot severity and AUDPS. Particularly, on fruit incubated at 20°C, the most effective antifungal coatings amended with SB for the control of black spot were those formulated with HPMC and CMCr (both with 10% total solid content (SC)), which reduced AUDPS values from 320 on uncoated tomatoes to 175 and 210, respectively. CMCr-SB coating was also the most effective on cherry tomatoes stored at 5°C, with AUDPS mean values for black spot at the end of the shelf life period of 120 as compared to 360 on uncoated controls. The fact that CMCr was extracted from rice stubble provides a potential use for this industrial by-product.

Keywords: /Postharvest Disease/ /Antifungal Edible Coatings/

Miranda-Linares, V., Escamilla-Rendón, P., Del Real-López, A., González-Reza, R.M. and Zambrano-Zaragoza, M.L. (2018). Solid lipid nanoparticles based edible coating for saladette tomato preservation. *Acta Hort.* 1194, 305-312.

Abstract

Recently, nanotechnology has occupied an important place in the food industry; the reason is that with size reduction there is an increment in surface area which leads to the modification of properties with potential effectivity on fresh fruit and vegetable preservation. The objective of this work was to evaluate the optical characteristics (luminosity, $^{\circ}h$ and a^*), mechanical and adhesion properties as well as the functionality of an edible coating based on lipid solid nanoparticles (SLN) when different concentrations of Candeuba[®] wax was used (5 and 10 g L⁻¹) compared with a xanthan gum coating and control batch with no treatment for preservation and extension of shelf life of fresh tomato fruits ('Saladette' cultivar) in a period of refrigerated storage (12°C) over a period of 26 days. Films prepared with varying concentrations of wax and plasticizer were prepared for mechanical tests where parameters like tensile strength (TS), elongation (%E) and elastic modulus (EM) were determined, showing that the higher the concentration of plasticizer, the higher %E was obtained; in the other hand, ME showed an inverse behavior. Luminosity was evaluated directly on the surface of coated tomato fruits, results showed that there was a 10% decrease in control samples and the ones with SLN while the samples coated with xanthan gum remained constant. Parameters evaluated were: pH, acidity, soluble solids, color changes, lycopene concentration, and mechanical properties as firmness.

Keywords: /Edible Coatings/ /Xanthan Gum/

Forney, C.F., LeBlanc, D.I., Vigneault, C., Toussaint, V., Bourgeois, G., Clément, A. and Bezanson, G. (2018). The interaction of storage temperature and duration on aroma volatiles in tomato fruit. *Acta Hort.* 1194, 343-350.

Abstract

Maintaining good flavor and aroma of fresh tomato (*Solanum lycopersicum*) fruit can be challenging. Storage temperature affects the synthesis of aroma volatiles and holding fruit at chilling temperatures can inhibit volatile synthesis. To gain a better understanding of the role temperature plays in volatile formation during postharvest storage and ripening of tomato, volatile profiles were assessed over a range of temperatures and storage times. Greenhouse grown tomatoes of the cultivar 'Trust' were harvested at the pink to light red stage of ripeness and held at 1, 10, 18 or 24°C and 85% RH. Fruit were sampled for volatile analysis after 0, 3, 6, 10 and 13 d. In addition, at each sampling time fruit were held for an additional 3 or 10 d at 20°C and then sampled for volatile analysis. Volatiles were analyzed from homogenized fruit tissue using headspace-GC-MS. Total volatile concentrations in tomato fruit increased about 3-fold after 10 or more days at 18°C. The most abundant volatile compounds in fruit held for 10 d at 18°C included hexanal, followed by 2-methylbutanol, E-2-hexenal, 6-methyl-5-hepten-2-one, 3-methylbutanal, 2-isobutylthiazole, 3-methylbutanol, geranylacetone, β -ionone, and pentanal. Little change in volatile composition occurred in fruit held at 1 or 10°C for 10 d. However, when fruit held for 3 d at 1 or 10°C were warmed to 20°C for an additional 10 d, total volatile concentration increased 6- and 4-fold, respectively when compared to initial values. In addition, volatile composition was similar to that in fruit held at 18°C, but concentrations were higher. When fruit held for 10 or 13 d at 1 or 10°C were warmed to 20°C for an additional 10 d, volatile synthesis was inhibited. Fruit held at 24°C for 10 d had volatile concentrations similar to those from fruit held at 18°C. While tomato fruit can tolerate chilling temperatures for short durations, prolonged exposures to temperatures below 10°C should be avoided since they can inhibit aroma volatile synthesis and thus impact tomato flavor.

Keywords: /Postharvest Storage/

Franzoni, G., Cocetta, G., Trivellini, A., Angeli, S. and Ferrante, A. (2018). Abscisic acid and carotenoids metabolism in tomato during postharvest. *Acta Hort.* 1194, 381-388.

