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As of MAY 2020

APPLE

Mditshwa, A., Fawole, O.A., Mokwena, L., Vries, F.A., van der Merwe, K., Crouch, E., Opara, U.L. (2020). Effect of dynamic controlled atmospheres on volatile compound production in 'Granny Smith' apples. ***Acta Horticulturae, 1275, 4. Doi:*** **10.17660/ActaHortic.2020.1275.4**

Abstract

This study investigated the effect of dynamic controlled atmospheres (DCA) on the production of volatile compounds in 'Granny Smith' apples. Fruits were stored in DCA (0.3-0.5 kPa O_2 + 1kPa CO_2) for 12, 16 and 20 wks at -0.5°C, air was used as the control. Gas chromatography-mass spectrometry (GC-MS) was used to analyze volatile compounds from the pulp of the fruit. Total amount of volatiles detected in the control fruit samples were significantly (p<0.05) higher than those exposed in DCA. Production of 1-butanol, 1-hexanol and 1-hexen-ol by fruit stored in DCA were 25, 45 and 27%, respectively, of the amounts detected in the control. DCA treatments also resulted in higher emission of ethanol compared with fruit stored in air. Production of 2-methylpropyl acetate by DCA stored fruit was 19% of that produced by the control fruit. Aldehydes emissions were lower in DCA compared to control fruit. Esters were the main volatiles detected (50%) with the highest emission obtained in the control treatment. The known characteristic flavour volatiles in apples, ethyl hexanoate and hexyl acetate were significantly lower in DCA stored fruit, however, ethyl-2-methylbutyrate was notably higher compared to the control treatment. Titratable acidity loss was significantly reduced by DCA treatments compared to normal regular air storage.

Keywords: /*Malus domestica*/ /dynamic controlled atmosphere/ /volatiles/ /esters/ / fruit quality/

Toivonen, P.M.A. (2020). Factors affecting internal browning of new apple cultivars during storage. ***Acta Horticulturae, 1275, 1. doi:*** **10.17660/ActaHortic.2020.1275.1**

Abstract

Longer term controlled atmosphere (CA) storage of new apple cultivars has led to more frequent observations of diffuse and radial flesh browning but understanding of factors that influence the incidence of these browning disorders is limited. Salish™ apple was used as the model cultivar for this research since it is currently commercially grown in British Columbia. Three commercial orchards were selected to bracket a range of cultural practices seen for this cultivar. Apples were harvested at four different maturities as determined using I_{AD} values. They were stored at 1.5 kPa O_2 + 0.5 kPa CO_2 at 0.5°C for four and seven months and then placed into 30°C, 95% RH for two weeks before assessing internal browning incidence and severity. Internal browning developed in two of the three orchards. In the most susceptible orchard, internal browning was detected in fruit harvested at the most advanced maturity after storage for four and seven months. In the intermediately affected orchard, there was a low incidence at the most advanced harvest maturity but only after seven months of storage. The disorder was clearly associated with harvest maturity. In other experiments, it was determined that delayed cooling (holding at 10°C in air for 10 days before cooling and applying CA) and ultra-low O_2 (0.7 kPa O_2 + 0.5 kPa CO_2 at 0.5°C)

eliminated or significantly reduced incidence of internal browning at seven months, respectively. Internal browning can be managed by earlier harvests (based in I_{AD} index values) and either delayed cooling or ultra-low O_2 CA storage. The orchard effect on susceptibility may be related to relative stress levels of an orchard.

Keywords: /Maturity/ /Preharvest factors/ /Ultra-low oxygen storage/ / internal browning/ /Delayed cooling/

ARTICHOKE

El-Mogy, M. M., Parmar, A., Ali, M. R., Abdel-Aziz, M. E., & Abdeldaym, E. A. (2020). Improving postharvest storage of fresh artichoke bottoms by an edible coating of Cordia myxa gum. *Postharvest Biology and Technology*, *163*, 111143. doi: 10.1016/j.postharvbio.2020.111143

Abstract

This study aimed to prolong the shelf life of fresh-cut artichoke (*Cynara scolymus* L.) bottoms under refrigerated conditions (2 °C and 95 % RH) for a period of 9 d. Fresh artichoke bottoms were subjected to an edible coating of *Cordia myxa* gum (Cg) supplemented with or without calcium dichloride (CaCl2) 1 %, or ascorbic acid (AsA) 1 %. The key postharvest quality parameters which were investigated were weight loss, browning, polyphenol oxidase activity (PPO), firmness, vitamin C, and total phenolic compounds (TPC). Moreover, the microbial load of artichoke bottoms during the storage was also measured which comprised of total aerobic mesophilic and psychrotrophic bacteria, fungi, and *E. coli*.
Results indicated that edible coating with Cg, when supplemented with CaCl2 or AsA, had a significant positive effect on weight loss, vitamin C, and TPC. Browning and PPO activities were significantly inhibited by Cg supplemented with AsA. The mesophilic and psychrotrophic bacterial count was significantly reduced in the presence of CaCl2 with or without Cg. For moulds and *E. coli* control, again Cg in combination with CaCl2 seems to be the most effective treatment. Hence, based on these findings, it can be recommended that postharvest coating Cg supplemented with CaCl2 could be a new application for delaying browning and extending the shelf-life of artichoke bottoms during refrigerated storage. Further research and development are required in commercial settings to test and scale the application of Cg in fresh-cut artichoke bottom industry.
Keywords: /Artichoke/ /Edible coatings/ /Shelf-life/ /Ascorbic acid/ /Calcium chloride/ /*Cynara scolymus*/

AVOCADO

Iñiguez-Moreno, M., Ragazzo-Sánchez, J. A., Barros-Castillo, J. C., Sandoval-Contreras, T., & Calderón-Santoyo, M. (2020). Sodium alginate coatings added with Meyerozyma caribbica: Postharvest biocontrol of Colletotrichum gloeosporioides in avocado (Persea americana Mill. cv. Hass). *Postharvest Biology and Technology*, *163*, 111123. doi: 10.1016/j.postharvbio.2020.111123

Abstract

Edible coatings have been used as a medium for the incorporation of functional compounds and biocontrol agents to postharvest diseases control on fruits and to maintain their quality parameters. However, there are few reports about the use of biocontrol agents entrapped in polymeric matrices; to our knowledge, there is no report of their application to anthracnose control in avocado fruit. Hence the aims

of this study were to investigate the production of volatile organic compounds (VOCs) by *Meyerozyma caribbica* and the ability of the yeast entrapped in sodium alginate (SA) coatings to control anthracnose caused by *Colletotrichum gloeosporioides* Pa14 in avocado fruit. The yeast viability, biocontrol activity, effect on weight loss as well as the efficacy of the bioactive coatings to preserve postharvest quality by prevention or cure of *C. gloeosporioides* infection were assessed. The main VOCs identified were alcohols (1-Butanol, 3-methyl- and phenethyl alcohol) and esters (ethyl acetate). Results revealed SA as a matrix able to maintain the yeast viability during the storage on coated avocado fruit, with minimal reductions between 0.39 and 1 Log10 CFU mL−1, depending on storage conditions. Moreover, it was demonstrated the ability of the yeast to increase its population during the ripening of avocado fruit previously-stored at 6 °C. Films with *M. caribbica* were capable to inhibit *C. gloeosporioides* growth *in vitro*. Meanwhile, *in vivo*, the preventive treatments were more effective than curative treatments in anthracnose controlling; at 25 °C the severity was halved, while at 6 °C the reduction reached 100 %. Additionally, in avocado fruit with the bioactive coatings, the weight loss was reduced by 2–3.7 % respect to the control. In conclusion, this study demonstrates the ability of *M. caribbica* to produce VOCs as a mechanism of action against *C. gloeosporioides*; additionally, SA coatings with *M. caribbica* were effective to reduce the weight loss and its potential as an alternative to control of postharvest diseases in avocado fruit.

Keywords: /Biocontrol agents/ /Postharvest pathogens/ /Subtropical fruits/ /Edible coatings/

Rodríguez-Rivera, R., Herrera-González, J.A., Mercado-Silva, E.M., Vázquez-Barrios, M.E., Rivera-Pastrana, D.M. (2020). Natural coatings and essential oils effects on postharvest quality and antioxidant system of organic avocado (Persea americana Mill. 'Hass'). *Acta Horticulturae, 1275, 21.* doi: 10.17660/ActaHortic.2020.1275.21

Abstract

Avocado (*Persea americana* Mill.) is a commodity highly consumed in America since the pre-Hispanic age. Mexico is the major producer globally with the highest share in the organic market of tree fruits. The most critical food losses in the supply chain take place between farm and fork, due to a lack of, or inadequate strategies oriented to preserve quality and prolong shelf life of vegetable products. Recent evidence support that the application of natural coatings or the use of essential oils (EO) could contribute significantly to preserve quality and extend shelf life of different crops during storage. The objective of this work was to evaluate the application of a commercial organic coating (Natural NDASH Shine 505-OR®) in combination with oregano and thyme essential oils (3 and 5 mL L^{-1}) on avocado postharvest quality (firmness, weight loss, internal and external color) along with total soluble phenols (TSP) and flavonoids (TSF) contents, and its relation with antioxidant capacity (DPPH and ABTS methods) during cold storage at 6°C for 21 days. The application of coatings, with or without EO, showed a 1.5% reduction of weight loss and results on 6 fold firmness values compared with control fruits (without natural coating). No positive correlations of secondary metabolites content like TSP and TSF with antioxidant activity were observed in treated fruits. Nevertheless, antioxidant capacity levels did not exhibited nominal reductions during storage at the reported conditions of this work. The application of natural coatings contributed positively to maintain quality parameters and antioxidant activity of organic avocado.

Keywords: /Natural coatings/ /Organic/ /avocado/ /antioxidant system/

Shezi, S., Tesfay, S.Z., Magwaza, L.S., Mditshwa, A., Motsa, N.M. (2020). Gaseous ozone and plant extract-based edible coatings as postharvest treatments for 'Hass' avocado (*Persea americana* Mill.) fruit. *Acta Horticulturae, 1275, 8. doi:* 10.17660/ActaHortic.2020.1275.8

Abstract

There is a high global demand for reducing the use of chemicals on fruit due to the residue levels which results in serious health concerns. Furthermore, naturally produced plant products and gases are gaining significant interest to consumers as alternative postharvest treatments of fruit. Edible coatings and ozone have been known to have potential in enhancing fruit quality during postharvest fruit storages since they do not pose any health problems after consumption. However, there is no literature regarding the use of edible coating under cold ozonized storage in the postharvest quality of avocado fruit. This research was conducted to evaluate the combined effects of plant-based edible coatings and gaseous ozone in maintaining postharvest quality of avocado (*Persea americana* Mill.) fruit. Hass fruit were treated with moringa 2% in carboxymethyl cellulose (CMC, 1%) and Rosemary 2% in CMC 1% and the fruit was thereafter exposed to two levels of ozone (with and without ozone) in a cold storage chamber with air delivery of 5.5°C for 21 days. Fruit mass loss, firmness and color were measured on 7-day intervals from day 0, 7, 14, 21 and 28. The results revealed significant differences between coated and uncoated fruit under ozone and no ozone storage conditions. Coated avocados significantly reduced mass loss (1.61±0.18%) compared to control (3.12±0.09), retained higher firmness (61.1±1.2 N) than the control (53.9±1.2 N), and slowed down the rate of color change. These findings demonstrated that edible coatings of moringa and rosemary extracts in CMC plus ozonized cold storage prolong shelf-life and maintain overall quality avocados during postharvest life, therefore it is advisable that they are researched further as potential substitutes of chemical treatments in current use.

Keywords: Moringa/ /Rosemary/ /Carboxyl methyl cellulose/ /Ozone/

BLACKBERRY

Horvitz, S., Chanaguano, D. (2020). Microbial and sensory quality of an Andean blackberry (*Rubus glaucus* Benth) cultivar. *Acta Horticulturae, 1275, 17. doi:* 10.17660/ActaHortic.2020.1275.17

Abstract

The “moras de Castilla” (Andean blackberries) are the blackberries most commonly cultivated in Ecuador. They are considered as non-climacteric fruit and thus, they are usually harvested at full maturity. They are also very perishable as rapid mold growth occurs during the postharvest period. The aim of this study was to evaluate the effects of harvest maturity and storage temperature on the microbiological and sensory quality of Andean blackberries. Blackberries were harvested at maturity stages 3 (light red) and 5 (dark purple), packed in PET clamshells (200±10 g) and stored under room temperature (18±2°C) or cold storage (8±1°C). The analyses were performed on days 0, 3, 6, and 9 of storage for sensory (visual quality, color, aroma, firmness and overall impression) and microbiological quality (total aerobic mesophiles, psychrotrophes, and yeasts and molds). Molds and yeasts' growth was the main factor limiting blackberries shelf-life. The counts for this microbial group continuously increased during the storage period, mainly under room temperature. Psychrotrophes were detected only after 6 and 9 days of cold storage in the more immature fruit and, regardless of maturity stage, mesophiles counts were greater in the blackberries stored at 18°C. The more mature fruit received higher scores in the sensory analyses

and were preferred by the panelists as the blackberries harvested at maturity stage 3 were “too firm” and did not develop their full color and characteristic aroma. Based on our results, and even when the Ecuadorian Quality Standard allows to harvest blackberries when they reach the maturity stage 3, the fruit should be harvested at maturity stage 5 and kept under cold storage as refrigeration was effective in delaying microbial growth and in extending the shelf-life period from 3 days at 18**°**C to 8 days in cold storage.

Keywords:/Harvest maturity/ /Cold storage/ /Sensory analyses/

BROCCOLI

Hagen, S.F., Larsen, H. (2020). Shelf life of broccoli in different packages stored under two temperature regimes. *Acta Horticulturae, 1275, 45. doi:* 10.17660/ActaHortic.2020.1275.45

Abstract

Broccoli (*Brassica oleracea* var. *italica*) is a perishable vegetable with limited shelf life, and improved postharvest routines are needed in order to reduce food waste. Although storage at 0-1°C is recommended, broccoli is commonly exposed to a wide temperature range from harvest to consumption in Norway. The aim of this study was to evaluate the performance of three different packaging materials for broccoli, with unpackaged product as control, under conditions that simulate transport, distribution, retail sale and consumer storage. Quality and shelf life were evaluated during 16 days of storage in darkness at 4°C (‘Cold storage’) or during 4 days in darkness at 4°C + 3 days in light at 19°C + 9 days in darkness at 4°C (‘Realistic storage’). The different packages were 1) polypropylene (PP) flowpack film with 40 needle perforations per package, 2) PP flowpack film with a row of 560 needle perforations per 10×10 cm in the middle, and 3) polyethylene (PE) cling film. The respective weight losses for packaged and unpackaged broccoli were <1.2 and 16% after ‘Cold storage’ and <4 and 27% after ‘Realistic storage’. Temperature had little effect on the firmness of broccoli heads, whereas packaged broccoli retained firmness better than unpackaged broccoli. Development of decay (mold, soft rot) was observed in all packaged products during ‘Realistic storage’. ‘Realistic storage’ resulted in severe yellowing of the broccoli flower buds, whereas packaging had little effect on colour deterioration. The results demonstrate the importance of packaging to prevent weight loss and retain firmness in broccoli, but none of the packages tested could prevent yellowing or decay development during the period at room temperature. Hence, to prolong shelf life, broccoli should be packaged and kept cold during the whole distribution chain, including retail display.

Keywords: /Postharvest storage/ /Packaging materials/ /Weight loss/ /Texture/ /Colour/ /Decay/ Quality degradation

Pintos, F. M., Hasperué, J. H., Vicente, A. R., & Rodoni, L. M. (2020). Role of white light intensity and photoperiod during retail in broccoli shelf-life. *Postharvest Biology and Technology*, *163*, 111121. doi: 10.1016/j.postharvbio.2020.111121

Abstract

White light illumination during retail has been suggested as a simple, non-chemical way to extend the

shelf-life of green vegetables. Unfortunately, the influence that key factors like radiation intensity and photoperiod have on the efficacy of such treatments efficacy is barely understood. Herein, we evaluated the influence that the intensity and photoperiod of white light illumination during retail, had on the shelf-life of cold stored broccoli. Broccoli florets were stored at 5 °C and illuminated with white light emitting diodes (LEDs) under three different light intensities (*Low*, 3.6; *Mid*, 9.5; and *High,* 19.0 W m−2). At each light intensity condition samples were subjected to four different light:darkness cycles (3h:21 h;6h:18 h;12h:12 h or 24h:0 h). One set of samples packed and stored at 5 °C, but kept in darkness, was used as a control. After 0, 11 or 19 d of storage we evaluated weight loss, color, chlorophylls, total sugars, sucrose, glucose and fructose contents. We also assessed the changes in ascorbic acid, carotenoids and phenolic antioxidants. *Mid-* and *High-intensity* treatments proved highly beneficial to delay senescence. Storage under *Mid-* and *High-* intensity white LEDs for 3–12 h per day was markedly more effective to prevent yellowing than continuous illumination. Exposure to *Mid-intensity* light, 3 h a day also reduced dehydration, chlorophyll, sucrose, glucose and fructose losses. In addition, broccoli maintained higher levels of ascorbic acid, carotenoids and phenolics at the end of the storage period. These results show that white LED illumination during retail may be used to extend the shelf-life of refrigerated broccoli and set the stage for proper intensity and photoperiod usage.

Keywords: /*Bassica oleracea var. Italica/ /*Light/ /Senescence/ /Chlorophylls/ /Antioxidants/

CABBAGE

Izumi, H. (2020). Viability of chlorine-injured indicator and pathogenic coliform bacteria on fresh-cut cabbage stored in high CO_2 atmospheres. *Acta Horticulturae, 1275, 2.* doi: 10.17660/ActaHortic.2020.1275.2

Abstract

Electrolyzed water containing chlorine can induce bacteria to be in a sublethal, injured state. Sublethally injured indicator and pathogenic coliform bacteria on shredded cabbage were evaluated during storage in air or high CO_2 controlled atmospheres (CA) of 5, 10, and 15% at 10°C and in a modified atmosphere packaging (MAP) using two types of packaging (an equilibrium of 5% CO_2/15% O_2 and 15% CO_2/ 5% O_2) at 5 and 10°C, using the thin agar layer (TAL) method. When shredded cabbage rinsed with electrolyzed water containing 25 ppm available chlorine was stored in a CA and MAP, coliform counts on TAL plates increased 2-3.2 log and 3-4.5 log from the initial counts during storage at 5 and 10°C, respectively, with the increase being greater in low CO_2 atmospheres. The extent of injury ranging from 24 to 87% for the coliform bacteria was detected on samples on the initial day and during subsequent storage irrespective of the CO_2 atmosphere, except for a MAP storage at 10°C. Shredded cabbage was inoculated with chlorine-injured *E. coli* O157:H7 (% injury = 45-65%) by using electrolyzed water containing 1 ppm available chlorine, and then stored in a CA and MAP. Counts of *E. coli* O157:H7 on TAL plates increased 0.5-1.4 log from the initial counts during storage at 10°C, with the increase being greater in high CO_2 atmospheres. Chlorine-injured *E. coli* O157:H7 (% injury = 34-74%) were detected on samples during storage irrespective of the CO_2 atmosphere and temperature. These results indicated that chlorine-injured indicator and pathogenic bacteria on fresh-cut cabbage were capable of exhibiting different degrees of injury during storage regardless of the storage atmosphere and temperature.

Keywords: /Injured bacteria/ /Coliform/ /*Escherichia coli* O157:H7/ /Controlled atmosphere/ /Modified atmosphere packaging/

CARROT

Condurso, C., Cincotta, F., Tripodi, G., Merlino, M., Giarratana, F., & Verzera, A. (2020). A new approach for the shelf-life definition of minimally processed carrots. *Postharvest Biology and Technology*, *163*, 111138. doi: 10.1016/j.postharvbio.2020.111138

Abstract

The shelf-life of minimally processed carrots is considered strictly correlated to the microbial outgrowth and appearance deterioration. However, during storage minimally processed carrots undergo also to a nutritional and sensory quality decay that can affect the consumer's acceptance of the product. This research aimed to verify the importance of considering the interaction between product and consumer's quality perception in the shelf-life definition of minimally processed carrots. For this purpose, changes of the microbial population, pH, aw, carotenoid content, volatile profile, sensory features, and consumer acceptability of minimally processed carrot samples were investigated during 9-day refrigerated storage (labeled shelf-life). The recorded results highlighted that whereas the microbial counts remained below the maximum acceptable contamination values for more than 6 days of storage, significant changes ($P < 0.05$) occurred in most of the considered quality parameters starting already from the 3rd day of storage. This quality decay was perceived also by consumers that, evaluating the global acceptability of the minimally processed carrots attributed significantly ($P < 0.05$) lower scores at samples stored for three days or more. Based on the consumer acceptance/rejection responses, a preference distribution function was obtained by applying the Survival Analysis methodology and a shelf life of four days at 4 °C were estimated. In conclusion, this study demonstrated that the shelf life of fresh-cut carrots is strongly dependent on sensory quality, as a consequence the shelf life estimation based on consumer perception, by the application of the Survival Analysis methodology, resulted to be more reliable than that estimated on the basis of the microbial load of the produce.

Keywords: /Fresh-cut carrots/ /Microbial population/ /Volatile compounds/ /Descriptive sensory analysis/ /Consumers science/ /Survival analysis/

Heltoft, P., Thomsen, M.G. (2020). Effect on storability of pre-storage wound healing in carrot (*Daucus carota* subsp. *sativus*), swede (*Brassica napus*) and celeriac (*Apium graveolens* var. *rapaceum*). *Acta Horticulturae, 1275, 25. doi:* 10.17660/ActaHortic.2020.1275.25

Abstract

After harvest, vegetables go from storing assimilates to break down of assimilates and it is of crucial importance to slow down this process. Controlling the pre-storage period may contribute to maintain high quality in root vegetables during long-term storage. The aim of this 2-years study was to investigate the effect of seven different pre-storage strategies (direct to 0°C vs. down 1°C per day vs. 0.2°C temperature reduction per day and wound healing at 10°C with low/high humidity) on root storability in four cultivars of carrot (*Daucus carota* subsp. *sativus*) stored in 2016/2017/2018, swede (*Brassica napus*) in 2017/2018 and celeriac (*Apium graveolens* var. *rapaceum*) in 2017/2018. Mass loss and disease incidences were

determined during and after long-term storage (6-7 month) in small-scale stores. Wound healing with low humidity resulted in larger mass loss than the other pre-harvest strategies in carrot and celeriac. In carrot, slow temperature reduction (0.2°C per day) also resulted in larger mass loss than the other strategies. Significantly higher numbers of infected roots, dominated by licorice rot (*Mycocentrospora acerina*), tip rot and gray mold (*Botrytis cinerea*), occurred in carrots stored at 0°C immediately compared to roots with a period of wound healing and slow temperature decline. In celeriac, the incidence of gray mold (*Botrytis cinerea*) and licorice rot (*Mycocentrospora acerina*) were significantly reduced with wound healing at low humidity. Storage quality of swede was not affected by pre-storage strategies. This study shows that pre-storage strategies affect mass loss and disease incidence in celeriac and carrot during and after long-term storage.

Keywords: /Storage technology/ /Postharvest diseases/ /Mass loss/

Janmeja, N., Jha, D.K., Arul, J. (2020). Effect of pre-storage UV-B treatment on disease resistance and health-beneficial properties of stored carrots. ***Acta Horticulturae, 1275, 12.*** **doi: 10.17660/ActaHortic.2020.1275.12**

Abstract

UV-B radiation (280-320 nm) is known to elicit multiple protective responses in plants, including antioxidant defense system and synthesis of phenolic compounds. The objective of this work was to investigate the potential of pre-storage treatment with UV-B light to enhance disease resistance and health-beneficial phyto-compounds in carrots. Fresh carrots (LSQUOSun255RSQUO) were treated with UV-B (0.0-14.0 kJ m^{-2}) and stored at 4°C. The disease resistance of treated carrots was determined by challenge-inoculation with *Botrytis cinerea*. The titers of phyto-compounds of significance in disease resistance; the GC-MS secondary metabolite profiles; and the physiological and quality characteristics of treated carrots were monitored at regular intervals during six weeks of storage. The UV-B dose-disease resistance response relationship was bi-phasic, and the hormetic dose of UV-B for the induction of disease resistance was 7.0 kJ m^{-2}, where the disease inhibition was about 70%. The disease resistance strongly related to the accumulation of phytoalexin 6-MM. UV-B treatment also greatly enhanced the accumulation of myristicin, with its titer increasing with increasing UV-B dose. However, the levels of polyacetylenes were not affected significantly by the treatment. Furthermore, the treatment enhanced the levels of phytochemicals, including phenylpropanoids, terpenoids, and iso-coumarins. The initial respiration rate and electrolyte leakage of treated carrots were higher immediately after the exposure to UV-B, which increased with increasing dose; but they gradually decreased to steady state levels comparable to the control. In addition, the weight loss and antioxidant capacity of the treated carrots were not affected significantly during storage. The results suggest a strong potential for pre-storage treatment with UV-B to preserve fresh carrots by controlling diseases, maintaining quality, and enhancing the levels of plant protective and health-beneficial phyto-compounds.

Keywords: /Hormesis/ /*Botrytis cinerea*/ /Disease resistance/ /6-methyoxymellein/ /Phytochemicals/ /Electrolyte leakage/ /Antioxidant capacity/

Larsen, H., Hagen, S.F. (2020). Shelf life of cauliflower in different packages stored under two temperature regimes. *Acta Horticulturae, 1275, 29.* doi: 10.17660/ActaHortic.2020.1275.29

Abstract

In Norway today, cauliflower (*Brassica oleracea* L. var. *botrytis*) is not packaged before distribution and sales in grocery stores. Unpackaged cauliflower heads are prone to weight loss giving rubbery texture, loose florets and yellow and withered leaves. The aim of this work was to evaluate the performance of three different packaging materials for cauliflower with unpackaged product as control. Quality and shelf life was evaluated during 16 days of storage in darkness at 4°C ("Cold storage") or 4 days in darkness at 4°C + 3 days in light at 19°C + 9 days in darkness at 4°C ("Realistic storage"). The different packages were 1: polypropylene (PP) flowpack film with 40 needle perforations ("Low-perf"), 2: PP flowpack film with a row of 560 needle perforations per 10×10 cm in the middle ("High-perf") and 3: polyethylene cling film ("Cling"). The weight loss was 10% for unpackaged cauliflower and below 1% for the packaged products stored at cold conditions for 16 days. At "Realistic storage" conditions, weight loss was 19% for unpackaged cauliflowers, 2.6% for the "High-perf" film and below 1% for the "Low-perf" film and the "Cling" film. "Realistic storage", including 3 days at room temperature, had the highest effect on development of black spots (mold) on the cauliflower heads, whereas limited effect was found for the different packaging materials on black spot development. Packaged cauliflower had firmer heads and better leaf quality than unpackaged samples. Cauliflower may benefit from packaging in order to inhibit weight loss and quality degradation, but packaged products stored for a short period at room temperature have increased risk of black spot development. Cold display in the grocery shops will give the best quality and longest shelf life for both packaged and unpackaged cauliflower.