Abstract

Tomato is one of the most consumed vegetables in the world. Carotenoids are largely appreciated health-related compounds in tomato fruit and are recognized as bioactive substances with powerful antioxidant activity. Lycopene and β -carotene (vitamin A) are the most abundant carotenoids accumulated in the fruit. In the last few years, several studies were carried out on carotenoids focusing on their cleavage products, in particular to abscisic acid (ABA). ABA plays important roles in plants, including regulation of plant growth and development, seed and bud dormancy, apical dominance, senescence abscission and stress responses in both plant and postharvest. In this work we aimed to study ABA metabolic pathway and its related metabolites in the cultivar 'Ailsa Craig'. Tomatoes were grown under controlled conditions, then

fully ripen fruits were collected and maintained at 20°C for two weeks in order to evaluate quality changes during a shelf life period. During shelf life, colour changes, lycopene, β -carotene, ABA, volatile organic compounds (VOCs) from direct headspace GC-MS analyses were evaluated. Lycopene and β -carotene increased during shelf life. The analysis of VOCs allowed identifying the most abundant compounds and changes on the postharvest storage at 20°C. During storage, the 3-methyl butanal, pentanal, 3-methyl-1-butanol and 2-carene, were no longer detectable, while heptane, which was not present at harvest was detected. Moreover, an unknown compound, was detected only at 7 and 14 days of storage.

Keywords: /Storage/

Huang, Y., Lu, R., and Chen, K. (2018). Prediction of firmness parameters of tomatoes by portable visible and near-infrared spectroscopy. *Journal of Food Engineering*, 222, 185-198.

Abstract

Firmness is an important parameter for determining maturity/ripeness and postharvest processing quality of tomatoes. This paper reports on the prediction of different fruit firmness parameters of tomatoes by using visible and near-infrared spectroscopy. Interactance spectra were taken from 600 freshly harvested tomatoes of six maturity stages, using two portable spectrometers which cover the two commonly used spectral regions, i.e., the visible and short-wave near-infrared (Vis/SWNIR) range of 400–1100 nm and the near-infrared (NIR) range of 900–1700 nm, respectively. Different firmness parameters for the tomatoes were measured using acoustic, impact, compression and puncture tests. Partial least squares (PLS) regression models, coupled with four preprocessing methods (i.e., original, logarithmic, autoscale, and logarithmic plus autoscale), were developed to predict the firmness parameters of tomato fruit. The PLS models gave better predictions of impact firmness, compression area and puncture slope for the tomato fruit, with the correlation coefficients for prediction of 0.899, 0.917 and 0.935 for Vis/SWNIR, and 0.846, 0.831 and 0.853 for NIR. Overall, autoscale preprocessing performed better for both Vis/SWNIR and NIR spectra. Visible and near-infrared spectroscopy in interactance mode can be useful for nondestructive assessment of tomato firmness measured by both destructive and nondestructive reference methods.

Keywords: /Visible and near-infrared spectroscopy/ /Tomato/ /Firmness/ /Maturity/ /Prediction/

Dari, L., Nenguwo, N., & Afari-Sefa, V. (2018). Evaluation of packaging liners in wooden and plastic crates for handling tomatoes. *Journal of Postharvest Technology*, 6:1, 36-40.

Abstract

Postharvest losses of tomato are high and can be attributed to a series of factors which include variety of tomato, harvest treatments, packaging materials, handling techniques, transportation and market availability. Standard wooden crates which are perceived as large (about 90%) are used in the packing and transportation of tomatoes in Ghana which often leaves produce smashed due to the size and internal surface of crates. This research was conducted using plastic crates (50, 30 kg) and wooden crates (large and improvised 30 kg) and packaging liners such as jute hessian material, perforated paper and thin latex foam was used to assess which of the treatments would preserve the fruits. From the results, all treatments had percentages of damaged and undamaged fruits at varying levels. Jute lined 30 kg plastic and paper lined wooden crates and paper lined 50 kg both plastic and wooden proved effective in curbing losses better than the remaining treatments. The wooden 50 kg control crate however, had more damaged quantities at 55% than all treatments which had damages ranging between 20 - 50. The use of crates with adequate and suitable packing liners could reduce the quantities of damaged fruits in tomato.

Keywords: /Packaging Liners/ /Postharvest Losses/ /Quality/

TRUFFLE

Marco, P., Campo, E., Oria, R., Blanco, D. and Venturini, M.E. (2018). Effect of lyophilisation in the black truffle (*Tuber melanosporum*) aroma: a comparison with other long-term preservation treatments (freezing and sterilization). *Acta Hort.* 1194, 831-838.