Keywords: /*Brassica oleraceae* L. var. *botrytis*/ /Abused temperature/ /Packaging materials/ /Perforations/ /Weight loss/ /Quality degradation/

CITRUS

Dündar, Ö., Demircioğlu, H., Belik, M., Özkaya O. (2020). Effect of hot water application on storage and quality properties of 'Miho Wase' mandarin. *Acta Horticulturae, 1275, 62. doi:* 10.17660/ActaHortic.2020.1275.62

Abstract

In this study, hot water application in 'Miho Wase' mandarin was kept for 1 min at 52°C, 1 min at 54°C and 1 min (Control) at 20°C. The fruits were stored for 3 months 2°C temperature and 90% relative humidity. The weight loss, color change, fruit juice, titratable acidity (%), total soluble solids (%), pH, vitamin C (L-ascorbic acid), total fenolic compounds (mg gallic acid L^{-1}), antioksidant activity (%) and decay values of the fruits kept storage were evaluated periodically. Results showed that hot water application had a positive effect on overall quality parameters of 'Miho Wase' mandarin.

Keywords: /Mandarin/ /Storage/ /Hot water/ /Quality/

Wang, S., Ruan, C., Yi, L., Deng, L., Yao, S., & Zeng, K. (2020). Biocontrol ability and action mechanism of Metschnikowia citriensis against Geotrichum citri-aurantii causing sour rot of postharvest citrus fruit. *Food Microbiology*, *87*, 103375. doi: 10.1016/j.fm.2019.103375

Abstract

This study investigated the biocontrol efficiency of *Metschnikowia citriensis* strain FL01 against *Geotrichum citri-aurantii*, and evaluated possible mechanisms. The results showed that *M. citriensis* could effectively control the development of sour rot, and significantly inhibit the mycelial growth and spore germination of *G. citri-aurantii*. The population dynamics results and Scanning electron microscopy (SEM) analysis indicated that *M. citriensis* could rapidly colonize wounds and tightly adhere to the surface of the wounds to compete with *G. citri-aurantii* for nutrition and space. *M. citriensis* also showed the biofilm formation action in vitro. The response of *G. citri-aurantii* to different components of *M. citriensis* culture showed that only the yeast cells but not the extracellular metabolites and the volatile organic compounds (VOCs) exhibited inhibitory effect on the growth of *G. citri-aurantii*. *M. citriensis* adhered to the hyphae of *G. citri-aurantii* loosely and sparsely, and the production of lytic enzymes β-1, 3-glucanase (GLU) and Chitinase (CHI) could not be induced by *G. citri-auranti*. Iron affected the pulcherrimin pigment production and antagonism of *M. citriensis* indicating iron depletion as the most important antagonistic mechanism. Besides, *M. citriensis* also induced resistance of fruit against sour rot. These results suggested that *M. citriensis* could be used as the potential alternative of fungicides to control postharvest pathogens on citrus fruit.

Keywords: /*Metschnikowia citriensis/ /Geotrichum citri-aurantii/ /*Citrus/ /Sour rotIron depletion/

Cheng, Y., Xia, X., Lin, Y., Cao, H., Yao, J., & Li, Z. (2020). Ubiquitylome study highlights ubiquitination of primary metabolism related proteins in fruit response to postharvest pathogen infection. *Postharvest Biology and Technology*, *163*, 111142. doi: 10.1016/j.postharvbio.2020.111142

Abstract

As an important post-translational modification, protein ubiquitination is proven to be involved in plant resistance to pathogens. Postharvest diseases on fruit caused by fungal pathogens lead to huge economic losses worldwide, but fruit resistance remains relatively unexplored compared with well-studied leaf resistance and nothing is currently known ubiquitination in fruit resistance. Here, we report ubiquitylome analysis of citrus fruit infected by *Penicillium digitatum* (*Pd*), a most harmful postharvest pathogenic fungus. *Pd* infection promoted ubiquitination of total proteins in citrus fruit. Based on proteome-wide enrichment of ubiquitination using the anti-K-ε-GG antibody, we identified 4168 Lys ubiquitination sites in 1726 citrus proteins, among which 3082 sites in 1377 proteins were quantified. A total of nine conserved motifs for 2581 unique sites were identified and there was a significant preference for aliphatic residues Ala and Glu at positions adjacent to ubiquitinated Lys residues. Compared with uninfected citrus fruit, 174 sites in 129 proteins and 102 sites in 91 proteins were up-regulated and down-regulated in infected citrus fruit, respectively. Further bioinformatic analysis indicated that ATPases, transporters or pyruvate kinases and dehydrogenases or thioredoxins were preferentially up-regulated and down-regulated, respectively. Noticeably, both up-regulated and down-regulated sites in citrus proteins were mainly enriched in primary metabolic pathways which were affected by *Pd* infection and are proven to involve in plant disease resistance by increasing evidences. Our results reveal the involvement

of ubiquitination, especially ubiquitination of primary metabolism related proteins, in fruit response to postharvest pathogen infection.

Keywords: /Ubiquitination/ /Citrus/ /Fruit resistance/ /Postharvest disease/ /*Penicillium digitatum*/ /Primary metabolism/

CUCUMBER

Pristijono, P., Bowyer, M.C., Scarlett, C.J., Vuong, Q.V., Stathopoulos, C.E., Golding, J.B. (2020) Effect of low pressure storage on the quality of greenhouse cucumbers. ***Acta Horticulturae, 1275, 24. doi:*** **10.17660/ActaHortic.2020.1275.24**

Abstract

Freshly harvested cucumbers (*Cucumis sativus* L.) were stored under low pressure (4 kPa) at 10°C for 7 and 11 days with 100% RH. Upon removal from low pressure storage and after being transferred to normal atmosphere (101 kPa) at 20°C for 3 days, fruits were assessed for weight loss, flesh rots, color, firmness and overall acceptability. Fruit weight loss was significantly higher in fruit which stored at low pressure (4 kPa) for 11 days at 10°C than fruits that were stored at regular atmospheres (101 kPa) at 10°C. The effect of low pressure treatment on fruit weight loss was greater after the additional three days storage at normal atmospheric pressure at (101 kPa) at 20°C. There was no difference in flesh rots, flesh firmness and color retention between fruits stored at low pressure and regular pressure at 10°C for 7 and 11 days. Cucumbers were stored at regular pressure (101 kPa) 20°C for 11 days had highest flesh rots and lowest acceptability compared to other treatments

Keywords: /Storage/ /Postharvest/ /Fresh rots/ / Color/ /Firmness/

FEIJOA

Oseko, J., East, A., Heyes, J. (2020). Can changes in chlorophyll fluorescence be used to determine chilling injury of cold stored feijoa?. ***Acta Horticulturae, 1275, 18. doi:*** **10.17660/ActaHortic.2020.1275.18**

Abstract

Feijoa is a subtropical fruit that has potential for increased export from New Zealand, but its storage life is limited by over-ripening and chilling injury. Physiological indicators that show when plants are experiencing chilling injury before it has become irreversible would be extremely useful, as they would allow remedial steps (such as intermittent warming) to be taken. These indicators would need to be independent of ripening-related changes. Chlorophyll fluorescence analysis (CFA) can be used as an indicator of stress in photosynthetic systems but much remains to be known before application to successfully protect stored products from CI. The objective of this study was to determine if changes in CF could be used to monitor ripening and detect development of chilling injury (CI) of stored feijoa. In the first season of research, a 15% reduction in maximum photochemical efficiency of photosystem II (Fv/Fm ratio) was found during prolonged storage when measured at 2 or 4°C and when fruit were rewarmed after prolonged cold storage the Fv/Fm declined further (0.77-0.656). Data fro/ this season revealed a

decline in CF during storage with about 21% of fruit developing chilling injury after 6 weeks of storage for 'Triumph' feijoa. Intermittent warming to 20°C for 24 h after every 6 or 10 d was assessed as a means of preventing CI development. Decline in Fv/Fm was more in fruit exposed to intermittent warming yet the fruit showed less CI. Results from this study suggest that Fv/Fm is not a good tool to assess CI development in 'Triumph' feijoa since the decline in Fv/Fm preceded CI development and appears more closely related to ripening.

Keywords: /*Acca sellowiana*/ /Intermittent warming/ /chlorophyll fluorescence/

FRUITS AND VEGETABLES

Bihon, W., Coulibaly, A., Chagomoka, T., Sanogo, O., Cisse, F., Ognakossan, K.E., Diouf, O. (2020). Extending the shelf-life of vegetables using low cost evaporative cooling systems in Mali. ***Acta Horticulturae, 1275, 58.*** **doi: 10.17660/ActaHortic.2020.1275.58**

Abstract

Vegetables are nutrient dense and important sources of micronutrients. However, postharvest losses in sub-Saharan African countries range from 20 to 80%. To reduce postharvest vegetables loss, there is a need for affordable and locally available technologies. The aims of this study were a) to compare the efficiency of different zero energy cooling chambers (ZECCs) at reducing temperature, maintaining humidity and prolonging shelf-life of stored vegetables, and b) to assess with farming communities in rural Mali, the efficacy and potential for adoption of different clay pot cooling systems. Different ZECC types (bricks, sacks and straw) as well as clay pots (pot-in-pot, cylinder-pot-in-dish and round-pot-in-dish) were constructed and installed. Temperature and humidity were monitored regularly. Different vegetables were placed in ZECCs and pots in order to assess the effect on shelf-life. The control mimicked the traditional storage practice and similar vegetables were stored using baskets. The results indicated that the ZECC made from bricks significantly reduced temperature and increased humidity up to 90%. The straw and sack ZECCs held less water and thus needed the water replenishing more frequently than the brick ZECCs. The *zeer* pot, the pot-in-pot system provided reduced temperature and an increased humidity. As a result, the shelf life of the vegetables was longer in the brick ZECCs and pots-in-pots followed by the grass. Overall, these results indicated that ZECCs and clay pot evaporative cooling chambers could play significant role in poor, rural communities to improve incomes and income stability by reducing post-harvest losses through extending vegetable shelf-life. Hence, policy makers should promote and enable implementation of these simple technologies in major vegetable producing and small market locations.

Keywords: /Vegetable/ /Postharvest technology/ /Evaporative cooling chamber/ /Clay pots/ /ZECCs/

Du, Z., Zeng, X., Li, X., Ding, X., Cao, J., & Jiang, W. (2020). Recent advances in imaging techniques for bruise detection in fruits and vegetables. ***Trends in Food Science & Technology*****,** ***99*****, 133–141. doi: 10.1016/j.tifs.2020.02.024**

Abstract

Bruising is the most common type of mechanical damage, which is inevitable along the postharvest chain,

including harvesting, sorting, packaging and so on. It's the major cause of postharvest loss. However, the detection of bruises mainly relies on manual inspection which is time-consuming and mistake-prone, especially for the early bruises. In recent years, with the development of computer vision, more and more imaging techniques for real-time and automated bruise detection are proposed and studied again. This review provides an overview of recent advances in imaging techniques for bruise detection. The imaging techniques presented include spectral techniques (biospeckle imaging, hyperspectral/multispectral imaging, fluorescence imaging and structured-illumination reflectance imaging), nuclear magnetic techniques (magnetic resonance imaging and X-ray imaging) and thermal imaging. The basic principles of these imaging techniques and their application in bruise detection are concisely introduced. The imaging techniques mentioned above exhibit potential to detect the bruised tissue and the bruise volume in real time and to overcome the fallibility, tediousness, destructiveness, and time-consumption, which are the disadvantages of traditional methods. In future research, integration of these techniques, developing specific algorithms for bruise detection and attempting to apply them into an assembly line for commercial value will be the research hotpots. In addition, the range of applications of these techniques for fruit and vegetable types also needs to be extended, and applying them in a practically assembly line should be enhanced.

Keywords: /Non-destructive/ /Computer vision/ /Mechanical damage/ /Quality evaluation/ /Agricultural products/

Herrera, A.O., Castellanos, D.A., Mendoza, R., Patiñ0, L.S. (2020). Design of perforated packages to preserve fresh produce considering temperature, gas concentrations and moisture loss. ***Acta Horticulturae, 1275, 26.*** **Doi: 10.17660/ActaHortic.2020.1275.26**

Abstract

In order to properly preserve fresh produce such as fruits and vegetables, the packaging system must have a suitable configuration to reduce its metabolic processes, microbial activity and deterioration. For this, it is necessary to establish an equilibrium modified atmosphere packaging (EMAP) with favorable concentrations of O_2 and CO_2, relative humidity (RH) and storage temperatures that do not result in chilling injury. The EMAP system is established once a balance is reached between the product's metabolism and the gas transfer through the package. For this study, a mathematical model has been developed to estimate the change in gas levels in perforated packages by considering their configuration, the respiration and transpiration in the product, the storage conditions and by using the appropriate mass and heat differential balance equations. From the developed model, a design strategy is proposed to configure the packaging system for a defined product to rapidly establish an EMAP with low O_2 and moderate CO_2 levels in the headspace to reduce the product's metabolic processes and inhibit the microbial growth. Likewise, a high enough relative humidity (80-90%) to avoid excessive water evaporation and weight loss, but minimizing the possibility of saturation inside the package to avoid moisture condensation that contributes to deterioration in the product. To validate the design strategy, two different products, banana and tomato fruits, were taken as example and packaging materials with different permeation rates to O_2, CO_2 and water vapor such as polypropylene (PP), polylactic acid (PLA) and ethylene vinyl alcohol (EVOH) were used to establish a suitable packaging configuration for each product.

Keywords: /Configuration/ /EMAP/ /Mass balance/ /Permeation/ /Respiration/ /Transpiration/

Jasper, J., Wagstaff, C., & Bell, L. (2020). Growth temperature influences postharvest glucosinolate concentrations and hydrolysis product formation in first and second cuts of rocket salad. *Postharvest Biology and Technology*, *163, 111157*. doi: 10.1016/j.postharvbio.2020.111157

Abstract

Rocket salad species (*Diplotaxis tenuifolia* and *Eruca sativa*; also known as *E. vesicaria*) are known for their high concentrations of health-related isothiocyanates, which are derived from secondary metabolites called glucosinolates. Increases in temperature due to climate change and extreme weather event frequencies over the coming decades are likely to influence not only the growth of leafy vegetables, but also their nutritional density. It is therefore essential to determine the impacts of these in order to mitigate crop losses and nutritional decline in future. Our data show there is a strong influence of pre-harvest growth temperatures on glucosinolate biosynthesis and formation of glucosinolate hydrolysis products postharvest, and that this is genotype dependent. High growth temperature (40 °C) severely retarded germination, growth, regrowth, and survival of rocket plants. Highest glucosinolate concentrations were observed in first and second cuts at 40 °C, but did not correspond to highest isothiocyanate concentrations (observed at 30 °C, second cut). Hydrolysis product formation is proportionately not as great as glucosinolate increases at 40 °C, possibly due to inhibition of enzyme function(s) at higher temperatures. These data indicate that high growth temperatures increase glucosinolate accumulation, but growth and productivity is significantly reduced. Much greater emphasis is needed for breeding cultivars tolerant to high growth temperatures in order to maximise nutritional benefits imparted by temperature stress.

Keywords: /Arugula/ /*Diplotaxis tenuifolia/ /Eruca sativa/ /*Liquid chromatography mass spectrometry/ /Abiotic stress/ /Isothiocyanates/

Mahiuddin, M., Godhani, D., Feng, L., Liu, F., Langrish, T., & Karim, M. A. (2020). Application of Caputo fractional rheological model to determine the viscoelastic and mechanical properties of fruit and vegetables. *Postharvest Biology and Technology*, *163, 111147*. doi: 10.1016/j.postharvbio.2020.111147

Abstract

Determination of accurate viscoelastic and mechanical properties of fruit and vegetables (FV) is essential not only for designing appropriate equipment for harvesting, transporting, sorting and storing but also to determine the most appropriate process parameters in any food processing operation. Traditionally, classical models are used to determine these properties, which require many parameters and therefore deemed complex and computationally expensive. Moreover, many of these properties are not available in the literature. In this research, a comprehensive experimental investigation has been carried out to determine some rheological and mechanical properties such as relaxation modulus, apparent modulus, Poisson's ratio and Lame's coefficient of eight different fruit and vegetables using both classical and fractional viscoelastic models. The Caputo Fractional Rheological Model was found to be the better model than the classical models for determining viscoelastic properties as the single element fractional model was found to be sufficient to predict the viscoelastic properties with fewer parameters compared with the three elements classical model. A database of the mechanical properties of different fruit and vegetables have been presented. A relationship between the viscoelastic properties and the porosity has been established. It was also found that the Poisson's ratio of the fruit and vegetables widely varied with

changing loading rates.

Keywords: /Mechanical properties/ /Rheological properties/ /Fresh produce/ /Caputo fractional/ /viscoelastic model/ /Single stage relaxation test/ /Compression test/

Schmittgen, S., Groher, T., Klein, S., Hunsche, M., Noga, G. (2020). Solanaceous crops: a sustainable source of valuable bioactive leaf compounds? *Acta Hortiulturae, 1275, 20. doi:* 10.17660/ActaHortic.2020.1275.20

Abstract

Modern horticulture targets both sustainable food production and non-competitive use of biomass residues for the extraction of bioactive compounds potentially of high interest for both health care and pharmaceutical sectors. Annually, huge amounts of green biomass accrue in sweet pepper and tomato cultivation. These materials contain many different secondary metabolites such as phenolics and isoprenoids. According to their healthy and medicinal properties these plant-based compounds are of high interest for the pharmaceutical, cosmetic and dietary sector. From the plant biochemical perspective, the accumulation of secondary metabolites is a measure of plants to cope with abiotic stress conditions. As well-known example, flavonoids accumulate in leaves due to severe nutritional imbalances, unusually high or extended light exposure, drought or salt stress. Thus, despite manipulation of the growing parameters, a targeted enrichment of specific bioactive leaf compounds is feasible. The determination of highly accumulated amounts and, therefore, of optimal harvest time points can be supported by optical measurement techniques, e.g. fluorescence and hyperspectral devices assessing physiological and biochemical alterations in the plant tissues. In the context of the BioSc project InducTomE (www.biosc.de/inductomewww.biosc.de/inductome) and the recently started BMBF-project TaReCa, we are focusing on the accumulation of flavonoids and isoprenoids during additional lighting and salt stress in sweet pepper and tomato. One aim is to monitor the accumulation of the bioactive compounds using fluorescence and spectral based non-destructive indices as well as standard HPLC analysis. Our first results in tomato show that the content of rutin increased in young leaves under LED light and sodium vapor lamps, while the content of solanesol was significantly enhanced in mature leaves under salt stress cultivation. Metabolic alterations were also triggered in sweet pepper under different light and salt conditions. The changes of plant metabolism were well indicated by the index of epidermal flavonols (FLAV) under light impact and the blue-to-red-fluorescence ratio (BFRR_UV) under salt influence. To ensure the utilization of solanaceous biomass residues, further effective treatments will be identified for triggering the enrichment of bioactive compounds under commercial-like greenhouse production conditions.

Keywords: /Abiotic stress/ /Sustainable horticulture/ /Bio-waste/ /Bio-based compounds/

Walsh, K., Mcglone, V., & Han, D. (2020). The uses of near infra-red spectroscopy in postharvest decision support: A review. *Postharvest Biology and Technology*, *163*, 111139. doi: 10.1016/j.postharvbio.2020.111139

Abstract

This review considers applications of near infrared spectroscopy (NIRS) in context of postharvest decision

support, as opposed to an assessment of NIRS technology, *per se*. Two 'generations' of use are discussed, the first involving the direct assessment of chemical or physical attributes related to postharvest quality at the time of assessment, and the second involving the forward prediction of a postharvest attribute of the fruit or vegetable. A review of statistical functions relevant to sorting is also presented, with consideration given to the measurement error inherent in an estimate based on near infrared spectroscopy and the use of Receiver Operating Characteristic and similar parameters. Case studies involving implementation of NIRS into various aspects of postharvest value chains are presented.

Keywords: /Near infrared spectroscopy/ /NIRS/ /SWNIRS/ /Herschel region/ /Quality/ /Internal defect/ /Sorting/ /Statistics/

GUAVA

Etemadipoor, R., Dastjerdi, A. M., Ramezanian, A., & Ehteshami, S. (2020). Ameliorative effect of gum arabic, oleic acid and/or cinnamon essential oil on chilling injury and quality loss of guava fruit. *Scientia Horticulturae*, *266*, 109255. doi: 10.1016/j.scienta.2020.109255

Abstract

Guava is a perishable fruit and susceptible to low temperatures. In this study, guava fruit were coated with gum Arabic (10 %), oleic acid (1 %) and cinnamon essential oil (1 %). These were used either solely or in combination with each other. Their effects on guava fruit were evaluated during cold storage (at 10 ± 1 °C and 90 % relative humidity) for 28 days. The combination of gum Arabic, oleic acid and cinnamon essential oil (CEO), as an edible coating, significantly delayed the development of browning on guava, as compared to the other treatments. The combined treatment maintained fruit firmness and reduced weight loss. Furthermore, it prevented lipid peroxidation and reduced the electrolyte leakage at the end of storage period. Bioactive compounds such as ascorbic acid, phenolics, flavonoids and antioxidant activity were higher in fruit treated with combined formulation. Also, higher levels of TSS and TSS/TA ratio, along with lower TA, were observed in these fruit. The combination of gum Arabic, oleic acid and CEO effectively ameliorated the changes in quality during cold storage. Combination of gum Arabic, oleic acid and CEO could be a useful edible coating for preventing chilling injury and ameliorating changes in bioactive compounds of guava fruit.

Keywords: /Browning/ /Ascorbic acid/ /Antioxidant activity/ /Malondialdehyde/ /Phenolic compound/

LETTUCE

Pongprasert, N., Jitareerat, P., Srilaong, V. (2020) Effect of carbon dioxide micro bubbles in combination with chlorine dioxide solution to reduce microbial contamination and browning of fresh-cut cos lettuce (*Lactuca sativa* L.). *Acta Horticulturae, 1275, 6*. doi: 10.17660/ActaHortic.2020.1275.6

Abstract

In this research, the effect of carbon dioxide micro bubbles (CO_2-MBs) in combination with chlorine dioxide solution (ClO_2) to reduce microbial contamination and maintain the quality of fresh-cut cos lettuce

was investigated. Fresh-cut cos lettuce was washed in 5 ppm ClO_2 for 5 min and compared with CO_2-MBs + 5 mg L^{-1} of ClO_2. Fresh-cut cos lettuce washed in water (5 min) were used as control. Treated lettuce then was packaged in modified atmosphere packaging (MAP) and stored for 10 days at 4°C. Initially, ClO_2 water and CO_2-MBs combined with ClO_2 reduced the total mesophilic population by 1 log reduction. However, treated lettuce washed in CO_2-MBs + ClO_2 showed lower amount of total bacteria count after 2-10 days of storage. Washed with CO_2-MBs + ClO_2 also inhibited the growth of yeast and mold and coliform bacteria during storage. ClO_2 solution treatment activated browning symptom as compared with control. However, CO_2-MBs + ClO_2 reduced browning symptom of fresh cut lettuce compared with ClO_2 water alone. The amount of phenolic compounds of the fresh cut lettuce was reduced by CO_2-MBs + ClO_2 treatments. Washing with CO_2-MBs + ClO_2 also reduced PPO activity as compared with washing in ClO_2 alone which is correlated with a high value of L* and a lower browning score during storage. An inhibitory effect of browning enzyme and substrate resulted in a lower browning symptom of fresh-cut lettuce during storage. This result indicated that CO_2-MBs + ClO_2 could be an alternative method to ClO_2 for fresh-cut cos lettuce due to a bacterial inhibitory effect and reduction of the adverse effect of ClO_2 to browning.
Keywords: /Carbon dioxide micro bubbles/ /Chlorine dioxide/ /Fresh-cut lettuce/ /Browning LOTUS/

Ali, S., Khan, A. S., Anjum, M. A., Nawaz, A., Naz, S., Ejaz, S., & Hussain, S. (2020). Effect of postharvest oxalic acid application on enzymatic browning and quality of lotus (Nelumbo nucifera Gaertn.) root slices. *Food Chemistry*, *312*, 126051. doi: 10.1016/j.foodchem.2019.126051

Abstract

Post-cut surface browning is one of the major constraints for shelf-life extension of lotus root slices. In the present study, lotus roots slices were treated with 0, 5 and 10 mmol L−1 oxalic acid and stored at 20 ± 1 °C for 5 days. Results showed that 10 mmol L−1 oxalic acid treated lotus slices exhibited reduced browning, superoxide anion, hydrogen peroxide, electrolyte leakage and malondialdehyde content than control. The 10 mmol L−1 treated slices had better visual quality and higher ascorbic acid and total phenolic contents. In addition, 10 mmol L−1 treated slices showed reduced total bacterial count along with lower soluble quinones, peroxidase and polyphenol oxidase activities in contrast to control. Similarly, 10 mmol L−1 treatment showed higher superoxide dismutase, catalase and ascorbate peroxidase activities as compared to control. In conclusion, 10 mmol L−1 oxalic acid application could be considered suitable to delay post-cut browning of lotus root slices.

Keywords: /Fresh-cut/ /Lipid peroxidation/ /Oxidative stress/ /Polyphenol oxidase/ /Visual quality/

LONGAN

Lin, Y., Lin, H., Lin, M., Chen, Y., Wang, H., Fan, Z., … Lin, Y. (2020). Hydrogen peroxide reduced ATPase activity and the levels of ATP, ADP, and energy charge and its association with pulp breakdown occurrence of longan fruit during storage. *Food Chemistry*, *311*, 126008. doi: 10.1016/j.foodchem.2019.126008

Abstract

The effects of hydrogen peroxide (H_2O_2) on the contents of adenosine triphosphate (ATP), adenosine diphosphate (ADP) and adenosine monophosphate (AMP), the level of energy charge, and the activity of

adenosine triphosphatase (ATPase) in pulp of harvested longan fruit, and its association with longan pulp breakdown occurrence were studied. The results showed that, compared to the control longans, H_2O_2-treated longans exhibited a higher index of pulp breakdown, a higher amount of AMP, but lower levels of ATP, ADP and energy charge. H_2O_2-treated longans also exhibited lower activities of Mg^{2+}-ATPase, Ca^{2+}-ATPase, and H^+-ATPase in mitochondrial membrane, vacuolar membrane, and plasma membrane as compared to the control longans. Above findings demonstrated that H_2O_2 caused longan pulp breakdown by depleting energy and lowering the ATPase activity, indicating H_2O_2-induced pulp breakdown in harvested longan fruit was due to energy deficit.