Abstract

The aim of this work was to evaluate the effect of different preservation methods (freeze-drying or lyophilisation, traditional freezing and canning) on the aroma profile of *Tuber melanosporum* truffles. Volatile compounds were extracted by a solid-phase microextraction (SPME) technique and further analysed by gas-chromatography olfactometry, in order to monitor changes occurring in key-aroma compounds as a result of the technology applied. Samples were also submitted to descriptive sensory analysis by a panel of trained judges, and to a preference (ranking) test by a group of truffle experts. Data revealed that the aromatic profile of *T. melanosporum* freeze-drying truffle was less modified with respect to the genuine truffle aroma than the rest of products. Freeze-drying was the only treatment able to keep truffle key-compounds such as dimethylsulphide (DMS) and dimethyldisulphide (DMDS), evoking a typical black olives aroma. On the contrary, several aldehyde compounds (methional, hexanal and Z-4-heptenal) appeared as important odour molecules, which could influence the final aroma of the product. Descriptive analysis and expert's ranking showed the relative proximity among fresh and freeze-drying truffle, and confirmed the deep changes

occurring in aroma as a consequence of the traditional freezing and canning process. Freeze-drying arises therefore as an adequate technique to better preserve the original aroma of fresh truffle.

Keywords: /Preservation Methods/ /Freezed-Drying/ /Truffle Aroma/

VEGETABLES

Poonlarp, P., Boonyakiat, D., Chuamuangphan, C. and Chanta, M. (2018). Improving postharvest handling of the Royal Project vegetables. *Acta Hortic.* 1194, 595-602.

Abstract

The Royal Project Foundation has underlined the importance of the Research and Development in farming vegetables and herbs from the very beginning stage until the products were delivered to end customers. The Royal Project produces were Good Agricultural Practices (GAP) and Good Manufacturing Practice (GMP) certified, which represents safety in the entire food chains from farms through end consumers. This has significantly increased products' capacity to compete both domestically and internationally. Appropriate postharvest management to reduce losses of vegetables in the Royal Project Foundation was conducted by surveying and gathering information on supply chain of five vegetables, namely broccoli, spinach, head lettuce, cabbage and Chinese cabbages. Postharvest losses of vegetables were determined at each stage of the supply chain starting from Chiang Mai province through Bangkok; in the field after harvesting, at the Development Center packinghouse, at Chiang Mai packinghouse, at Bangkok packing house and at the Royal Project retail shop in Bangkok. The results showed that broccoli, spinach and head lettuce postharvest losses were 71.89, 58.66 and 51.32%, respectively. The main factor contributing to losses of broccoli was due to mechanical damage and underutilized parts and/or short of minimum quality standard. Postharvest losses of cabbage and Chinese cabbage were 38.64 and 32.75%, respectively. After applying appropriate postharvest management, for example, temperature control, hygienic cleaning, using active packaging and reducing the duration of the supply chain, postharvest losses of all vegetables were remarkably reduced.

Keywords: /Postharvest Losses/

Chiebao, H.P., Jenott, J.R., Unruh, D.A., Gragg, S.E., Rivard, C.L. and Pliakoni, E.D. (2018). Postharvest treatments to improve quality and safety of locally-grown vegetables stored at non-optimum temperatures. *Acta Hortic.* 1194, 1353-1360.

Abstract

Access to cold storage is limited for vegetable growers in Kansas and recent survey data indicate that 32% have access to cooling facilities with 6% having access to refrigerated trucks. This is a significant barrier for vegetable growers that wish to reach wholesale markets. Modified atmosphere packaging (MAP) is a technique that could supplement refrigeration. The objective of this project was to investigate the effects of passive MAP, and of washing with ozonated water on the quality, safety and storage life of vegetables stored at non-optimum temperatures. Spinach, asparagus, and broccoli were purchased from local farms and six treatments were evaluated from combining unwashed, washed with cold water (4°C) and washed with ozonated water, with the two package types: produce bags, normally found in the supermarket, and passive MAP bags. Samples were stored at 13°C and 85% RH. CO₂ and O₂ concentrations were monitored daily. Every three days, samples were evaluated for visual quality and decay as well microbiological growth. MAP bags equilibrated at an atmosphere of 7% CO₂ and 4-6% O₂; 3.5% CO₂ and 8% O₂ and 12% CO₂ and 3% O₂ for spinach, asparagus and broccoli, respectively. Treatments had no effect on the microbiological growth. The utilization of passive MAP allowed to increase in five and six days the shelf life of spinach and broccoli stored at 13°C, respectively, regardless the type of washing. MAP did not affect the shelf life of asparagus. Passive MAP can be an alternative to extend the shelf of spinach and broccoli life when it is not possible to use the refrigeration.

Keywords: /Modified Atmosphere Packaging/ /Asparagus/ /Broccoli/ /Spinach/ /Ozonated Water/

YELLOW PITAHAYA

Vilaplana, R., Páez, D., Vásquez, W., Viera, W. and Valencia-Chamorro, S. (2018). Hot water treatments to control black rot caused by *Alternaria* sp. in yellow pitahaya (*Selenicereus megalanthus*). *Acta Hort.* 1194, 209-214.