Keywords: /Longan fruit/ /Pulp breakdown/ /Hydrogen peroxide/ /Energy metabolism/ /Energy level/ /ATPase/

MANGO

Emongor, V.E., Pholoma, S.B., Tshwenyane, S.O. (2020). Hot water treatment and duration alleviates chilling injury of mango (*Mangifera indica* L.). *Acta Horticulturae, 1275, 38.* doi: 10.17660/ActaHortic.2020.1275.38

Abstract

Low temperature storage is the most effective method of extending postharvest life and marketing period and maintain fruit quality. Unfortunately, for chilling injury (CI) sensitive fruits, low temperature storage may be detrimental due to CI which reduces fruit quality and customer acceptance, limits marketing and compromises storage for long periods. The effects of storage temperature and hot water at various temperatures and durations on alleviation of mango chilling injury were evaluated on 'Keitt' mango fruit cultivar in Botswana. Mango fruit at physiological maturity were dipped in water at room temperature (25±2°C-control), or in a hot water bath (50 and 55°C for 3, 5 or 10 min) and subsequently stored at 4, 7, 10, 13 or 25±2°C (95% relative humidity). Storage temperature, hot water treatment temperature and duration significantly (P<0.05) influenced the mango CI incidence and severity. As storage temperature decreased below 13°C, CI injury increased. As water temperature and treatment duration increased CI incidence and severity significantly (P<0.05) decreased. There was a significant (P<0.05) effect of the storage temperature and water temperature interaction on mango proline content and electrolyte leakage immediately after cold storage and after a 7-day shelf life period. As the storage temperature and water temperature decreased, the proline content and electrolyte leakage increased significantly (P<0.05).

Keywords: /Storage temperature/ / Hot water/ /Duration/ / Chilling injury/ /Mango/

Liu, S., Huang, H., Huber, D. J., Pan, Y., Shi, X., & Zhang, Z. (2020). Delay of ripening and softening in 'Guifei' mango fruit by postharvest application of melatonin. *Postharvest Biology and Technology*, *163*, 111136. doi: 10.1016/j.postharvbio.2020.111136

Abstract

Melatonin (MT) functions as an important bio-active molecule in diverse physiological processes in higher plants. In the present study the role of MT in modulating ripening and softening in relation to ethylene and abscisic acid (ABA) biosyntheses in stored mango fruit was evaluated. The results showed that

application of MT (0.5 mM, immersion for 1 h) to ‘Guifei’ mangoes effectively delayed the changes in ripening parameters including firmness, pulp color, β-carotene levels, soluble solids content (SSC), titratable acidity (TA) and respiration rate. MT markedly delayed climacteric ethylene production and 1-aminocyclopropane-1-carboxylic acid (ACC) levels in mango fruit during storage, likely a consequence of reduced activities of ACC synthase (ACS) and ACC oxidase (ACO). MT treatment resulted in delayed accumulation of ABA through reducing activity of a key ABA biosynthetic enzyme (9-cis-epoxycarotenoid dioxygenase, NCED). MT treatment suppressed the changes in activities of pectin-modifying enzymes including polygalacturonase (PG), β-galactosidase (β-Gal) and pectin methylesterase (PME), and limited the solubilization and depolymerization of pectin polysaccharides. The results indicate that MT could be involved in modulation of ripening and softening in mango fruit through inhibiting the biosyntheses of ethylene and ABA.

Keywords: /Mango/ /Softening/ /Melatonin/ /Ethylene biosynthesis/ /Polygalacturonase/

Pristijono, P., Bowyer, M.C., Scarlett, C.J., Vuong, Q.V., Stathopoulos, C.E., Golding, J.B. (2020). Postharvest UV-C treatment affects peel degreening 'Kensington Pride' mango fruit stored at 20°C. *Acta Horticulturae, 1275, 30. doi:* 10.17660/ActaHortic.2020.1275.30

Abstract

Ultraviolet irradiation (100-400 nm) has been reported to have beneficial effects on maintaining the postharvest quality of horticultural produce. Specially, a short-term pre-storage treatment with UV-C (180-280 nm) has been shown to extend the postharvest shelf-life of many horticulture crops. In this preliminary experiment, mature green 'Kensington Pride' mangoes (*Mangifera indica* Linn.) were exposed to UV-C light at four different intensities 0, 4.0, 8.3 and 11.7 kJ m^{-2}, and stored for 7 days at 20°C. After storage, fruit were assessed for skin color, flesh color, flesh firmness, soluble solids content (SSC) and titratable acidity (TA). The results showed that the rate of peel degreening following UV-C treatment and storage at 20°C was significantly lower than untreated fruit. This response was dose dependent, where increasing levels of UV-C irradiation resulting in slower peel degreening. UV-C irradiated fruits also remained significantly firmer than untreated fruits. In addition, UV-C treatment also significantly affected the flesh color, SSC and TA levels. These results show that a pre-storage UV-C irradiation treatment could be a potential postharvest treatment that can delay the peel degreening and other associated ripening related events in 'Kensington Pride' mango fruit when handled and stored at 20°C.
Keywords: /Storage/ /Peel degreening/ /Color/ /Firmness/

MELON

Chen, C., Zhang, H., Zhang, X., Dong, C., Xue, W., & Xu, W. (2020). The effect of different doses of ozone treatments on the postharvest quality and biodiversity of cantaloupes. *Postharvest Biology and Technology*, *163*, 111124. doi: 10.1016/j.postharvbio.2020.111124

Abstract

Although cantaloupes are extremely popular fruits, they are prone to easy decay and present potential vehicles for foodborne disease transmission. This study examined the effects of different doses of ozone treatments on the postharvest quality of cantaloupes during storage. These results revealed that

cantaloupe subjected to the appropriate dose of ozone (15.008 mg m−3) displayed lower respiration rate, ethylene production rate, and the number of microorganisms, as well as higher levels of firmness, pectin content, reducing sugar and titratable acidity of both the sarcocarp and exocarp. Next-generation sequencing results showed that this particular ozone dose inhibited most genera responsible for cantaloupe decay and human pathogenicity to a certain extent. Principal component analysis, as well as the analysis of co-occurrence network patterns further confirmed that an ozone dose of 15.008 mg m−3, improved and prolonged the postharvest quality of cantaloupe.

Keywords: /Cantaloupe/ /Ozone/ /Dose/ /Postharvest quality/ /Biodiversity/

MUSHROOM

Ikiz, O. Sen, F., Yuzel, Y., Eren, E. (2020). Effects of citric and ethylenediaminetetraacetic acids on brown mushroom (*Agaricus brunnescens*) stored in different temperatures. *Acta Horticulturae, 1275, 23.* doi: 10.17660/ActaHortic.2020.1275.23

Abstract

This study was conducted in order to determine the effects of citric acid or ethylenediaminetetraacetic acid (EDTA) on brown mushroom stored at 0, 4 or 7°C. Brown mushrooms were harvested at the 1st flush, and then treated with citric acid or EDTA for 3 min with a dose of 40 g L^{-1}. Non-treated mushrooms were evaluated as control. Treated and untreated mushrooms were covered with stretch film by placing into the polystyrene foam plates. Packed mushrooms were stored at 0, 4 or 7°C at 90% relative humidity for 15 days. Changes of mushroom quality parameters were determined at 3 days intervals. With the extension of the storage period, weight loss was found higher at 7°C than at 0°C. The color of the mushrooms treated with EDTA became partially darker, thus, L* value was lower compared to the other treatments. These values showed declining trend during storage period and effects of treatments and storage temperatures were found limited. Firmness of EDTA treated mushrooms were measured lower than the other treatments after 12 and 15 days of storage. Besides the negative effects of EDTA on color, untreated mushrooms had the higher scores even after 15 days of storage at 0 and 4°C in terms of appearance. The results showed that brown mushrooms treated with citric acid could be stored successfully for 12 days at 0 and 4°C. Untreated ones could be stored for 15 days in both temperatures.

Keywords: /Weight loss/ /Firmness/ /Appearance/ /Phenolic compounds/ /Color

ONION

Galsurker, O., Kelly, G., Doron-Faigenboim, A., Aruchamy, K., Salam, B. B., Teper-Bamnolker, P., Lers, A., & Eshel, D. (2020). Endogenous sugar level is associated with differential heat tolerance in onion bulb scales. *Postharvest Biology and Technology*, *163,* 111145. Doi: 10.1016/j.postharvbio.2020.111145

Abstract

Postharvest heat treatment stimulates desiccation and browning of outer scales of onion (*Allium cepa*. L) bulb to dry papery skins. Inner scales resist the heat treatment, as evidenced by high moisture levels.

During heating, inner scales showed increasing soluble sugar levels followed by higher osmolarity, vs. a dramatic decrease in both in the outer scales. Exogenous feeding of outer scales with sucrose, glucose or fructose solutions before heat treatment reduced water loss during heating, suggesting a role for soluble sugars in water retention and therefore, heat tolerance. Vacuolar invertase (VInv) is a key enzyme regulating the levels of sucrose, glucose and fructose in plant tissue. In onion outer scales, VInv activity increased during heating but reducing sugars decreased, possibly due to their rapid metabolism during scale senescence to form skin. Transcriptomic analysis demonstrated upregulation of genes involved in lignin biosynthesis and secondary cell-wall formation in outer scales during heat exposure, and upregulation of genes involved in energy-related pathways in inner scales. This study reveals the dual role of soluble sugars in different onion scales, as osmoprotectants or building blocks, under heat stress.
Keywords: /Heat tolerance/ /Hexose/ /Onion/ /Osmolarity/ /Sugar/ /Transcriptome/ /Vacuolar invertase/

Sun, J., Künnemeyer, R., McGlone, A., Tomer, N., & Sharrock, K. (2020). A spatially resolved transmittance spectroscopy system for detecting internal rots in onions. Postharvest Biology and Technology, 163. doi: 10.1016/j.postharvbio.2020.111141

Abstract

This study presents the development of a spatially resolved transmittance system for detecting internal rots in onions, particularly small and localised rots. A two-wavelength classifier was chosen by considering sensitivities to rots and path-length variations. Near-infrared spectroscopy transmittance measurements were carried out onrot-affected onions, to determine wavelength sensitivities to the presence and severity of rots. Finite Element simulations of light transport in onions were run to determine wavelength sensitivities to source-detector se-paration. A spatially resolved transmittance system was then developed, using two laser diodes as sources (728and 805 nm wavelengths) and a single photodiode as detector. The system was experimentally verified, with the measured spatial profiles of the transmittance ratios of the two source wavelengths being sensitive to variation in position and size of internal rots in onions.

Keywords: /Spatially resolved/ /Onion rot/ /Laser/ /Internal defect/ /NIR spectroscopy/

ORANGE

Fabroni, S., Amenta, M., Timpanaro, N., Todaro, A., & Rapisarda, P. (2020). Change in taste-altering non-volatile components of blood and common orange fruit during cold storage. *Food Research International*, *131*, 108916. doi: 10.1016/j.foodres.2019.108916

Abstract

Cold storage may cause changes in the volatile and non-volatile components of orange fruit, in association with the decrement of the characteristic fruit flavour and sensory acceptability. The aim of this work was to evaluate the changes of some non-volatile taste-altering components (total and individual sugars, acids, anthocyanins, putrescine and limonin) that may affect the organoleptic perception of cold-stored orange fruit. Three blood orange varieties ('Tarocco TDV', 'Tarocco Gallo', and 'Moro') and a common variety ('Washington navel') were stored at 6 ± 1 °C and 90–95% Relative Humidity (RH) for 60 d. Chemical and sensory assessments were performed during fruit storage at 15 d intervals. During

storage, no dramatic change of the physicochemical parameters was recorded and the ascorbic acid content remained almost unchanged in all varieties. As expected, total anthocyanins significantly increased during storage. Limonin significantly decreased in all varieties. A consistent and significant increase in putrescine occurred during storage in the fruit of the pigmented varieties, not recorded in the common orange variety. Putrescine behaviour showed direct correlation with the accumulation of off-flavour in cold-stored 'Moro' and 'T. TDV' fruit, showing a clear influence of its relative concentration on the sensory perception of fruit. Finally, principal component analysis showed that the complete quality profile of the four investigated varieties represented clear differentiation without overlapping clusters. Our results suggest that the arise of a negative sensory perception in cold stored blood orange fruit might be linked to their accumulation of putrescine.

Keywords: /Orange/ /Cold storage/ /Flavour/ /Putrescine/ /Sensory acceptability/

Ncama, K., Magwaza, L.S., Tesfay, S.Z., Mditshwa, A., Mbili, N.C. (2020). In-field application of portable NIR to assess 'Valencia' orange fruit maturity. *Acta Horticulturae, 1275, 9.* Doi: 10.17660/ActaHortic.2020.1275.9

Abstract

Harvest maturity of orange fruit is currently estimated based on total soluble solids (TSS). Juice TSS is analysed from few samples representing the entire orchard using a destructive method based on a refractometer. The technique restricts the number of representative samples due to its destructive nature. Significant loss of fruit occurs if the number of reference samples is increased to properly represent big farms with varying orchard conditions. This study was conducted to develop models for in situ non-destructive assessment of maturity stage of 'Valencia' orange using a portable visible to near infrared spectrometer (Felix, F750, Vis-NIR) equipped with a xenon-tungsten lamp as light source and lead-sulphide detector. The robustness of models developed in this study was increased by acquiring three spectra from each sample at 10, 20 and 30°C from morning to early evening. Partial least square regression models for assessing TSS, titratable acidity (TA), maturity index (TSS:TA) and BrimA were developed from spectral and chemical data using The Unscrambler® X chemometric software. The developed models were assessed based on high correlation between values predicted during cross-validation and actual values. Final models were also tested on external fruit set. Good model for assessing TSS was developed as indicated by high regression coefficient (R^2=0.988) and the ratio of performance deviation (RPD=9.062), and low root mean square error of prediction (RMSEP=0.114%). Successful models were also developed for predicting TA (R^2=0.938; RPD=3.150; RMSEP=0.024%), TSS:TA (R^2=0.727; RPD=1.522; RMSEP=0.575) and BrimA (R^2=0.905; RPD=3.227; RMSEP=0.255%). Commercial application of portable spectrometers with the developed models can increase the number of assessed harvest maturity parameters and the number of reference samples since this technique does not need harvesting of sample fruits.

Keywords: /Orange BrimA/ /Chemometrics/ /Fruit quality/ /Maturity index/

Zhang, H., Zhan, B., Pan, F., & Luo, W. (2020). Determination of soluble solids content in oranges using visible and near infrared full transmittance hyperspectral imaging with comparative analysis of models. *Postharvest Biology and Technology*, *163*. doi : 10.1016/j.postharvbio.2020.111148

Abstract

The feasibility of using visible and near infrared full transmittance hyperspectral imaging for predicting soluble solids content (SSC) in oranges has been assessed. A combination of competitive adaptive reweighted sampling and successive projections algorithm (CARS-SPA) was used to select the effective wavelengths. Size of fruit was used as a compensation factor to establish a calibration model coupled with spectral information. Full transmittance spectra and physiochemical parameters (SSC and size) of samples were extracted. The potential outliers in samples were eliminated by Monte-Carlo outlier detection method. Effective wavelengths were selected by CARS algorithm and the newly proposed CARS-SPA combination method. Three types of models including partial least squares (PLS), multiple linear regression (MLR) and least squares-support vector machine (LS-SVM) were established for SSC analysis of fruit based on different inputs. Results indicated that all models can realize the satisfactory prediction of SSC in oranges. Ranges of coefficient of determination () and root mean square error of prediction (*RMSEP*) were 0.88-0.89 and 0.48-0.48 % for PLS models, 0.83-0.85 and 0.49-0.55 % for MLR models, 0.86-0.90 and 0.40-0.48 % for LS-SVM. Compared among all SSC analysis models, CARS-SPA was a powerful effective wavelength selection combination and CARS-SPA-LS-SVM model with size had the optimal prediction accuracy (= 0.90, *RMSEP* = 0.40, *RPD* = 3.18). Overall, the results revealed that full transmittance hyperspectral imaging can be used to non-invasively to rapidly measure the SSC of oranges. A robust and accurate model could be established based on CARS-SPA-LS-SVM method with size compensation. These results may provide a useful reference for assessment of other internal quality attributes, such as acidity, of the thick-skinned fruit.

Keywords: /Internal quality assessment/ //Fruit/ /Hyperspectral imaging/ /Wavelength selection/ /Chemometrics/

Flechas, N.C., Melgarejo, L.M., Hernádez, M.S., Fernández-Trujillo, J.P. (2020). Postharvest response of purple passion fruits (*Passiflora edulis* f. *edulis* Sims) grown under controlled fertilization. *Acta Horticulturae, 1275, 14. doi:* 10.17660/ActaHortic.2020.1275.14

Abstract

The purple passion fruit is an important species in the international market, but basic knowledge on fruit quality is scarce. This study contributes to gain knowledge about fertilization in order to improve gulupa fruit quality. Three stages of maturity (green, semi-ripe and mature fruits) and five fertilization treatments (0, 25, 50, 100, and 150% of the doses considered optimal) were tested. The measured quality traits included peel color, epicarp hardness, soluble solids, titratable acidity, peel thickness, maturity index, fruit respiration, and citric, malic, ascorbic and oxalic acid contents. The two main components of the principal component analysis (PCA) established the main source of variation. The first axis was associated with fruit maturity. More mature fruit were mostly associated with soluble solids, hue angle and maturity index and less mature with hardness, thickness, skin lightness and skin chroma index. The second axis was mainly associated with fertilization treatments and was mainly influenced by organic acids and titratable acidity. A MANOVA confirmed the principal effects of the maturity stage and fertilization on the selected variables. Skin chroma and hardness are proposed for further studies on stage of maturity at harvest while malic acid can be a good index for fertilization doses.

Keywords: /Fruit quality traits/ /Preharvest/ /Ripening/ /Organic acids/

PEACH

Ma, C., Feng, L., Pan, L., Wei, K., Liu, Q., Tu, K., … Peng, J. (2020). Relationships between optical properties of peach flesh with firmness and tissue structure during storage. *Postharvest Biology and Technology*, *163*, 111134. doi: 10.1016/j.postharvbio.2020.111134

Abstract

The relationship between optical properties and tissue structure of firmness has been investigated. The light absorption (absorption coefficient, *μa*) and scattering properties (reduced scattering coefficient, *μ's*) of 'Baifeng' and 'Xiahui 8' peaches were acquired using a single integrating sphere (SIS) system combined with an inversion algorithm over a 6 d period at 20 °C. The relationship of *μa* and *μ's* with the firmness, equivalent diameter (*dF*), roundness (*e*), cell wall thickness (CWT) and intercellular space rate (*R*is) were quantitatively analyzed at different wavelengths, and prediction models were established by partial least squares regression (PLSR). The results showed that firmness was correlated with structural parameters (except *e*), especially with *R*is and CWT ($r \geq 0.750$). In addition, firmness, *R*is and CWT had good correlations with optical scattering in melting 'Baifeng' peaches ($r \geq 0.919$). Similar results were also found for prediction models of firmness, CWT and *R*is based on *μ's* ($Rp2 \geq 0.799$). Moreover, in nonmelting 'Xiahui 8' peaches, both firmness and CWT had good correlations with optical scattering ($r \geq 0.976$), which is consistent with the correlation analysis results of firmness and structural parameters. In addition, in the models based on *μ's* for predicting firmness and CWT, $Rp2 \geq 0.823$. These results further verified that the prediction of firmness based on optics may be related to the high correlation between tissue structural parameters and scattering properties.

Keywords: /Peach flesh/ /Firmness/ /Tissue structural parameters/ /Optical properties/ /Correlation/

Zhang, L, Zhang, Lin, X., Liu, Y., Meng, Q., Shang, P., Chen, C., Zhu, S. (2020). Regulation of nitric oxide on lipoxygenase in peach fruit during cold storage. *Acta Horticulturae, 1275, 5. doi:* 10.17660/ActaHortic.2020.1275.5

Abstract

Nitric oxide (NO) has become a new messenger in plant biology with an important role in a plethora of physiological processes. In order to investigate the regulation of NO on the lipoxygenase (LOX) in 'Feicheng' peach fruit during cold storage, peaches at physiological maturity were treated with 5, 15 and 30 μmol L^{-1} NO solution, respectively. The activity of LOX in peach fruit was inhibited by NO during cold storage, especially at 15 μmol L^{-1} NO. The expression level of *PpLOX* family genes in fruit decreased during cold storage. The expression of *PpLOX1*, *PpLOX2* and *PpLOX3* was first promoted and then inhibited over a week by NO; by contrast, the gene expression of *PpLOX4* was inhibited and then promoted over two weeks by NO. The effects of 15 μmol L^{-1} NO was more obvious than those of 5 and 30 μmol L^{-1} NO. Isobaric tags for relative and absolute quantitation (iTRAQ) technology was used to analyze LOX protein in peaches. Compared with control, the protein contents of LOX-1, LOX-3 and LOX-4 were downregulated by NO during cold storage, while LOX-2 was upregulated. Density functional theory (DFT) B3LYP method was used to simulate the interaction between NO concentration and LOX protein. The results showed that NO could bind to the active site of LOX protein via hydrogen bonding, and tended to undergo *S*-nitrosylation reaction. It can be concluded that NO can control the activity of LOX by regulating the gene expression of *PpLOX* in peach fruit, and then affect the storage quality of peach fruit.

Keywords: /Peach fruit/ /Nitric oxide/ /Lipoxygenase/

Zhang, X., Wu, F., Gu, N., Yan, X., Wang, K., Dhanasekaran, S., … Zhang, H. (2020). Postharvest biological control of Rhizopus rot and the mechanisms involved in induced disease resistance of peaches by Pichia membranefaciens. *Postharvest Biology and Technology*, *163*, 111146. doi: 10.1016/j.postharvbio.2020.111146

Abstract

Biological control of postharvest diseases of fruit by antagonistic yeast has been considered to be an effective and promising strategy to reduce the postharvest loss of fruits. In this study, the biocontrol efficacy of *Pichia membranefaciens* against Rhizopus rot of peaches was investigated. Also, the study was aimed to explore the mechanisms involved in the induced disease resistance of peaches by investigating the activities of defense-related enzymes and transcriptome analysis. The results indicated that *P. membranefaciens* had significant biocontrol efficacy against Rhizopus rot of peaches. The activities of defense-related enzymes including PPO, POD, PAL and CAT were potentially induced by this yeast. The transcriptome analysis revealed that MAPK cascade signaling pathway and signal transduction pathways of ethylene (ET), jasmonate (JA) and salicylic acid (SA) were triggered in peaches by *P. membranefaciens* to regulate the transcription factors (TFs). Then, these TFs further mediated the expression of downstream defense-related genes including PR genes (*PR1*, *CHI4* and *major allergen Pru ar 1*) and glutathione S-transferase (GST) genes (*MKP11.22* and *Atlg10370*), the genes classified into plant-pathogen interaction pathways (*CML48*, *MUK11.19* and *ROBHA*) and the genes involved in the synthesis of secondary metabolites (*GGPS*, *PKS5*, *CHS1*, *CYP75B2*, *DFR*, *LDOX, PAL*, *PNC1* and *ROMT*) to enhance the disease resistance potential of peaches. Besides, the accumulation of some antifungal compounds including flavonoids and lignin was stimulated to enhance the antifungal ability of peaches. Consequently, the present study contributes to understand the mechanisms behind the induced disease resistance of peaches by antagonistic yeast, and would provide new disease control strategy by improving the defense responses of fruit against pathogens.

Keywords: /Antagonistic yeast/ /Defense-related enzyme/ /Transcriptome/ /Antifungal compound/

PEACH

Jiang, J., Gong, L., Dong, Q., Kang, Y., Osako, K., & Li, L. (2020). Characterization of PLA-P3,4HB active film incorporated with essential oil: Application in peach preservation. Food Chemistry, 313, 126134. doi: 10.1016/j.foodchem.2019.126134

Abstract

This study aimed to develop an active film by using biodegradable materials and antioxidant essential oils to improve gas and water vapor permeability during peach preservation. O2 and CO2 volume fractions and water status were investigated by using an oxygen meter and conducting low-field nuclear magnetic resonance (LF-NMR), respectively. Results revealed that the film added with angelica essential oil (AEO) had a 49.4% increase in 2,2-diphenyl-1-picrylhydrazyl free radical scavenging activity and high O2 and CO2 transmission rates and water vapor permeability. The film added with AEO showed the best preservation effect, effectively delaying the oxidation of peach, maintained the combined water, and

extended the shelf life of peaches to more than 15 days. This study provided a relatively new LF-NMR method for tracking the internal water status of packaged peaches and served as an effective reference for the development of active food packaging.

Keywords: /Polylactic acid/ /Active packaging/ /Essential oil/ /Shelf life/ /Low-field nuclear magnetic resonance/

PEAR

Dai, L., Zhang, J., & Cheng, F. (2020). Cross-linked starch-based edible coating reinforced by starch nanocrystals and its preservation effect on graded Huangguan pears. *Food Chemistry*, *311*, 125891. doi: 10.1016/j.foodchem.2019.125891

Abstract

Starch-based nanocomposite film/coating made from cross-linked cassava starch reinforced by starch nanocrystals (SNCs) was successfully prepared. The effects of SNCs contents on the color, transparency, roughness, mechanical properties, water vapor permeability, and FTIR spectroscopy of the films were explored. The results showed that the film with 6% SNCs had the best comprehensive performance. Subsequently, graded Huangguan pears were coated with the formulation-optimized coating and stored at 20 °C for 4 weeks. From the physicochemical parameters of pears, it can be found that the grading treatment was detrimental to the preservation of pears, while the coating treatment was significantly effective for extending shelf life. Besides, the pattern of grading before coating was more advantageous for pear preservation. In general, this study firstly applied cross-linked starch-based nanocomposite coating on the preservation of pear, which had practical significance for expanding the use of nanocomposite coating reinforced by SNCs and pear preservation methods.

Keywords: /Starch nanocrystals/ /Nanocomposite coating/ /Grading/ /Pear/ /Preservation/

Dilmaçünal, T., Yıldırım, A.N., Şan, Yıldırım, B. F., Koyuncu, M.A. (2020). Determination of cold storage quality and shelf life of a new Asian pear cultivar 'Chojuro Nashi'. *Acta Horticulturae, 1275, 15.* doi: 10.17660/ActaHortic.2020.1275.15

Abstract

The objective of this study was to investigate cold storage quality and shelf life of a new Asian pear cultivar 'Chojuro Nashi'. We attempted to identify the quality in relation to marketability of the fresh pear fruits affected by controlled atmosphere composition, cold storage and shelf life conditions. For this purpose pear fruits were transported to the laboratory immediately after harvest. Fruits without injury or decay were selected and divided into two groups. Group 1 (control) was stored in regular air (RA) at 0.5°C temperature and 90-95% relative humidity (RH) for 24 weeks. Group 2 was stored in controlled atmosphere (CA, 2.5% O_2 + 1% CO_2) condition at 0.5°C temperature and 90-95% RH for 32 weeks. During the experiment, fruits were removed from the RA and CA conditions at each analysis period and kept at room conditions (20°C temperature and 65±5% RH) for 5 days. Fruits were analyzed for weight loss, fruit peel and flesh color, flesh firmness, pH, titratable acidity, total soluble solids, respiration rate, ethylene production and sensorial evaluation (fruit juiciness, sourness, firmness, grittiness, ripeness,

taste, aroma, visual quality and overall liking) during the experiment at 8 weeks intervals for RA, CA and subsequent shelf life conditions. Our findings suggest that 'Chojuro Nashi' pear fruit could be stored at marketable quality for 16 weeks in RA (5.8 point) and 16 weeks + 5 days (5.1 point) in shelf life conditions. The quality of the fruit maintained better in CA than RA condition. The pear fruits were in good quality for 32 weeks in CA (7.3 point) and 32 weeks + 5 days (8.3 point) in shelf life conditions.