Abstract

Postharvest fungal infections in yellow pitahaya (*Selenicereus megalanthus*) cause the majority of losses during export. Synthetic fungicides are the main strategy for disease control, but constraints associated with the use of this kind of products have led to the search for alternative methods to reduce fungal infections. In this research, the efficacy of hot water dips at several temperatures and times for the control of black rot of yellow pitahaya was assessed by measuring lesion diameter on fruit pre-inoculated with *Alternaria* sp. The results showed that both treatments 50°C for 2 min and the fungicide imazalil (0.4 g L⁻¹) significantly, reduced lesion diameter (62.8 and 71.4% of reduction, respectively) after 21 days of storage at 12°C compared with control fruit (pre-inoculated with *Alternaria* sp. and non-treated). The hot water treatment had no significant effect on fruit physiological quality, with similar results for color, firmness, titratable acidity and solid soluble content (SSC) were obtained on fruit treated with hot water and fruit treated with chemical fungicide. In conclusion, these results indicated

that dips in hot water may provide a non-chemical alternative treatment for postharvest control of black rot caused by *Alternaria* sp. in yellow pitahaya. It is a residue-free method, respectful with human health and environment.

Keywords: /Hot Water Dips/

ZUCCHINI

Megías, Z., González-Rodríguez, L.J., Aguado, E., García, A., Manzano, S., Reboloso, M.M., Valenzuela, J.L. and Jamilena, M. (2018). Effect of cold storage time on chilling injury in two zucchini cultivars. *Acta Hort.* 1194, 479-486.

Abstract

Chilling injury (CI) is one of the most serious problems that reduce the quality of zucchini. Usually the damage increases during exposure to room temperature after cold storage, therefore the aim of this experiment was to evaluate the fruit postharvest quality of two zucchini cultivars when they are transferred to room temperature after different cold storage times. All fruits used were harvested from plants of two commercial hybrids ('Sinatra' and 'Victoria'), grown in the same field trial under standard greenhouse conditions in Almeria, Spain. Fruits of uniform length (18-20 cm) were harvested on the same day in the middle of the productive period with a view to minimizing the effects of environmental conditions. Fruits were stored for two weeks, but under the following conditions: they were randomly divided in 6 different lots of 36 fruits each in order to apply 6 different cold storage times: 2, 3, 5, 7, 10 and 14 days at 4°C. After cold treatments, the fruits were kept at 20°C during 12, 11, 9, 7, 4 and 0 days, respectively, for completing the two weeks of conservation. CI was evaluated after each cold storage (2, 3, 5, 7, 10 and 14 days) and ethylene production and respiration rate were assessed at 0, 7 and 14 days of storage in a lot of fruits of each cultivar and cold storage time. Respiration rate increases gradually during the 14-day experience, regardless of length of cold storage, however, ethylene production reached a maximum peak at 7 days, then ethylene production decreased irrespective of the cold storage time. A different sensitivity to CI was found between the two cultivars, 'Sinatra' being the most sensitive.

Keywords: /Chilling Injury/ /Cold Storage/

Carvajal, F., Palma, F., Jiménez-Muñoz, R., Pulido, A. and Garrido, D. (2018). Changes in the biosynthesis of cuticular waxes during postharvest cold storage of zucchini fruit (*Cucurbita pepo* L.). *Acta Hort.* 1194, 1475-1480.

Abstract

The cuticle is a continuous hydrophobic layer that constitutes an important barrier against the outer conditions. In fruit, the cuticle plays a central role modulating the

growth and development, being also important for the fruit postharvest life. In zucchini fruit (*Cucurbita pepo* L. morphotype zucchini), postharvest cold storage extends their commercial life but also causes chilling injury (CI). Tolerance to this physiological disorder is cultivar-dependent and can also be induced in fruit after different postharvest treatments before cold storage. We present an analysis of the expression of genes implicated in synthesis of cuticular wax in zucchini fruit stored 14 days at 4°C. The aim of this work is to compare this expression in two cultivars with different cold tolerance, and in preconditioned fruit. The results showed that preconditioned fruit had a higher expression of β -ketoacyl-CoA synthase (CER6 and FDH), β -ketoacyl-CoA reductase (KCR), β -hydroxyacyl-CoA dehydratase (PAS2), and enoyl-CoA reductase (CER10) genes; that form the Fatty Acid Elongase (FAE) complex, but no differences were found in ECERIFERUM proteins 1 and 3 (CER1 and CER3), responsible of the alkane-forming pathway. Long-term cold storage diminished the expression of most of the genes analyzed, thus a short-term study would shed more light on these findings.

Keywords: /Postharvest/ /Cold Tolerance/ /Cuticle/ /Wax/