Keywords: /*Pyrus pryfolia*/ /Controlled atmosphere/ /Fruit quality / /Respiration rate/ /Sensorial evaluation/

Li, Q., Cheng, C.-X., Zhang, X.-F., Wang, C.-H., & Yang, S.-L. (2020). Preharvest bagging and postharvest calcium treatment affects superficial scald incidence and calcium nutrition during storage of 'Chili' pear (Pyrus bretschneideri) fruit. *Postharvest Biology and Technology*, *163*, 111149. doi: 10.1016/j.postharvbio.2020.111149

Abstract

Superficial scald, which appears as black or brown necrotic patches on the skin, is a serious postharvest physiological disorder of pear fruit. The occurrence of scald in 'Chili' pear (*Pyrus bretschneideri*) fruit during storage at 2 °C in response to preharvest polyethylene (PE) bagging and non-woven fabric bagging has been investigated. The non-woven fabric bagging treatment of fruit prevented scald development, while the PE bagged fruit had a higher incidence of scald than the untreated fruit. Fruit from the PE bagging treatment had lower Ca content, less distribution and lower flux rate of Ca2+ than no bagging and non-woven fabric bagging fruit. The treatment also was associated with greater expression of genes encoding calmodulin-like (CML) proteins, such as *PbCML19*, *PbCML5*, *PbCML38*, *PbCML42-1,* and *PbCML42-2*. In contrast, non-woven fabric bagging did not affect the expression of these genes in the fruit. In addition, CaCl2 treatment reduced scald development in PE bagged pear fruit during storage. Our results suggest that Ca2+ may play a role in regulating the occurrence of superficial scald in pear fruit.

Keywords: /Superficial scald/ /Disorders/ /Calcium/

Stropek, Z., & Gołacki, K. (2020). Bruise susceptibility and energy dissipation analysis in pears under impact loading conditions. *Postharvest Biology and Technology*, *163*. Doi: 10.1016/j.postharvbio.2020.111120

Abstract

The relationship between bruise susceptibility and internal damage energy with impact velocity has been in-vestigated using two pear cultivars. Bruise susceptibility of both pear cultivars increased with the increasing impact velocity, stabilizing at the highest impact velocity of 3 cm3J−1. Internal damage energy also increased with higher impact velocity. The internal damage energy was close to 0 for impact velocities at which pearbruising did not occur. The bruise depth and width measured 48 h after the impact, as well as the peak deformation and contact width directly during the impact were also determined. For the three largest velocities (1-1.5 m s−1) the bruise depth was 2.5 times larger than the peak deformation. For the same velocities the contact width was 1.4 times greater than the bruise width which can lead to erroneous estimation of critical stress from the bruise width. The impact results recorded by means of high speed camera were analyzed using Tema Motionsoftware to obtain

displacement and velocity in time. Additionally, the software allowed calculating the contact width of the pear with a flat rigid plate at any time of impact.

Keywords: /Internal damage energy/ / Bruise susceptibility/ /Pear/ /Impact/

PEPINO

Pascual-Seva, N., Solis, G., Pascual, B. (2020). Quality changes during refrigerated storage of pepino (*Solanum muricatum* Ait.) fruit. *Acta Horticulturae, 1275, 22. doi:* 10.17660/ActaHortic.2020.1275.22

Abstract

Pepino (*Solanum muricatum* Ait.) is a native plant of the Andean region and is cultivated for its fruit. Although until recently commercial cultivation of pepino has been limited to the area of origin, there is an increasing interest in its cultivation beyond these areas. In Valencia (Spain) different studies have been conducted with the aim of introducing this crop in local horticulture. Fruits are harvested when they reach the optimal stage for the market, based on the fruit color. After harvesting, fruits remain physiologically active and experience some metabolic reactions, causing a loss of quality during the postharvest period. The aim of this study is to determine the possible changes in morphology (size) and physical and chemical properties (weight loss, color, soluble solid content, firmness, titratable acidity, and fructose, glucose, sucrose and starch content) in pepino fruit stored in refrigerated conditions (10°C, 90% relative humidity). In two consecutive seasons, fruits from three clones and three ripening stages (immature, mature and ripe), were stored in a cold room for 15 or 30 days after harvesting, after which they were analyzed. There were no differences in the response of the main quality attributes between the two years and among the three clones tested. Fruit only registered a small weight loss and no significant decrease in the firmness during storage, while the other parameters were not affected. The storage conditions used in this study did not induce chilling injury. The results show that fresh pepino fruits can be stored at 10°C and maintain all their properties due to the limited changes in their sugar content.

Keywords: /Monosaccharide/ /Disaccharide/ /Color indexes/ /Firmness/ /Weight/ /Titratable acidity/ /Soluble solid content/

PEPPER

Korkmaz, A., Atasoy, A. F., & Hayaloglu, A. A. (2020). Changes in volatile compounds, sugars and organic acids of different spices of peppers (Capsicum annuum L.) during storage. *Food Chemistry*, *311*, 125910. doi: 10.1016/j.foodchem.2019.125910

Abstract

Changes in sugars, organic acids and volatile compounds (VC) of red pepper flakes (RPF), traditional (TRI), and industrial (INI) *isot* peppers were evaluated during one year storage at the room condition. The changes in the flavor components were significantly affected by the production methods and storage time. Glucose content decreased gradually along storage and reduced by about 21.23, 47.22 and 56.65% for TRI, INI and RPF, respectively. However, fructose decreased significantly only in RPF (11.29%). Citric

and succinic acids exhibited slight changes, but malic acid showed an increasing trend, especially in RPF (4-fold). Most of the VC in all samples decreased or disappeared after storage. The major quantitative losses in these compounds were found in TRI during the first 3 months as 81.76%. The storage was found to be caused deterioration flavor properties in red pepper spices and revealed the importance of appropriate storage conditions.

Keywords: /Red pepper/ /*Isot* pepper/ /Flavor changes/ /Red pepper flakes/ /Sugar and organic acids/ /Volatiles profile/

POMEGRANATE

Golkarian, M., Sen, F., Oksar, R.E. (2020). Effects of pre-cooling and modified atmosphere packaging on storability of pomegranate (*Punica granatum* 'Hicaznar') fruit. *Acta Horticulturae, 1275, 33. doi:* 10.17660/ActaHortic.2020.1275.33

Abstract

Preserving quality to extend the product availability in the markets are becoming more and more important as pomegranate production rapidly increases. This study is carried out to determine the effects of pre-cooling and modified atmosphere (MA) packaging on quality changes and pathological and physiological losses in pomegranate fruit. Pomegranates ('Hicaznar') were harvested at full maturity and packed with two different modified atmosphere packages (MA1 and MA2). Fruits were pre-cooled for 24 h at 3 different conditions; a) pre-cooled at 6°C and 90-95% relative humidity (RH) right after harvest b) at 6°C 90-95% RH after 2 days of storage at 14°C 70% RH; and c) at 10°C and 90-95% RH after 2 days of storage at 14°C 70% RH. Packages were sealed after pre-cooling and stored under 6°C 90% RH conditions for 5 months. In storage, the weight loss in MA2 package was significantly higher than those in MA1 package. After 5 months of storage, decay development was higher in MA1 compared to those in MA2. On the other hand, sensory evaluation scores of fruits were lower in MA2 at the end of the storage period. The weight loss of fruits pre-cooled immediately after harvest were found lower, however decay development was slightly higher than the fruit pre-cooled after 2 days. Effects of the tested modified atmosphere packages and pre-cooling conditions were found similar on in-package atmospheric composition, total soluble solids, titratable acidity, total phenolic contents and antioxidant activity. Limited effects were determined on peel and aril color. The results prove that selecting proper MA packages and pre-cooling conditions according to the storage duration is important to obtain a better performance.

Keywords: /Weight loss/ /Decay/ /Total phenolic contents/ /Antioxidant activity/ /Sensory quality/

SOYBEAN

Coradi, P. C., Oliveira, M. B. D., Carneiro, L. D. O., Souza, G. A. C. D., Elias, M. C., Brackmann, A., & Teodoro, P. E. (2020). Technological and sustainable strategies for reducing losses and maintaining the quality of soybean grains in real production scale storage units. *Journal of Stored Products Research*, *87*, 101624. doi: 10.1016/j.jspr.2020.101624

Abstract

Soybean is the oilseed most cultivated worldwide and is in full production expansion in Brazil. However, the logistics and grain quality in post-harvest stages is increasingly concerning. The objective of this work was to evaluate different sustainable strategies of managing the mass of soybean grains in function of water content, optimizing the combined drying and storage operations to improve grain flow and quality in real production scale storage units. The experimental were consisted in two step, first: moisture soybean (SUL) (17%), dry soybean from the RR crop (SSLRR) (14%), dry soybean from the RR2 crop (SSLRR2) (14%), soybean dried in a continuous dryer (SSS1) (12%), in silo-dryer (SSS2) (14%), and in intermittent dryer (SSS3) (14%), moisture soybean (SUL) submitted to aeration drying (Silo 1), to partial drying (SSS1, SSS2, SSS3), and supplemented with aeration drying (Silo 2), dry soybean from the RR2 crop (SSLRR2) and stored in aeration (Silo 3), dry soybean from the RR crop (SSLRR) and stored in aeration (Silo 4), and second step: the lots of soybean (RR and RR2) was submitted the drying at low air temperatures of 35, 45, and 55 °C until the grains reached water content of 12% for cold storage at 10 and 20 °C, over two months. It was determined the physical and physical-chemical quality of soybean grains before and after drying and during the time in storage. The best option of preprocessing and storage strategy to obtain soybean flow and quality in high-capacity storage and handling unit was the combined drying (SSS1, SSS2, SSS3) and dry-aeration storage systems. The soybean grains harvested at high water contents submitted to drying at low temperatures and stored under artificially refrigerated conditions presented better grain quality over storage time but increased the operational drying time, hindering the flow of grain mass.

Keywords: /Drying forms/ /Flow of products/ /Moisture content/ /Post-harvest/ /Pre-processing/ /Temperature/

STONE FRUIT (DRUPE)

Francesco, A. D., Foggia, M. D., & Baraldi, E. (2020). Aureobasidium pullulans volatile organic compounds as alternative postharvest method to control brown rot of stone fruits. *Food Microbiology*, *87*, 103395. doi: 10.1016/j.fm.2019.103395

Abstract

Volatile compounds produced by L1 and L8 strains were assayed against mycelia and conidia growth of Monilinia laxa, M. fructicola, *M. polystroma*, and *M. fructigena* of stone fruits. Results showed that volatile metabolites inhibited significantly pathogens growth, in particular *M. fructigena* mycelium growth (70% by L1 and 50% by L8) and *M. fructicola* conidia germination (85% by L1 and 70% by L8) compared to the control. Moreover, the antagonistic activity was enhanced by the addition of asparagine (120 mg L−1) in the culture media composition. Synthetic pure compounds were tested *in vitro* on pathogens mycelial and conidia growth and their EC50 values were estimated, confirming 2-phenethyl as the most active compound. For this reason 2-phenethyl and VOCs of both yeast strains were assayed *in vivo* on cherry, peach, and apricot fruits. Regarding peach fruit, both treatments, yeasts and pure compounds, displayed the best inhibiting action against all the pathogens especially against *M. laxa* (100% by L1, 84% by L8 and 2-phenethyl). ATR/IR spectroscopy analysis showed how VOCs produced by both strains increase the fruit waxes complexity reducing the pathogens attack so playing an essential role in the antagonistic activity of both *yeast strains* and on fruit structural composition.

Keywords: /Stone fruits/ /*Monilinia* spp./ /Metabolites/ /*Aureobasidium pullulans*/ /ATR spectrometry/

STRAWBERRY

Céline, M., Valérie, G., Karine, G., Sandrine, C., Nathalie, G., Stéphane, G., & Sébastien, G. (2020). Consumer behaviour in the prediction of postharvest losses reduction for fresh strawberries packed in modified atmosphere packaging. *Postharvest Biology and Technology*, *163*, 111119. doi: 10.1016/j.postharvbio.2020.111119

Abstract

MAP can maintain the storage life of products and thereby reduce food losses. However, the benefits of MAP for reducing losses is not well quantified, especially in relation with practices in the postharvest chain. This paper proposes an innovative approach, at the intersection between the domains of food engineering, social sciences and humanities and computer science to quantify the real benefit of using MAP in the postharvest chain of fresh strawberries. To take into account the diversity of postharvest storage conditions and consumer practices on reduction of food losses, 132 scenarios for storage of fresh strawberries were investigated with a numerical model and used as inputs to calculate the losses generated in the postharvest chain as a function of product deterioration. Considering the probability of occurrence of each scenario and consumer practices, the use of MAP instead of commercial macro-perforated packaging, would lead to 17 % reduction of losses on average. The losses reduction is low because 50 % of consumers open the packaging before storing the fruit into the refrigerator, disrupting the benefit of MAP before the fruit is consumed. Losses would be reduced by as much as 74 % if all the consumers stored the strawberries in the fridge and kept the MAP intact.

Keywords: /MAP modelling tool/ /Food loss reduction/ /Consumer behaviour/ /Supermarket/ /Post-harvest scenarios/ /Fresh fruit and vegetables/

Gumede, M., Mditshwa, A., Tesfay, S.Z., Magwaza, L.S., Mbili, N.C. (2020). The effect of ozone and UV-C irradiation on strawberry postharvest quality. *Acta Horticulturae, 1275, 3. doi:* 10.17660/ActaHortic.2020.1275.3

Abstract

Strawberries (*Fragaria* × *ananassa* Duchense) are globally among the most important fruits. The fruit is an important source of nutrients and bioactive compounds including vitamins, phenolics, antioxidants and dietary fiber. However, strawberries rapidly lose quality during postharvest and their short shelf-life is a serious challenge to face producers and consumers. Chemical treatments have previously been used to maintain quality and extend the shelf-life of strawberries. However, health implications associated with postharvest use of chemicals on food products have necessitated research on non-chemical postharvest treatments. Gaseous ozone and UV-C irradiation are some of non-chemical technologies that have shown potential in prolonging the shelf-life of various fruits and vegetables. This study investigated the effect of gaseous ozone and UV-C irradiation in maintaining the quality and extending the shelf-life of strawberries. Briefly, strawberries harvested at fully ripe stage were irradiated at 0 or 208.2 μW cm^{-2} while the other fruit lot was exposed to continuous ozone treatment. All the fruit was stored at 5.8°C for 7 days and thereafter followed by shelf-life of 2 days at 25°C. After storage, fruit mass loss, decay incidence, antioxidant capacity and soluble sugars were measured. Fruit exposed to UV-C and continuous ozone had significantly lower decay incidence compared to the untreated fruit. Moreover, fruit mass loss was

much lower in fruit stored in ozonated atmospheres compared to the UV-C and control treatment. Antioxidant capacity was significantly higher in ozone and UV-C treated fruit. This study has shown the potential of gaseous ozone and UV-C irradiation as non-chemical postharvest treatment for strawberries.

Keywords: /Strawberry/ /Postharvest/ /Ozone/ /UV-C irradiation/ /Antioxidant capacity/ /Shelf-life/

Ortiz-Solà, J., Valero, A., Viñas, I., Colás-Medà, P., & Abadias, M. (2020). Microbial interaction between Salmonella enterica and main postharvest fungal pathogens on strawberry fruit. *International Journal of Food Microbiology*, *320*, 108489. doi: 10.1016/j.ijfoodmicro.2019.108489

Abstract

The microbial interaction between *Salmonella enterica* and the main postharvest fungal pathogens of strawberries was evaluated. Inoculation of fungal suspension was done 2 (D2) and 1 (D1) day(s) before and at the same time (D0) as *S. enterica*. Fruits were stored at 20 °C and 4 °C. At both temperatures, *Botrytis cinerea* and *Rhizopus stolonifer* caused a decrease in *S. enterica* population. Treatments where the mould was inoculated (D2, D1 and D0) achieved a significant logarithmic reduction ($P < 0.05$) of *S. enterica* populations after 48 h (20 °C) and 14 days (4 °C) compared to fungal-uninoculated fruits (CK). Regarding temperature, average reductions were significantly higher at 4 °C (3.38 $\log_{10}$ CFU/wound) than at 20 °C (1.16 $\log_{10}$ CFU/wound) ($P < 0.05$). Average reductions comprising all treatments were 1.91 and 0.41 $\log_{10}$ CFU/wound for *B. cinerea* and *R. stolonifer* at 20 °C, and 3.39 and 3.37 $\log_{10}$ CFU/wound for *B. cinerea* and *R. stolonifer* at 4 °C. A linear $\log_{10}$ model was fitted in order to predict the inactivation rate (k_{max}, $\log_{10}$ CFU/h) of *S. enterica*. Inactivation rates were higher at 20 °C for D2 treatments than at 4 °C throughout the running time. The main inactivation rate was obtained for *B. cinerea* at 20 °C (0.160 ± 0.027/h), which was found to have stronger inhibitory activity against *S. enterica* than *R. stolonifer*. Univariate analysis ANOVA was carried out to evaluate the effect of different external variables on the inhibition of *S. enterica*. Results found that single effects were significant ($P < 0.05$) except for the pH. The inhibitory effect caused by the action of moulds in conjunction with some environmental factors could indicate the potential interactions between strawberry fungal pathogens and *S. enterica*.

Keywords: /*Botrytis cinerea/ /Rhizopus stolonifer/ /*Metabiotic association/ /Survival/

TABLE GRAPE

Assaf, L. R., Pedrozo, L., Nally, M., Pesce, V., Toro, M., Figueroa, L. C. D., & Vazquez, F. (2020). Use of yeasts from different environments for the control of Penicillium expansum on table grapes at storage temperature. *International Journal of Food Microbiology*, *320*, 108520. doi: 10.1016/j.ijfoodmicro.2020.108520

Abstract

A wide range of fresh fruits and vegetables is attacked by *Penicillium* species causing diseases during their postharvest handling. Many of these species are psychrotrophic and they are able to cause food spoilage at refrigeration temperature as happens with table grapes. After the harvest, grape bunches are stored inside boxes with SO2 generator pads to reduce the contamination with fungal conidia. However, SO2 residues are dangerous to people allergic to sulfites and they negatively affect the quality of fresh

fruit. Biological control of phytopathogens with microbial antagonists naturally present on fruit surfaces could be helpful against postharvest diseases. The present study aimed to select native yeasts isolated from fermentation microenvironments and the surface of refrigerated grapes for their use in the biological control of *P. expansum* on table grapes stored in cold rooms. Non-pathogenic and pathogenic *Penicillium* species were isolated, and the four most aggressive pathogen isolates were identified as *Penicillium expansum*. Twenty yeast isolates identified as *Aureobasidium pullulans*, *Cryptococcus magnus*, *Metschnikowia pulcherrima* and *Rhodotorula glutinis* presented positive antagonistic activity against *Penicillium expansum*; they controlled the development of at least one of the fungi, significantly reducing the disease incidence. The results showed that three antagonistic yeasts (*M. pulcherrima* 22, 36 and 43) reduced the disease incidence and severity of all 4 *P. expansum* isolates. It was also found that the fruit surface is not the only source for isolation of biological control agents. Microenvironments with different stress conditions could be a promising source to isolate antagonistic microorganisms.

Keywords: /Biological control/ /Cold storage/ /Blue mold/ /Antagonistic yeasts/

Daniels, A.J., Opara, U.L., Poblete-Echeverría, C., Nieuwoudt. (2020). New technologies to maintain quality and reduce postharvest losses of table grapes. *Acta Horticulturae, 1275, 16. doi: 10.17660/ActaHortic.2020.1275.16*

Abstract

Delivering table grapes that are of exceptional quality and free of any defects or disease to different export markets is vital for table grape industries. After harvest, table grapes (non-climacteric fruit) do not improve, and maintenance of the quality achieved in the vineyard up to retail shelves remains a challenge. Currently, visual inspection before and during harvest in the vineyard, after harvest and before packaging in the pack house, is used to assess the risk of quality defects developing during cold storage period prior to transportation to export markets. Table grapes are complex fruit that is prone to many different types of defects like berry crack, gray mold rot, SO_2 damage and browning. The berry browning phenomenon alone can be manifest in 24 different phenotypes on white seedless grapes. Fourier transform near-infrared spectroscopy (FT-NIR) is an established method for measuring quality attributes of a wide range of fresh produce. Here we report on the detection of two different browning phenotypes (chocolate browning and friction browning) during cold storage of 'Regal Seedless' table grapes using FT-NIR spectra that were obtained in reflection mode of whole bunches. Visual inspection was used to score the browning defects of individual berries on bunches. The defects were then scored as 0 = no defect and 1 = defect present. Results obtained with partial least squares discriminant analysis (PLS-DA) of the bunch spectra showed that classification between healthy and affected bunches was possible. These results open up new possibilities for the development for quality checks of packed table grape bunches prior to export. This has a significant impact for the table grape industries for it will now be possible to evaluate bunches non-destructively during packaging to determine the possibility of these browning types being present.

Keywords: /Whole bunch/ /Chocolate browning/ Friction browning/ /Nondestructive measurements/ /Infrared spectroscopy/ /qualitative calibration models/ /PLS-DA/

TOMATO

Jha, D.K., Arul, J. (2020). Effect of ultrasound on postharvest quality and stress markers in tomato fruit during storage. *Acta Horticulturae, 1275, 11.* Doi: 10.17660/ActaHortic.2020.1275.11

Abstract

Tomato (*Lycopersicon esculentum*) is one of the most consumed fruit/vegetables, and its consumption is associated with many health benefits. However, it is a perishable crop and its storable life is limited. One approach that is gaining interest is to intensify the natural defenses of crops against diseases, and enhance plant protective phyto-compounds. That can also be health-beneficial by conditioning with hormetic doses of abiotic stresses such as ultrasound. Thus, the objective of this work was to determine the hormetic dose of US (Power 135 W, Frequency 42±5 kHz and treatment time 0-90 min at temperature of 16°C), and to monitor the early stress markers (respiration, ethylene, H_2O_2 production), following the exposure to US. Physiological and biochemical responses such as color change (ripening and senescence) and primary metabolites, especially precursors of secondary metabolites were also monitored during storage. The ripening rate of treated tomato treated with US for 45 min was the lowest, suggesting that this was hormetic for ripening response. Early responses, ethylene production and H_2O_2 accumulation, were dose-dependent and reached peak levels 4 and 18 h after US application, respectively. Amino-acids (AA) with high titer (>100 µg of ribitol equivalent g^{-1} dry peel) were GABA, proline, and serine, increased up to the hormetic dose, but decreased above the hormetic dose. However, the titers of branched-chain AAs (valine, leucine, and isoleucine) in tomato, treated with hormetic US dose, were lower compared to those of the control, but they increased with higher US doses. Reduced titers of these AAs may indicate their utilization as carbon substrate during stress-induced altered metabolism and biosynthesis of volatiles. Reduced titers of oxalate, citrate, ketoglutarate and succinate may suggest fast-acting TCA cycle. Enhanced titers of phenylalanine indicate activation of shikimic acid-phenylpropanoid pathways. Results suggest that early events of ethylene and H_2O_2 production and changes in the levels of AAs could be used as stress markers to infer the severity of the stress. However, the effect of the hormetic dose of US on the changes in the free AA profile may provide some insights into US-induced modifications in the secondary metabolites derived from those AAs.

Keywords: /Ultrasound/ /Non-thermal effect/ /Hormesis/ /Early responses/ /Metabolic profile/ /Bio markers/

Tolesa, G.N., Workneh, T.S. (2020). A comparison of the influence of different low-cost cooling technologies on tomato cooling time and temperature. *Acta Horticulturae, 1275, 39. doi:* 10.17660/ActaHortic.2020.1275.39

Abstract

Cooling of fruits and vegetables is very critical for postharvest shelf-life extension. The field heat removal should take place immediately after harvest. Different low-cost fruit and vegetables cooling technologies that were proven to be affordable by smallholder farmers are required to ensure better marketability for reasonably extended period in a supply chain. The aim of this study was to compare the effectiveness of different cooling methods in terms of cooling time requirement of the fresh tomato fruit. The cooling technologies used in this study include the low-cost evaporative cooling (EC), CoolBot-air conditioner (CBAC) and the combinations EC with CBAC which are known to be feasible technologies for low-income farmers in arid and semi-arid regions. Fresh tomato cooling experiment to remove field heat during summer was conducted for 72 h for each of the EC, CBAC and EC+CBAC storage systems. The results

showed that 6, 12-18 and 24 h were required to reduce the temperature of tomatoes using CBAC, EC+CBAC and EC alone, respectively. The EC, CBAC and EC+CBAC reduced and maintained the micro-environment air temperature inside the coolers to 6, 8-13 and 19°C, respectively. The ambient temperature varied between 34 and 40°C. Hence, CBAC, EC+CBAC and EC can be from the best to the lowest choice by farmers, respectively, for cooling the fruit by reducing the field temperature after harvest.

Keywords: /CoolBot-air conditioner/ /Combined cooler/ /Evaporative cooler/ /Tomato fruit/ /Cooling time/

Tang, H., Zhang, X., Gong, B., Yan, Y., & Shi, Q. (2020). Proteomics and metabolomics analysis of tomato fruit at different maturity stages and under salt treatment. *Food Chemistry*, *311*, 126009. doi: 10.1016/j.foodchem.2019.126009

Abstract

Proteomics and metabolomics were used to study the changes in proteins and metabolites in tomato fruits at different ripening stages and the effect of salt treatment on fruit quality. The results showed 2607 and 153 differentially expressed proteins in ripe fruits compared with mature green fruits and in NaCl-treated ripe fruits compared with control ripe fruits, respectively. KEGG analysis indicated that these proteins were mainly involved in photosynthesis, pentose and glucuronate interconversions in different ripening stages of fruits, and salt-induced proteins were involved in flavonoid biosynthesis and linoleic acid metabolism. A series of metabolites, including carbohydrates and amino acids showed significantly different accumulations between ripe and mature green fruits and between salt-treated and control fruits. Combined analysis explored glycine, L-alanine, D-xylose and sucrose and some proteins involved in multiple metabolic pathways under salt conditions. Their interactions might affect fruit development and fruit quality under salt treatment.

Keywords: /Proteomics/ /Metabolites/ /Tomato fruit quality/ /Salt treatment/ /Fruit ripening/